



# Research Reactor Center

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22 August 2008

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Director, Division of Spent Fuel Storage and Transportation  
Office of Nuclear Material Safety and Safeguards  
U.S. Nuclear Regulatory Commission  
Washington, D.C., 20555-001

**Subject:** Request for Extending Use of Expiring Transportation Packages

Dear Director Brach,

This letter serves as a request from the University of Missouri Research Reactor (MURR) to the U.S. Nuclear Regulatory Commission (NRC) that NRC grant MURR permission to continue using packaging for the shipment of Type B quantities of radioactive materials beyond October 1, 2008, when authorization to use those packages is set to expire.

Specifically, MURR requests permission for continued, but limited, use until October 1, 2010 of the existing Type B packages currently in service. These packages were built and are maintained to U.S. Department of Transportation (DOT) specifications 20WC and 6M conforming in all aspects to the requirements of 49 CFR Subchapter C, in effect on October 1, 2003. On or before October 1, 2010 it is expected that a fleet of radioactive materials packages compliant with 10 CFR 71 will be in service at MURR.

Per NRC Regulatory Issue Summary 2008-18 "Information on Requests for extending use of Expiring Transportation Packages," the following information is provided. Please note that this same request for extended use of the packages has been submitted under separate cover to DOT, in accordance with 49 CFR 107.105.

**1. Package Information**

Please refer to **Table 1** below for a comprehensive listing of the DOT specification package fleet currently operated by MURR, along with their serial numbers, model, and year of manufacture.

**Table 1 DOT Specification Packaging Operated By MURR**

<b>Serial Number</b>	<b>Model</b>	<b>Year of Manufacture</b>
4016	20WC-1	1996
4018	20WC-1	1996
4021	20WC-1	1996
4023	20WC-1	1996
4001	20WC-1	2000
4002	20WC-1	2000
4003	20WC-1	2000
4004	20WC-1	2000
1802	6M (15 gallon)	1997
1803	6M (15 gallon)	1997
1820	6M (15 gallon)	1997
1824	6M (15 gallon)	1997
1863	6M (30 gallon)	1997
2256	6M (10 gallon)	1999
2162	6M (10 gallon)	2000
2257	6M (10 gallon)	2002
1866	6M (10 gallon)	2003
2161	6M (10 gallon)	2003
1864	6M (10 gallon)	2004
2160	6M (10 gallon)	2004
2165	6M (30 gallon)	2004
2991	6M (10 gallon)	2004
2992	6M (10 gallon)	2004
2993	6M (10 gallon)	2004
2994	6M (10 gallon)	2004

2995	6M (10 gallon)	2004
2996	6M (10 gallon)	2004
2998	6M (10 gallon)	2004
2999	6M (10 gallon)	2004
2258	6M (10 gallon)	2004
2990	6M (10 gallon)	2004
2997	6M (10 gallon)	2004

2. **Identification of Shipments.** (a) Number of shipments; (b) number of packages per shipment; (c) packaging serial numbers; (d) package contents; (e) end use of the radioactive material; (f) shipment origin and destination; (g) mode; (h) general timeframe (e.g., first quarter 2009); and (i) date last shipment will be completed.

MURR is the primary or sole domestic source for many radionuclides used daily in cancer-fighting radiopharmaceuticals, research techniques and industrial applications. These shipments are made on a regular, ongoing basis and will continue until new packages are available in October 2010.

**Table 2** gives a breakdown and summary of those shipments and **Table 3** provides details on the use of the radioactive material shipped.

All shipments originate at MURR, located in Columbia, Missouri.

The packaging serial numbers will vary as packages are rotated in and out of service, though the general package type (either 6M or 20WC) will be the same for each shipment. Please see **Table 1** for a complete list of serial numbers for each package in service at MURR.

**Table 2 Shipment of Type B Quantities of Radionuclides from MURR**

Isotope	Packages Shipped per Week	Current Package Used	Form	Mode/Destination/Distance
Sm-153	1	6M	Solid	Charter Air/1300 miles/Boston Area
Ir-192	2	20WC	Solid	Ground (truck)/multiple destinations – New Orleans Area, Boston Area, Southern California/1000 miles – 1700 miles
Ir-194			Solid	<i>Impurity, see Table 3</i>
Ba-135m	1	20WC	Solid	Ground (truck)/Seattle area/2000 miles
Ba-131			Solid	<i>“Impurity,” see Table 3</i>
Cs-131			Solid	<i>“Impurity,” see Table 3</i>

P-32	1	6M	Solid	Ground (truck)/Boston Area/1300 miles
Yb-169	1	6M	Solid	Ground (truck)/Boston Area/1300 miles

**Table 1 Use of Radionuclides Shipped in Type B Quantities**

Isotope	Form	Use
Sm-153	Solid (powder in quartz vial in canister)	Cancer Treatment
Ir-192	Solid (wires or buttons in aluminum block or confinement)	Cancer Treatments, Industrial Radiography
Ir-194	Solid (wires or buttons in aluminum block or confinement)	<i>Impurity with Ir-192</i>
Ba-135m	Solid (powder in canister)	<i>Impurity with Ba-131, dominant isotope for shipping</i>
Ba-131	Solid (powder in canister)	Parent of Cs-131
Cs-131	Solid (powder in canister)	Cancer Treatment, daughter from Ba-131
P-32	Solid (powder in canister)	Tracer for biomedical research
Yb-169	Solid (powder in quartz vial in canister)	Cancer Treatment

3. **Reasons for Requesting Extended Use.** Justification for extending the use of expiring packages must describe why acquiring replacement packages is not practical and why shipments cannot be made before the October 1, 2008, expiration date. The justification must demonstrate that: (a) there are no alternative domestically approved packages available; (b) the contents cannot be reconfigured such that transport can be conducted in accordance with the regulations; and (c) the transport schedule cannot be adjusted so as to be conducted in accordance with the regulations. The justification must also describe any good-faith efforts to acquire replacement packages that meet the current package performance requirements, including a detailed description of past activities and the current status of acquiring replacement packages. In addition, any adverse impacts that will result if the shipment is not conducted should be fully described.

MURR has attempted to meet the regulations in a timely manner. Upon the implementation of the new regulations in 2003, it was expected that industry would provide packages to the 10 CFR 71 standard. MURR, as a research institution and producer of medical, industrial and research radioisotopes, planned to purchase approved designs in the open market.

Industry did not step forward and no designs meeting the varied research, medical and industrial radioisotope needs of MURR have been approved by the NRC as of this writing.

#### Unsuitability of Alternative or Currently Approved Packages

There are some packages that are currently permitted for use after October 1, 2008 that were considered by MURR as possible base designs to transport the radionuclides shown in **Table 2** and **Table 3**. These include:

- MIDUS approved under NRC Certificate of Compliance 9320
- ES-3100 approved under NRC Certificate of Compliance 9315
- MDS Nordion USA/0126/B(U)-96 under NRC Certificate of Compliance 0126
- A variety of packages dedicated to special form material, such as the SPEC-150 (CoC 9263), SPEC-300 (CoC 9282) and the IR-100 (CoC 9157)

The MIDUS package comes close to meeting many of the needs for a 20WC-1 replacement package. MIDUS is designed to transport Mo-99 as sodium molybdate in liquid form. The package weighs 330 kg (727 lbs) but is well-shielded and the basic design is approved. The manufacturer of the MIDUS submitted a response to the RFP issued in 2007, however the proposed cost structure was far too expensive for MURR's budget. This was unexpected as MURR had initially assumed that this proven design would require a relatively inexpensive refit to expand the contents and serve as a 20WC-1 replacement.

The ES-3100 is designed for fissile material transport and weighs 190.5 kg (420 lbs). In its current form, it is too heavy to replace the 6M, yet too lightly shielded (using a stainless steel containment vessel) to transport the high-activity radionuclides required by MURR's clients and research partners. A similar package, the 9977 B(M)F-96, was submitted in response to the second Request for Bid issued in 2005, but the cost structure proposed for a 6M replacement design and refit for 20WC-1 replacement was far too expensive.

The MDS Nordion package designated USA/0126/B(U)-96 is an excellent analog of the 20WC-1 and meets the needs for that type of packaging. It weighs 148 kg (326 lbs) and is approved for multi-radionuclide use. Using the design, investing in getting U.S. regulatory approval for domestic use and then building the packages through MDS Nordion was an early idea for meeting at least a portion of MURR's packaging needs. MDS Nordion consistently rejected MURR's inquiries over several years on grounds that the design is proprietary and that MDS Nordion saw no business interest in allowing MURR to license and/or buy the design.

The various special form packages are all highly specialized packages and dedicated to specific source types. In addition, many of these packages are designed by the companies that produce or ship the special form material and are considered proprietary designs. In addition, such designs are not easily reworked to ship solids and liquids rather than special form material. Such work and expense would be better spent on packages designed for the purpose.

In summary, while some packages that have been granted a Certificate of Compliance by NRC would appear to be good base designs to help meet MURR's packaging needs, none would

meet even a small portion of the Type B package replacement needs today and even with significant work and efforts to upgrade the designs, they fall far short of the replacement packages currently under contract for design and delivery.

### Reconfiguring the Contents

MURR investigated the possibility of dividing the radioactive material currently shipped in Type B quantities into multiple Type A shipments. Due to ALARA concerns, the nature of the material shipped and a variety of handling issues, this was not regarded as feasible

#### ALARA Concerns – Applies to Sm-153, Ir-192 (Ir-194), Ba-135m (Ba-131, Cs-131), P-32, Yb-169

As an NRC licensee, MURR is required to adhere to an “As Low As Reasonably Achievable” policy in regards to radiation exposure to staff per 10 CFR 20.1101(b).

After the designated irradiation period for the material in question, the material is allowed to decay for a period of time and then the canisters are removed from the reactor pool.

In the case of the material encased in quartz vials, the canisters are opened inside of a hot cell and the quartz vial removed. This quartz vial is enclosed in a shielded container which is then placed in a Type B package for shipment.

In the case of material that is stored in only the aluminum canister, the canister is placed directly into the Type B package, after being cleaned.

To require MURR to open a welded can containing open radioactive powder, or the break open a quartz vial containing radioactive powder in order to divide the material into multiple Type A shipments invites a host of potential exposure problems, including:

- Free powder can contaminate the hot cell in which the work is being performed. This dramatically increases the chances that the material will contaminate the manipulators and various surfaces in the hot cell, requiring hours or days of decontamination and survey work and consequently more radiation exposure to staff.
- Iridium wires or buttons are encased in aluminum blocks for irradiation positioning and shipping purposes. To saw, cut or dissolve the aluminum would require hours of work with intensely radioactive materials and an increase in the radioactive waste stream, generating mixed waste if the dissolution method was chosen.
- The extra hours spent on this process requires the hot cell workers to endure more exposure. Currently, typical exposure rates for hot cell workers are **5-10 mR per hour**. Adding hours of processing time or decontamination work would quickly increase the radiation exposure to those workers.
- Each package must be surveyed after loading. Instead of five to seven Type B packages to survey, the shipping and health physics staff would now have at least twenty or more Type A packages to survey, increasing the exposure time.

Exposure rates would increase dramatically under any plan that required MURR to break the materials into Type A quantities prior to shipping.

*Material and Handling Issues – Applies to Sm-153, Ir-192 (Ir-194), Ba-135m (Ba-131, Cs-131), P-32, Yb-169*

The materials shown in **Table 2**, above, are sealed in welded aluminum canisters and leak-tested prior to being irradiated. Some materials, such as Sm-153, are first sealed in quartz vials before being welded into the canisters. Other material, such as Ba-131/Ba-135m/Cs-131 product are sealed directly into the welded canister and not encased in a quartz vial.

A variety of handling issues also arise in subdividing radioactive material into Type A quantities. Any increase in complexity can have a direct impact on safety. Some issues include:

- The increased workload would result in a bottleneck in getting packages out the door as the number of packages shipped by MURR increased dramatically. This would result in delays and reduced efficacy of the radionuclides when used in cancer treatments, research or industrial uses.
- For our radiopharmaceutical clients, breaking the quartz vial and parcelling out the radioactive powder into smaller quantities would make it unusable in a radiopharmaceutical that has been approved by the Federal Drug Administration (FDA). Some of our clients require a specific target material and sample size as part of their processing procedures as approved by the FDA or other regulatory bodies. Their quality programs require the use of a single discrete sample etched with a QA number that must be confirmed by the radiopharmaceutical manufacturer before production can begin. Subdividing such quantities is not realistic for our clients' and partners' intended, approved, use.
- Similarly, the radionuclides that are used in medical applications are sterilized by the intense gamma radiation exposure they experience during irradiation at MURR. Opening these sealed containers (to separate the material into Type A quantities) in a non-sterile environment allows for the introduction of both biological and non-biological contaminants. This invites a host of contamination issues and likely renders the samples unusable.

The ALARA and materials handling issues raise significant concerns for workers and end-users, including patients. As a result, it is not feasible to subdivide all of MURR's Type B shipments into a greatly increased number of Type A shipments.

**Readjusting the Transport Schedule**

As MURR serves medical, research and industrial customers on an ongoing basis, a readjustment of transportation schedules would not help alleviate the need for permission from the NRC to continue using the DOT specification packages on and past October 1, 2008.

### Efforts to Meet the Regulations

It became clear over the course of 2004 that industry would not be stepping forward to design, gain approval for, and manufacture packages suited to the varied needs of MURR's research, medical and industrial partners. MURR then attempted to prod the market by initiating contract bids. Over the course of 2005, MURR initiated two Requests for Bid, soliciting industry for a contract to design, test and fabricate packages meeting 10 CFR 71. The first bid met with no response. The second bid produced one response that could not be implemented due to excessive costs.

In 2006, MURR then formed an investigative team to determine the feasibility of obtaining the necessary licensing to design, test and build packages to the 10 CFR 71 standard in-house. This was not a feasible solution in terms of expertise, experience and financing.

The above efforts having met with no success, MURR then issued a Request for Proposal in March of 2007 which resulted in four vendor responses. A vendor was awarded a contract in August of 2007 and work is underway for the design, testing and fabrication of Type B Packages that will satisfy 10 CFR 71.

The NRC has issued a docket number for each design. The 6M replacement has a docket number of 71-9337 and the 20WC-1 replacement has a docket number of 71-9338. Details on the project itself are provided in **Section 5**, below.

### Adverse Impacts

If MURR is denied permission to continue using DOT specification packaging, it will result in a severe impact on the domestic supply of radioisotopes for medical uses, industrial applications and research and will have dramatic consequences for MURR as it currently operates.

MURR relies on Type B DOT specification package shipments for roughly 30% of its Products & Services revenue. Losing this revenue will result in significant, unsustainable budget shortfalls. Such a significant loss of revenue, combined with the large sums already spent and budgeted for the Type B package replacement project could not be absorbed by MURR.

Having the ability to ship in DOT specification packaging becomes even more critical if some of MURR's partners and customers lose the ability to ship in their DOT specification packaging come October 1, 2008. If MURR is allowed to continue to ship, we can fill the gap for those customers of ours who choose not to apply for, or are denied, permission to operate DOT specification packages past the deadline. The shipment details provided in **Table 2** above do not include shipments made in customer-owned packages, some of which are DOT specification packages.

### *Effects on Individual Isotopes*

MURR is the sole domestic source for Sm-153, Ir-192, Cs-131, P-32, and Yb-169. MURR's relatively high flux ( $4E14$  n/cm<sup>2</sup>-sec), consistent operating schedule (averaging 150 hours/week, 52 weeks per year since the late 1970's) and our central geographic location make us the only

reliable and efficient source for the high-activity radionuclides needed for medical, industrial and research use.

The Sm-153 provided by MURR is the radioactive component of a cancer-fighting radiopharmaceutical, Quadramet®. Without the ability to ship the Sm-153 in a DOT specification package, that product can not be produced and provided to cancer victims.

The Ir-192 provided by MURR is used by a variety of companies for both brachytherapy applications and industrial radiography needs. These companies could rely on foreign reactors for this material, but MURR is a preferred supplier to them due to our reliable schedule. Without the ability to ship Ir-192 in DOT specification packages, the United States loses a major domestic source of this isotope, and the only source that can reliably produce it week in and week out.

The Cs-131 provided by MURR is used as the radioactive component for a variety of cancer treatments. We are the sole domestic source for this radionuclide. If we lose the ability to ship this radionuclide in DOT specification packaging, the manufacturer of the cancer therapy agents will be forced to turn to foreign reactors for supply.

MURR is the sole domestic source for P-32. Other reactors can provide it to our customer, but at the cost of relying solely on foreign reactors for this critical component of biomedical research.

Yb-169 is supplied to a customer for continuing cancer medicine research and therapies. As with the other radionuclides, MURR is the sole domestic source for this material.

If MURR loses the ability to ship these radioisotopes in DOT Type B specification packaging, the ripple effects will extend into various industries and into the lives of patients receiving cancer therapies.

**4. Safety Justification for Continued Use and Proposed Compensatory Measures.**

Since the expiring package designs may lack safety enhancements included in newer designs, the request must include a safety justification for continued use and a description of compensatory measures that will be used to provide an equivalent level of safety. Examples of compensatory measures that may be considered are: (a) special package inspections, tests, or determinations that ensure that the packaging is in unimpaired physical condition; (b) transport by exclusive use; (c) transport during time of low road usage; and (d) accompaniment of shipment by escort equipped to effect a recovery in an emergency situation or in case of a transportation accident.

MURR operates, and will continue to operate, the existing fleet of DOT specification packages in compliance with 49 CFR 173.416(c), which requires MURR to conform "in all aspects to the requirements of this subchapter in effect on October 1, 2003."

Adherence to the applicable regulations is governed by MURR SOP AP-SH-001 (Administrative Procedure, Radioactive Material Shipping).

Compliance with the DOT regulations is demonstrated through a variety of inspection, operation and maintenance programs. In addition, MURR operates the package fleet under an NRC-approved Quality Assurance (QA) program.

Please note that all Standard Operating Procedures referenced below, as well as the QA/QC Program Service Applications and official checklists are reproduced in full in **Appendix A**.

#### *Inspection*

Upon the return of a DOT specification package to MURR by a customer, the package is first surveyed for contamination, per MURR SOP **RP-HP-110** (Survey and Decontamination of Returned Shipping Containers).

The package is then inspected by a Certified Shipping Technician and the condition recorded on the "Type B Cask Inspection Log" which is kept for each DOT specification package. Every single DOT specification package must be inspected in this manner when it returns to the facility.

If there is a need for minor repairs or maintenance, this is noted and the maintenance is performed under the appropriate procedure.

#### *Operation*

MURR operates the packages in a manner that ensures safe operation of the fleet and provides for constant inspections of the packages themselves by both a worker and reviewer.

- **BPB-SH-002** (20WC-1 Packaging and Shipment of Type B Non-Waste Radioactive Material)
  - **FM-35** (Control Checksheet for Type B USA DOT 20WC-1 Radioactive Material Shipment)
  - **MURR-SAS-00007** (QA/QC Program: USA DOT 7A Inner Cask)
    - Attachment 1 (Control Checksheet for DOT 7A Inner Cask Lid Gasket)
    - Attachment 2 (Control Checksheet for DOT 7A inner Cask Lid Hold Down Bolt)
- **BPB-SH-005** (DOT 6M Packaging and Shipment of Type B Non-Waste Radioactive Material)
  - **FM-74** (Control Checksheet for Type B USA DOT 6M Radioactive Material Shipment)

#### *Maintenance*

The DOT specification packages are integrated into MURR's facility-wide preventive maintenance program. MURR utilizes a standard industry software package (MAXIMO) for

scheduling and tracking preventive maintenance. This software generates automatic notices of when maintenance is due, assigns the task to a responsible party and allows for tracking and status reports of the work.

The preventive maintenance items currently scheduled for the DOT specification packages are annual replacement of gaskets in the DOT 7A Inner Cask used by the 20WC-1 packagings and for calibration and inspection of the torque wrenches and other tools used in working with the packages.

Maintenance and inspection is intimately tied to Operation, requiring a constant review of all packages in service to assure that they meet the regulations governing packaging.

#### *NRC Quality Assurance Program*

MURR operates the DOT specification package fleet under **NRC QA Certification No. 71-0108, Revision No. 8** and the associated QA Plan. This plan may be found in **Appendix C**. This QA program allows for maintenance, repair and use of the packagings.

The QA plan provides a framework for compliance with 10 CFR 71, Subpart H. This QA Program applies to all activities affecting the DOT specification packages and their components. The program comprises the planned and systematic actions necessary to provide confidence that the package will perform satisfactorily while in service.

#### *The Program*

In summary, each package is subject to a complete inspection every time it is used and returned to MURR. This program allows for the constant monitoring of the fleet and provides for immediate action to repair the packages or replace components when necessary. This constant review of the packages helps to ensure that the fleet is maintained in at least fair condition at all times.

5. **A Plan and Schedule to Acquire Replacement Packages or Complete Necessary Shipments.** Details about the planned acquisition of replacement packages must be provided, along with key milestones, and proposed implementation dates, unless the licensee can show why acquiring a replacement package is not practical and why shipments cannot be made before the October 1, 2008, expiration date.

The University of Missouri Research Reactor (MURR) signed a \$2 million contract (in response to University of Missouri RFP #C032907) with a package design and manufacturing vendor, Croft Associates, Ltd. on 22 August 2007.

This contract requires the vendor to design, build and gain NRC and DOT approval of two new Type B package designs. These designs are:

1. The SAFKEG-LS, which will replace the 6M DOT specification package and weigh less than 68 kilograms (150 pounds) fully loaded

2. The SAFKEG-HS, which will replace the 20WC DOT specification package

Please refer to **Appendix B** for specification sheets describing each package design in general terms.

MURR has spent over \$320,000 to date on the Type B Package Replacement Project and is projected to spend over \$2 million total (for contracted and off-contract expenses) by the end of the contract.

Please note that we have split the program into separate production tracks for the LS and HS designs. There are substantial lead times involved in acquiring the depleted uranium (DU) necessary for the HS design. The LS design faces no such production challenges and the Safety Analysis Report for Packaging (SARP) for the LS will be submitted to the NRC several months in advance of the HS SARP.

It is hoped that the experience gained from the LS SARP review will speed the approval of the HS SARP by NRC, though this obviously cannot be guaranteed.

*Key Accomplishments to Date*

To date, the vendor has completed the following major tasks:

- Package Designs are complete, manufacturing drawings have been prepared for the designs
- Materials studies have been compiled for the stainless steel and DU components. Full testing of the proposed packing material is scheduled for August
- Extensive work has been done on describing and evaluating the means to contain the nearly 50 radionuclides that MURR will require to be listed on the eventual Certificate of Compliance, including the design of shielded re-usable containers that will be packed in the containment vessel
- Finite Element Analysis (FEA) for Stress has been performed for the package designs, analyzing the outer stainless steel shell, packing material and inner containment vessel
- Shielding calculations have been performed for the package designs using worst-case scenarios for placement and activity of radioactive material
- Orders have been placed with a specialty manufacturer to forge depleted uranium shields for the HS prototype
- The vendor's Quality Assurance program was audited by the NRC in May of 2008 and approval granted to conduct all design, testing and SARP work
- Drop tests have been performed at both ambient temperature and -40°C, from 9 meters, on a "pre-prototype" unit to confirm structural properties of the stainless steel and

packing material, as well as to acquire g-loadings for use in further FEA Stress calculations

- Significant progress on a draft SARP for each design has been made

The above tasks are merely highlights of the work conducted to date.

#### *Upcoming Tasks*

Some key upcoming task items and due dates are provided in **Table 4** below.

**Table 4 Key Upcoming Tasks for MURR Type B Package Replacement Project**

Task	Estimated Completion Date	Comments
LS Prototype Manufacture	29 August 2008	
LS Prototype Tests	13 October 2008	Includes steady state thermal testing and all drop tests and comparison to computer models
LS SARP Compilation	23 March 2009	Completion date is the expected submission date of Rev 0 to NRC
Issuance of SER and Certification by NRC	January 2010	This is an estimate and dependent upon the NRC review process.
LS Manufacturing	May 2010	This is entirely dependent upon the NRC review process
HS Prototype Manufacture	12 December 2008	
HS Prototype Tests	23 January 2008	Includes steady state thermal testing and all drop tests and comparison to computer models
HS SARP Compilation	11 May 2009	Completion date is the expected submission date of Rev 0 to NRC
Issuance of SER and Certification by NRC	March 2010	This is an estimate and dependent upon the NRC review process.
HS Manufacturing	July 2010	This is entirely dependent upon the NRC review process

Please refer to **Appendix C** for a complete Project Plan and Gantt chart that has been provided to MURR by the vendor. The Gantt chart provides a detailed list of both accomplished tasks and future work.

### Conclusion

The University of Missouri Research Reactor has made every effort to obtain compliant packaging so that we may continue our safe and responsible shipment of Type B quantities of radioactive materials throughout the United States. This request provides information and background material supporting the request that NRC allow MURR to continue to operate its existing fleet of 6M and 20WC packages for two (2) years past the October 1, 2008 deadline.

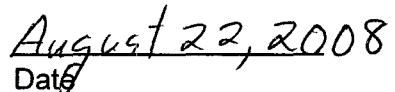
As MURR serves radiopharmaceutical companies with materials shipped in Type B quantity, we would appreciate the NRC notifying MURR as soon as practicable with their response to this request. MURR is obligated to provide our customers with as much lead time as possible to help them arrange for an orderly shutdown of production and for notification of cancer patients scheduled to receive treatments.

Your time and attention to our request is appreciated. If you have any questions or concerns, please do not hesitate to contact me at the address, phone number or email address above. In addition, you may contact Mr. Michael Flagg, the technical point of contact for this project at MURR, via email at FlaggM@missouri.edu or by phone at 573-882-5364.

Sincerely,



Ralph A. Butler  
Director, University of Missouri Research Reactor

  
Date

# Appendix A

*NRC Approved QA Plan and Relevant Standard Operating Procedures*

**UNIVERSITY OF MISSOURI-COLUMBIA  
RESEARCH REACTOR FACILITY**

**SHIPPING QUALITY ASSURANCE PROGRAM  
FOR TYPE B SHIPPING CASKS**

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### Appendix

- A. QA Personnel Responsibilities
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## **I. INTRODUCTION**

By this document the University of Missouri Research Reactor (MURR) establishes a Shipping Quality Assurance (QA) Program in accordance with 10 CFR 71, Subpart H. The MURR Shipping QA Program establishes requirements applicable to procurement, use, maintenance, and repair of packaging used in transport of licensed material in excess of a Type A quantity. The program includes the purchase, handling, shipping, storing, cleaning, assembly, inspection, testing, operation, maintenance, and repair of Type B shipping containers regulated by 10 CFR 71. The Shipping QA Program applies to those activities affecting the casks and their components, which are significant to safety. Quality assurance comprises those planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service. Shipping casks regulated by 10 CFR 71 will be released for shipping only after they have satisfactorily met the requirements of the MURR Shipping QA Program.

## **II. QUALITY ASSURANCE**

### **1. Organization**

The Associate Director of the MURR Regulatory Assurance Group (RAG) is responsible for the Shipping QA Program and shall assure the program complies with 10 CFR 71, Packaging and Transportation of Radioactive Material. The Associate Director (RAG) will have the following minimum qualifications: Bachelors degree in Engineering or related field; Certified Health Physicist (CHP); five years experience with reactors; and general knowledge of all aspects of research reactor operation.

The Associate Director (RAG) shall designate individuals, in writing, as Shipping QA Supervisors who have the responsibility to ensure that all work in their assigned area complies with 10 CFR 71, Subpart H- Quality Assurance. The Associate Director (RAG) shall designate in writing Shipping QA Inspectors, who have the responsibility to ensure that all requirements of Shipping QA procedures have been performed and verified. The Shipping QA Supervisor and Shipping QA Inspector positions may be collateral duties of the designated staff members.

All Shipping QA Supervisors, Inspectors, and Performers have the authority to stop unsatisfactory work in order to comply with federal regulations and MURR Shipping QA procedures. If a difference in opinion or a safety concern occurs between a Shipping QA Inspector and other Shipping QA personnel concerning compliance with the Shipping QA Program, the work evolution involved shall be stopped and put in a safe condition. The Shipping QA Inspector shall show the individual(s) the basis for the requirement. If the difference of opinion still exists, the appropriate Shipping QA Supervisor shall resolve the difference after consultation with the Associate Director (RAG).

MURR has divided the Shipping QA Program into four responsible groups: Hot Cell Operations, Radioactive Materials/Shipping, Reactor Operations and Hazardous Waste/Health Physics. Each group has a Shipping QA Supervisor to ensure that work in their assigned area meets the requirements of the MURR Shipping QA Program.

The Supervisor, Hot Cell Operations, is responsible for the packaging of Type B radioactive by-product materials and their preparation for shipment. The Supervisor, Hot Cell Operations is designated as a Shipping QA Supervisor. The Health Physics Manager is designated as an alternate Shipping QA Supervisor for Hot Cell Operations.

The Manager, Radioactive Materials/Shipping is responsible for all Type B shipments except for shipments of reactor spent fuel, fissile material and radioactive waste. The primary responsibility of the Manager, Radioactive Materials/Shipping is the safe transportation of Type B quantities of by-product radioactive materials. The Manager, Radioactive Materials/Shipping is designated as a Shipping QA Supervisor. The Health Physics Manager is designated as an alternate Shipping QA Supervisor for Radioactive Materials/Shipping.

The Assistant Reactor Manager-Physics is responsible for Type B shipments of reactor spent fuel and/or fissile material. The primary responsibility of the Assistant Reactor Manager-Physics is the safe shipment of reactor spent fuel. The Assistant Reactor Manager-Physics is designated as a Shipping QA Supervisor. The Assistant Reactor Manager-Engineering is designated as an alternate Shipping QA Supervisor for spent fuel and/or fissile material shipments.

The Hazardous Waste Coordinator/Health Physicist is responsible for Type B shipments of radioactive waste. The main responsibility of the Hazardous Waste Coordinator/Health Physicist is the safe shipment of radioactive waste. The Hazardous Waste Coordinator/Health Physicist is designated as a Shipping QA Supervisor. The Health Physics Manager is designated as an alternate Shipping QA Supervisor for the Hazardous Waste Coordinator/Health Physicist.

Per MURR Technical Specification 6.1, the Health Physics Manager shall annually review and approve the procedures for preparation of radioactive materials for shipping and the shipping of by-product material. The Assistant Reactor Manager-Physics shall annually review and approve all procedures for preparation and shipment of Type B radioactive materials of reactor spent fuel and/or fissile material.

## 2. Quality Assurance Program

The MURR Shipping QA Program establishes requirements applicable to procurement, use, maintenance, and repair of packaging used in transport of licensed material in excess of a Type A quantity. Where appropriate, procedures will be in place to ensure the implementation of the MURR Shipping QA Program requirements. Any action or procedure that could significantly affect the ability of any structure, system, or component to perform safely and as specified, falls within the scope of the MURR Shipping Quality Assurance Program.

The Shipping QA Program will be applied in a graded approach to an extent consistent with the importance to safety. Because MURR does not design or manufacture Type B shipping casks, the regulations in 10 CFR 71, Subpart D-Application for Package Approval, Subpart E-Package Approval Standards and Subpart F-Package, Special Forms, and LSA-III Tests are not applicable to the MURR Shipping QA Program.

Prior to use and shipment of Type B shipping packages, it is the responsibility of the appropriate Shipping QA Supervisor to ensure that MURR is registered with the NRC as an authorized user of the package and the shipment shall be made in accordance with the conditions of the NRC Certificate of Compliance.

For international shipments of Type B packaging, it is the responsibility of the appropriate Shipping QA Supervisor to ensure that MURR is registered with the U. S. Certificate of Competent Authority as an authorized user of the package and the shipment shall be made in accordance with the conditions of the U. S. Certificate of Competent Authority.

All Shipping QA Supervisors and Shipping QA Inspectors will have their training and experience documented by completion of the appropriate training records. In their assigned areas, each Shipping QA Supervisor shall ensure that all personnel who perform work in accordance with their Shipping QA procedures are adequately trained and qualified to perform this work.

3. Procurement Document Control

Prior to the purchase of Type B shipping packages, it is the responsibility of the appropriate Shipping QA Supervisor to ensure that the manufacturer of the packaging supplies all appropriate certifications verifying the designated packaging (model and serial number) was manufactured under the control of an NRC-approved QA program, identifies the type of verification activities required during use and maintenance, and designates other pertinent documentation to be furnished with the packaging (certificate of compliance, as-built drawings, use and maintenance manuals, photographs).

Prior to the purchase of replacement parts for Type B shipping casks, all parts important to safety will be reviewed by the appropriate Shipping QA Supervisor to ensure that all technical and QA requirements are included in purchase orders. When applicable, purchase orders shall be placed with suppliers/manufacturers previously qualified during fabrication of the packaging. For the purchase of replacement parts from suppliers/manufacturers not previously identified as qualified sources, it is the responsibility of the appropriate Shipping QA Supervisor to ensure that the replacement parts meet requirements at least as stringent as the original criteria.

4. Instructions, Procedures, and Drawings

Administratively controlled procedures shall be established for the use, maintenance, repair and preparation for transport of all Type B packaging.

5. Document Control

Control will be exercised for Shipping QA documents. Shipping QA documents consist of procedures, manuals, audits, instructions, specifications, training records, and drawings used in the procurement, use, maintenance, and repair of Type B shipping casks.

Prior to use, the Health Physics Manager will review and approve all Shipping QA procedures and revisions for the preparation and shipment of Type B quantities of by-product material. Prior to use, the Assistant Reactor Manager-Physics will review and approve all Shipping QA procedures and revisions for preparation and shipment of Type B quantities of reactor spent fuel and fissile material.

Controlled copies of approved Shipping QA procedures will be made available to persons responsible for using those documents.

In their assigned area, it is the responsibility of each QA Shipping Supervisor: to ensure the accuracy of all Shipping QA documents; to ensure that all personnel performing QA work are adequately trained and qualified to perform this work; and to ensure that all personnel performing QA work are aware of any revisions to the procedures. It is the responsibility of each Shipping QA Supervisor to ensure this training is completed and documented.

#### 6. Control of Purchased Material, Equipment, and Services

It is the responsibility of the appropriate Shipping QA Supervisor to ensure that purchased material, equipment, and services, whether purchased directly or through contractors, conform to the procurement documents. Source surveillance, audits of records, inspection and examination of products on delivery shall be performed as appropriate to ensure that the design and fabrication of Type B packaging was performed under the control of NRC-approved QA programs.

The appropriate Shipping QA Supervisor shall ensure that Type B packaging received at MURR is accompanied by appropriate documentation as identified in the purchase order. All documents that are referenced in the certificate of compliance, relate to the use and maintenance of the packaging, and identify necessary actions to be taken prior to the delivery of licensed material to a carrier for transport shall be present.

Contractors and suppliers are selected on the basis of references, past performance to MURR, reputation and other investigation. Appropriate credentials, and licenses if required by law, code or regulation, will be furnished and retained on file. No deviations from procurement documents are allowed without written request by the vendor and approval by the Associate Director of the MURR Regulatory Assurance Group (RAG) or his designated representative.

7. Identification and Control of Materials, Parts, and Components

The appropriate Shipping QA Supervisor shall ensure that materials, parts, and components used for repair of Type B packaging are adequately identified and controlled to prevent use of incorrect or defective items. When replacement of limited-life items is specified, the appropriate Shipping QA Supervisor shall ensure that no materials, parts and components are used whose shelf life or operation times have expired.

8. Control of Special Processes

The appropriate Shipping QA Supervisor shall ensure that all major repairs or inspections of Type B packaging requiring special processes such as welding or nondestructive testing be performed in accordance with the following criteria: all procedures, equipment, and personnel are qualified in accordance with applicable codes, standards, and specifications; the operations are performed by qualified personnel and accomplished in accordance with written process sheets with recorded evidence of verification; and qualification records of procedures, equipment, and personnel are established, filed, and kept current.

9. Inspection Control

The appropriate Shipping QA Supervisor or Shipping QA Inspector will perform a visual inspection of all Type B packaging upon receipt at MURR to ensure compliance with procurement documents. These visual inspections should include inspection of surface conditions; weld and structural integrity; the condition of flange faces or sealing areas, gaskets, seals, gauges, rupture disks, valves and pressure relief devices; the condition of tie-down members; labeling and marking; and leaktightness of the packaging. Any Type B packaging that does not comply with the procurement specifications or fails the visual QA inspection will be in noncompliance and immediately reported to the appropriate Shipping QA Supervisor and the Associate Director (RAG).

Procedures shall ensure adequate maintenance of Type B packaging. They shall identify the items to be maintained, criteria for acceptability or replacement, and the frequencies of inspection assigned to each item.

The appropriate Shipping QA Supervisor shall establish checklists to ensure that inspections are performed to verify that the following items have been complied with prior to each use:

1. Type B packages are properly assembled.
2. Valves are set to specifications.
3. All shipping papers are properly completed.
4. Type B packages are conspicuously and durably marked as required by DOT regulations.
5. Authorized individuals shall sign the shipping paperwork prior to release for shipment.

Procedural steps which require an independent QA inspection will be completed by a Shipping QA Inspector or a Shipping QA Supervisor who is not performing the activity being inspected.

10. Control of Measuring and Test Equipment

The appropriate Shipping QA Supervisor shall ensure that measurement and test equipment (gauges, fixtures, reference standards, and devices used to measure product characteristics of Type B packages) will be calibrated, adjusted and maintained at established intervals. Measurement and test equipment should be labeled or tagged to indicate the planned date of its next calibration, and the calibration records should be identified and traceable. Calibration shall be traceable to nationally recognized standards; or, where nationally recognized standards do not exist, provisions shall be established to document the basis for calibration.

Measurement and test equipment that fail calibration will be removed from service, and tagged as out of calibration equipment until repaired or replaced.

11. Handling, Storage and Shipping

The handling, storage, and shipping of Type B packaging will be controlled to assure safety, minimize degradation, damage and/or loss.

12. Inspection, Test, and Operating Status

A tag, label, marking, a log entry or other documentation will indicate the status of Type B shipping containers. The records will indicate when periodic surveillance tests have been performed. No deviation from required inspection, test or other critical operations are authorized without the approval of the Associate Director (RAG).

13. Non-Conforming Materials, Parts, and Components

The appropriate Shipping QA Supervisor shall ensure that nonconforming items for completed packaging, replacement parts or components shall include the following principal elements:

- (1) proper identification,
- (2) segregation of discrepant or nonconforming items,
- (3) disposition of the items of nonconformance, and
- (4) evaluation of the items of nonconformance.

All items or components found to be in noncompliance by procedure, inspection, testing or operations is to be immediately reported to the appropriate Shipping QA Supervisor. Nonconforming items will be quarantined or placed in a controlled hold area until disposition is completed. After designated repair, the appropriate Shipping QA Supervisor shall ensure that the acceptance of nonconforming items is verified by re-inspection or re-test against the original specifications. Final disposition of nonconformances shall be identified and documented. Nonconformance reports should be analyzed by QA personnel to determine quality trends for appropriate management review and assessment.

14. Corrective Action

For activities important to safety concerning use, maintenance and repair of Type B packages, the appropriate Shipping QA Supervisor shall ensure that conditions adverse to quality (e.g., those resulting from failures, malfunctions, deficiencies, deviations and defective material and equipment) are promptly identified and reported to appropriate levels of management. In the case of a significant condition adverse to quality, a root cause of the condition will be determined and corrective actions taken to preclude recurrence.

15. Quality Assurance Records

The appropriate Shipping QA Supervisor shall ensure the maintenance of QA records that are to be retained for the lifetime of packaging. These records include appropriate design and production-related records that are generated throughout manufacturing and furnished with packaging; records demonstrating evidence of operational capability; records verifying repair, rework and replacement; and audit plans, audit reports, corrective actions and records that are used as a baseline for maintenance. Records showing evidence of delivery of packages to a carrier and proof that all NRC and DOT requirements have been satisfied should also be retained with their retention times identified.

The Associate Director (RAG) is responsible for the prompt replacement of a record that is lost or damaged and for assessing and controlling records in MURR's possession.

QA records shall be maintained in storage locations that minimize the risk of damage.

16. Audits

The Associate Director (RAG) shall ensure that audits are performed in accordance with pre-established written procedures or checklists and are conducted by qualified personnel not having direct responsibility in the areas being audited. The audit shall verify compliance with all aspects of the Quality Assurance program and determine the effectiveness of the program.

The procedures or checklists shall list activities to be audited and the frequency at which each activity is to be audited. The frequency of audits should be based on the importance of the activity to safety; however, each activity should be audited at least once each year.

It is the responsibility of the appropriate Shipping QA Supervisor to ensure that corrective actions resulting from audits are completed and documented on a timely basis. Deficient areas shall be re-audited on a timely basis to verify implementation of corrective action.

## **QA PERSONNEL RESPONSIBILITIES**

### **Associate Director of the MURR Regulatory Assurance Group (RAG):**

The Associate Director (RAG) is responsible for the development and implementation of the MURR Shipping Quality Assurance Program.

### **Health Physics Manager:**

The Health Physics Manager shall annually review and approve the procedures for preparation of radioactive materials for shipping and the shipping of by-product material. Also designated as an alternate Shipping QA Supervisor for Radioactive Materials/Shipping, Hot Cell Operations and Hazardous Waste Coordinator.

### **Assistant Reactor Manager-Physics:**

The Assistant Reactor Manager-Physics is responsible for Type B shipments of reactor spent fuel and/or fissile material. Also shall annually review and approve all procedures for preparation and shipment of Type B radioactive materials of reactor spent fuel and/or fissile material.

### **Manager, Radioactive Materials/Shipping:**

The Manager, Radioactive Materials/Shipping is responsible for all Type B shipments except for shipments of reactor spent fuel, fissile material and radioactive waste.

### **Hot Cell Operations**

The Supervisor, Hot Cell Operations, is responsible for the packaging of Type B radioactive by-product materials and their preparation for shipment.

### **Hazardous Waste Coordinator:**

The Hazardous Waste Coordinator/Health Physicist is responsible for Type B shipments of radioactive waste.

### **Assistant Reactor Manager-Engineering:**

The Assistant Reactor Manager-Engineering is designated as an alternate Shipping QA Supervisor for spent fuel and/or fissile material shipments.

### **Shipping QA Supervisors:**

Shipping QA Supervisors are responsible for ensuring that work in their assigned area meets the requirements of the QA Program.

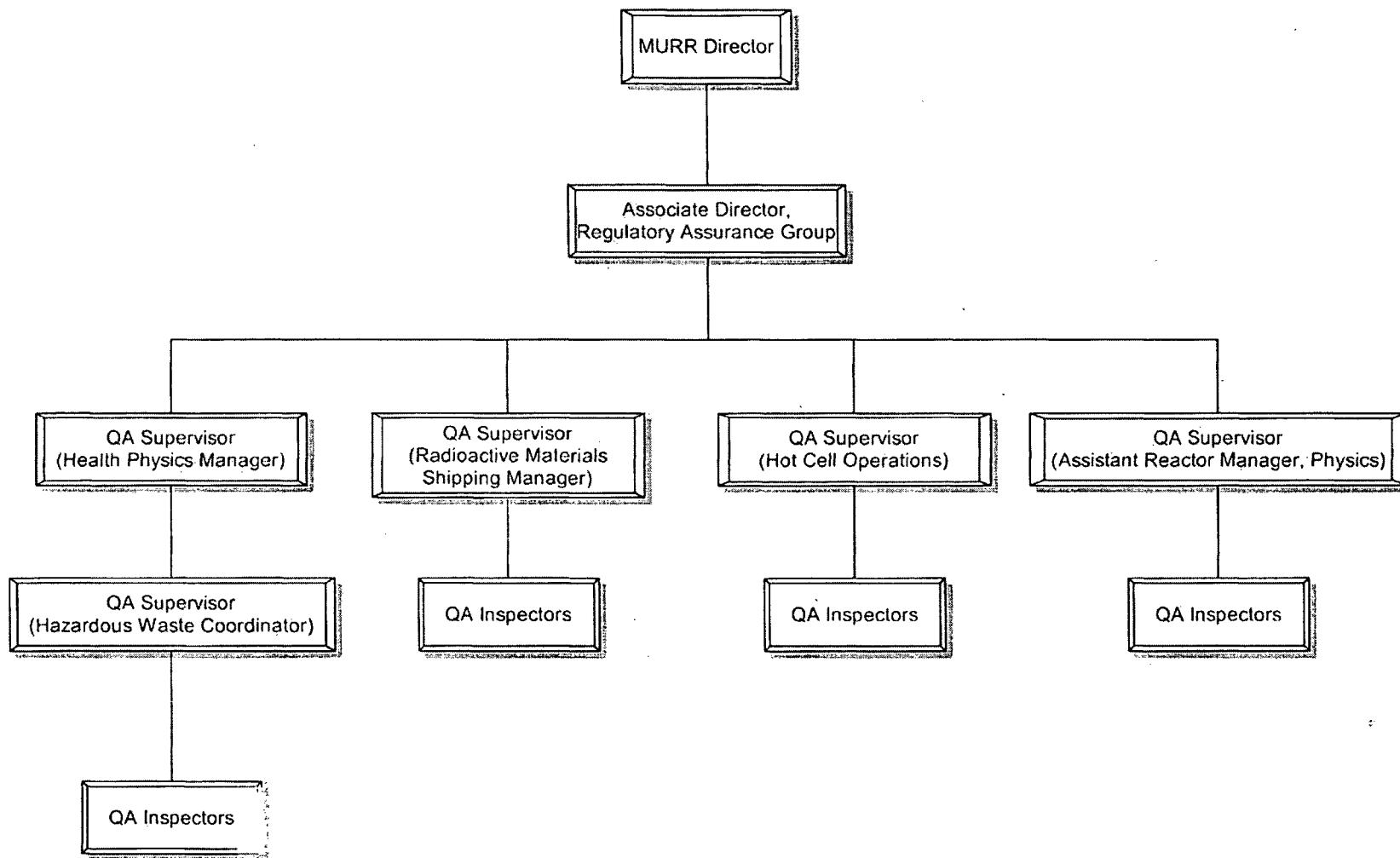
### **Shipping QA Inspectors:**

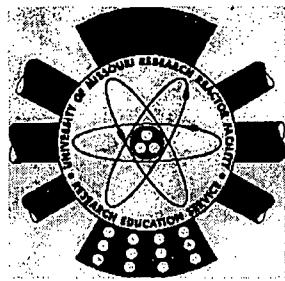
Shipping QA Inspectors shall perform the required QA inspection and have the authority to stop work not meeting the requirements of the QA Program.

## **REFERENCES**

1. 10 CFR 71
2. Regulatory Guide 7.10 (Rev. 1), June 1986, "Establishing Quality Assurance Programs for Packaging Used in the Transport of Radioactive Material"
3. ANS - 15.8 (N402) – 1976, "Quality Assurance Program Requirements for Research Reactors" (Reaffirmed December 15, 1986)

## SHIPPING QA ORGANIZATION





MURR

SHIPPING PROCEDURE

AP-SH-001

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ADMINISTRATIVE PROCEDURE  
RADIOACTIVE MATERIALS SHIPPING

RESPONSIBLE GROUP: Product & Service Operations, Shipping

PROCEDURE OWNER: Mike Kilfoil

APPROVED BY: Ronald J. Dobey, Jr. Ronald J. Dobey Date 11-20-06

APPROVED BY: Kenneth W. Brooks Kenneth W. Brooks Date 11/21/06

This procedure contains the following:

Pages	1	through	10
Attachments	1	through	2
Tables	None	through	
Figures	None	through	
Appendices	None	through	
Check-Off Lists	None	through	

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**ADMINISTRATIVE PROCEDURE - RADIOACTIVE MATERIALS SHIPPING****1.0 PURPOSE**

- 1.1 To establish the administrative guidelines necessary for the shipment of radiological isotopes, excluding shipments of fuel and waste, produced at the MURR facility. This procedure also defines general and technical terms and responsibilities that apply to *radioactive materials* shipping duties as performed by the Shipping Dept. and groups within MURR that have shipping related functions.
- 1.2 To provide general guidance to all persons having administrative and technical responsibilities that support or enhance the daily work activities of the shipping process.

**2.0 SCOPE**

- 2.1 Ensures that shipping activities comply with all applicable *Code of Federal Regulations (CFR)* and the *International Air Transport Association (IATA) Dangerous Goods Regulations*.
- 2.2 Establishes management's expectations regarding shipping activities of *radioactive materials*.
- 2.3 Ensures that *Shipping Technicians* can accurately interpret and correctly apply specific duties and responsibilities to procedural requirements.

**3.0 DEFINITIONS**

- 3.1 Refer to List of Definitions (Attachment 8.2) for a list of key words, terms or phrases that have a particular meaning to the shipping group.

**4.0 RESPONSIBILITIES****4.1 Reactor Manager:**

- 4.1.1 Provides 24-hour emergency response information concerning *radioactive material* shipments from MURR.
- 4.1.2 Notifies the *Radioactive Materials/Shipping Manager* or designee of all *incidents*.

## 4.0 RESPONSIBILITIES (CONT.)

### 4.2 Health Physics Manager:

- 4.2.1 Maintains the Radiation Protection Program.
- 4.2.2 Provides administrative, technical and operational support to the Shipping Department.
- 4.2.3 Maintains the Radiation Safety Program in support of the multi-faceted research, service and educational programs conducted at MURR.
- 4.2.4 Ensures that radiological survey and monitoring equipment and the required documentation used in the MURR Type B *Quality Assurance* Program are maintained in accordance with facility programs and procedures.
- 4.2.5 Reviews existing procedures and programs for their effectiveness and revise as necessary.

### 4.3 Radioactive Materials/Shipping Manager:

- 4.3.1 Maintains the equipment, procedures and required documentation used in the MURR Shipping *Quality Assurance* Program for Type B Shipping Casks.
- 4.3.2 Ensures all shipments of *radioactive material*, excluding shipments of fuel and waste, conform to applicable regulations of 10 CFR, 49 CFR, MURR Shipping *Quality Assurance* Program for Type B Shipping Casks and IATA.
- 4.3.3 Provides properly certified *packages* for shipment of *radioactive materials*.
- 4.3.4 Provides administrative, technical and operational support to personnel assigned to the Shipping Group.
- 4.3.5 Coordinates or specifies a training program to ensure that the hazmat employee has familiarity with the regulations governing the shipment of hazardous materials. This program includes:
  - The ability to recognize and identify the Hazardous Materials shipped from MURR
  - Knowledge of applicable requirements
  - Knowledge of Emergency Response Information
  - Self-protection measures
  - Accident prevention methods and procedures

#### 4.0 RESPONSIBILITIES (CONT.)

- 4.3.6 Supervises *Shipping Technicians* shipping activities.
- 4.3.7 Ensures assigned personnel are qualified to perform the duties of a *Shipping Technician* including but not limited to the following:
  - Identify initial training and recurrent training needs
  - Schedule and implement required training
  - Maintain documentation of completed training
- 4.3.8 Ensures all radionuclides are reported to the 95<sup>th</sup> percentile in accordance with 49 CFR 173.433(g) - Shipping Papers And Labeling, at the time of shipment for ground shipments only.
- 4.3.9 Maintains an expertise in domestic and international regulations governing the shipping process.
- 4.3.10 Provides emergency response information concerning *radioactive material* shipments from MURR.

#### 4.4 Shipping Technician:

- 4.4.1 Has multiple responsibilities for control of *samples* throughout the shipping process until finally released to the courier.
- 4.4.2 Reports all radionuclides to the 95<sup>th</sup> percentile in accordance with 49 CFR 173.433(g) at the time of the shipment for ground shipments only.
- 4.4.3 Performs the duties of a *Shipping Technician* (Shipper). This includes but is not limited to the following tasks:
  - Handling *radioactive materials*
  - Pre-assembling shipping containers
  - Preparing shipping documents and associated shipping labels
  - Properly *packaging radioactive material* for shipment
- 4.4.4 Ensures that *radioactive material* is shipped in accordance with approved procedures.
- 4.4.5 Ensures properly certified *packages* are used for shipment of *radioactive material*.

#### 4.0 RESPONSIBILITIES (CONT.)

- 4.4.6 Performs work activities in accordance with approved procedures or as directed by Supervision.
- 4.4.7 Reviews existing procedures and programs for their effectiveness and revise as necessary.
- 4.4.8 NOTIFIES Supervisor of any problem or condition that could affect the safety of the facility, public or environment.

##### 4.5 Irradiations Group:

- 4.5.1 Approves shipping activities for all non *secondary processed samples*.
- 4.5.2 Provides sample and consignee information, including isotope information required to be reported on the shipping paperwork for *non-secondary processed samples*.
- 4.5.3 Calculates all radionuclides to the 95<sup>th</sup> percentile in accordance with 49 CFR 173.433(g) at the time of the shipment for *non-secondary processed samples*.

##### 4.6 Secondary Processing Groups:

(Analytical Chemistry, Research & Development Radioisotopes, etc.)

- 4.6.1 Approves all shipping activities for *samples* originating in their departments.

##### 4.7 Associate Director, Product and Service Operations (PSO):

- 4.7.1 Provides technical and administrative support to the Shipping Group as required.
- 4.7.2 Ensures that information which is required for reporting on shipping paperwork is provided to the *Shipping Technicians*.

##### 4.8 Associate Director, Regulatory Assurance Group (RAG):

- 4.8.1 Maintains the MURR Shipping *Quality Assurance* Program for Type B Shipping Casks, Approval No. 0108.

## 5.0 PROCEDURE

### 5.1 GENERAL GUIDELINES

- 5.1.1 All persons participating in the shipping process of irradiated *samples shall:*
- a. Meet the qualifications of a *Shipping Technician*.
  - b. Maintain personnel exposures “As Low As Is Reasonably Achievable (ALARA).” Under normal conditions of work, exposures *must* not exceed levels specified in 10 CFR 20 - Standards For Protection Against Radiation (Reference 6.1).
  - c. Have familiarity with the regulations governing the shipment of hazardous materials. For the Shipping Group this will include:
    - the ability to recognize and identify Hazardous Materials shipped from MURR
    - knowledge of specific requirements applicable to functions performed by the *Shipping Technician*
    - knowledge of Emergency Response Information
    - self-protection measures
    - accident prevention methods and procedures
- 5.1.2 *Consignees* of MURR shipments of *radioactive materials* *must* be authorized to receive the type, form, and quantity of such material in accordance with provisions of 10 CFR 31 – General Domestic Licenses For Byproduct Material (Reference 6.1).
- 5.1.3 A *package* of *radioactive material* *shall* not be transported unless it is properly described, classed, marked, packaged and labeled in accordance with 49 CFR 173 - Shippers, General Requirements For Shipments And Packaging or the *IATA* Manual.
- a. If the *radioactive material* exceeds any of the applicable limits of 10 CFR - Energy, 49 CFR - Transportation, or *IATA* Manual, then the *Radioactive Materials /Shipping Manager* or designee *must* be immediately notified.
  - b. *Radioactive material* cannot leave MURR until applicable limits of 10 CFR - Energy and 49 CFR - Transportation or *IATA* Manual have been meet.

## 5.0 PROCEDURE (CONT.)

- 5.1.4 The University of Missouri Research Reactor *must* use an approved *Department of Transportation (DOT)* carrier for transport of hazardous material requiring placarding in accordance with 49 CFR, Subpart A.
- 5.1.5 All beta-gamma dose rate survey, contamination counting or gamma radioisotope instrumentation used during the preparation and shipping process *must* have a current calibration sticker attached to the survey equipment or have verification that the instrument is calibrated.
- 5.1.6 Each container or cask used in the shipment of *radioactive materials* *shall* conform to the appropriate regulations and specifications.
- 5.1.7 Non-fixed contamination on any external surface of any *package* *shall* be kept ALARA and under normal conditions of transport and *must* not exceed levels specified in:
  - 49 CFR 173.441 - *Radiation Level* Limits
  - 49 CFR 173.443 - Contamination Control
  - Applicable *IATA* Regulations
- 5.1.8 *Radioactive materials* having other hazardous characteristics *shall* be allocated Packing Groups I, II and III, as appropriate by application of the grouping criteria in accordance with:
  - 49 CFR 172.202 – Description Of Hazardous Material On Shipping Papers
  - *IATA*, Dangerous Goods Regulations
- 5.1.9 The *Performer* of a shipping process and *Inspector* *must* not be the same individual. The *Inspector* *must* also be qualified to perform the assigned task.
- 5.1.10 The *Primary Hazard* Label is used to identify the governing hazard for a *package*. Radioactivity is usually the governing hazard for *packages* shipped by MURR.

## 5.0 PROCEDURE (CONT.)

5.1.11 *Radioactive material shall be labeled in accordance with the following categories (Reference 49 CFR 172.403 - Class 7 Radioactive Material or IATA, Dangerous Goods Regulations):*

- a. White I: The maximum *radiation level* at any point on the external surface is 0.5 mrem/hr. The *Transport Index (TI)* is zero.
- b. Yellow II: The maximum *radiation level* on any point on the external surface is more than 0.5 mrem/hr but not more than 50 mrem/hr. The *TI* is more than zero (0) but not more than one (1).
- c. Yellow III: The maximum *radiation level* at any point on the external surface is more than 50 mrem/hr, but not more than 200 mrem/hr. The *TI* is more than 1 but not more than 10.
- d. *Packages with contact dose rates greater than 200 mrem/hr or with a TI greater than 10, shall be shipped as an Exclusive Use Shipment.*

NOTE:

The following specific duties and responsibilities help to establish management's expectations regarding preparation of *radioactive materials* for use within MURR labs or shipment from MURR.

## 5.2 SPECIFIC DUTIES AND RESPONSIBILITIES

5.2.1 All personnel who are directly or indirectly involved in the shipping process *must*:

- maintain a safe work place at all times
- employ the concepts of time, distance and shielding to keep radiation exposure ALARA
- identify and correct procedural problems that could adversely affect the preparation of *radioactive materials* for shipment from the MURR facility

## 6.0 REFERENCES

- 6.1 10 CFR, Energy
  - 10 CFR 20 - Standards For Protection Against Radiation
  - 10 CFR 31 - General Domestic Licenses For Byproduct Material
  - 10 CFR 71 - *Packaging and Transportation of Radioactive Material*
- 6.2 *International Air Transport Association (IATA) Dangerous Goods Regulations*
- 6.3 49 CFR, Transportation

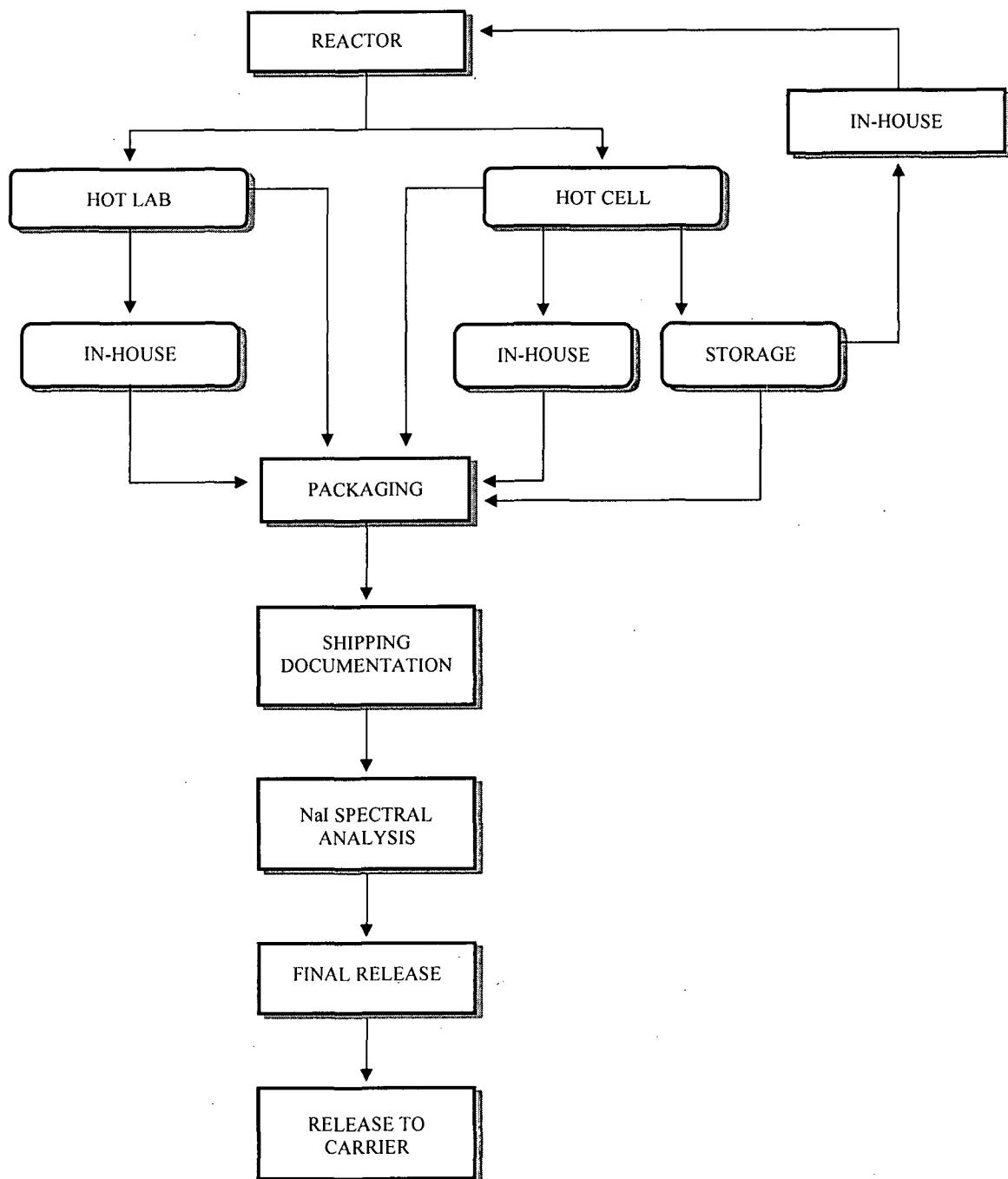
## 7.0 RECORDS

None

## 8.0 ATTACHMENTS

- 8.1 Typical Shipping Flow Chart
- 8.2 List of Definitions

**TYPICAL SHIPPING FLOW CHART**



The above flow chart is a simplified explanation of the shipping preparation process. Specific shipping tasks are detailed in appropriate procedures.

## LIST OF DEFINITIONS

The following is a list of key words, terms or phrases that have a particular meaning to the Shipping Group.

A table of A<sub>1</sub> and A<sub>2</sub> values for radionuclides can be found in 49 CFR and the IATA Regulations.

1. **Activity**: The rate at which a material gives off radiation.
  - A<sub>1</sub> - The maximum *activity* of “Special Form” *radioactive material* permitted in a Type A package.
  - A<sub>2</sub> - The maximum *activity* of “Normal Form” of *radioactive material* permitted in a Type A package.
2. **Becquerel (Bq)**: The SI unit of *activity* and is defined as one (1) atomic transformation per second. The *Becquerel* is such a small unit that the larger multiple units are used in shipping. The conversions are as follows:
  - Kilobecquerel: 1 KBq =  $10^3$
  - Megabecquerel: 1 MBq =  $10^6$
  - Gigabecquerel: 1 GBq =  $10^9$
  - Terabecquerel: 1 TBq =  $10^{12}$
3. **Capsule**: Aluminum secondary containment system for material run in the reactor region.
4. **Code of Federal Regulations (CFR)**: Regulations published by the Federal Government. The *CFR* contains TITLES (volumes) each of which is numbered and contains regulations pertaining to a specific subject, for example:
  - 10 *CFR*, Energy
  - 29 *CFR*, Labor
  - 49 *CFR*, Department of Transportation
5. **Concurrent Verification**: Inspection and corroboration of performance of a step at time it is completed.
6. **Consignees (receivers)**: A company/organization authorized to receive material shipped from MURR.
7. **Department of Transportation (DOT)**: Designated United States authority on the transport of hazardous materials.
8. **Emergency Call List (Shipping)**: A list maintained in the *Emergency Response Notebook* of individuals to be notified in case of a transportation *incident* involving *packages* prepared and shipped from MURR.

## DEFINITIONS (CONT.)

9. **Emergency Response Notebook:** A Notebook provided to Operations by the Shipping Group that contains the following:
  - Copy of the shipping documentation
  - Copy of the Emergency Response Information Sheet
  - A current copy of the Emergency Response Guidebook
  - The *Emergency Call List*
10. **Equivalent:** A system, component, device or material that meets the design requirements for purpose and/or function of a specified system, component, device or material.
11. **Excepted Packages:** Limited quantities of *radioactive materials*, instruments and articles, articles containing natural uranium, natural thorium or depleted uranium, and empty *radioactive materials packaging*. These *packages* are exempted from certain labeling, marking and paper work requirements.
12. **Experiment:** Any device or material that is exposed to significant radiation from the reactor and is not a normal part of the reactor or any operation designed to measure or monitor reactor characteristics or parameters.
13. **External Contamination:** Is radioactive contamination on any external surface of any *package*. It *must* be kept as low as practical and, under normal conditions of transport, *shall* not exceed the levels specified in the governing regulations.
14. **Fissile Material:** Material consisting of Plutonium 239, Plutonium 241, Uranium 233, Uranium 235, or any combination of these radionuclides. This does not apply to unirradiated natural uranium and depleted uranium, and natural uranium or depleted uranium that has been irradiated in a thermal reactor.
15. **Host Can:** A multi-carrier of *capsules*, which may be from:
  - previously irradiated *Host Cans*
  - stored material
  - new *Capsules(s)*
  - empty *Spacer Capsules*
16. **Hot Cell:** A sealed, shielded, and controlled area used to process *radioactive materials*.
17. **Hot Laboratory:** A controlled area to process *radioactive materials* containing a hood which exhausts to the facility ventilation exhaust system and may contain a drain connection to the radioactive liquid waste and disposal system.
18. **Incident:** Events that may affect safety or that have resulted in non-compliance with regulations.

## DEFINITIONS (CONT.)

19. Independent Verification: Inspection and corroboration that is separated by distance and time to insulate the verifier from the worker's performance and/or influence.
20. Inspector: See *Shipping Technician*.
21. International Air Transport Association (IATA) Dangerous Goods Regulations: Contains all of the requirements for the *International Civil Aviation Organization (ICAO)* regulations, and has included additional requirements, which are more restrictive. This reflects the industry standard practices or operational considerations.
22. International Atomic Energy Agency (IAEA): Develops guidance for the safe transport of radioactive materials.
23. International Civil Aviation Organization (ICAO): Uses the *IAEA* recommendations as the basis for developing the regulation for the safe transport of dangerous goods by air.
24. Low Specific Activity (LSA) Material: Material with limited *specific activity*, which satisfies specified descriptions and limits in applicable regulations.
25. Meter: Refers to instruments used in taking dose rate measurements.
26. Meter Stick: A ruler, one *meter* in length used to determine the *transport index*.
27. MURR Identification Number (MURR ID. No.): A unique number assigned to each radioisotope sample processed at MURR.
28. Must: A term *equivalent* to "SHALL" and is used to denote requirements imposed by MURR management which are above and in excess of and in addition to regulator requirements.
29. Non-fixed Radioactive Contamination: Contamination that can be readily removed from a surface by wiping with an absorbent material.
30. Normal Form Radioactive Material: Material, which has not been categorized nor qualified as "Special Form Radioactive Material."
31. Nuclear Regulatory Commission (NRC): The United States government agency established to regulate all the licensing and related regulatory functions of the nuclear industry.
32. Package: The *packaging* together with its *radioactive contents* as presented for transport.
33. Packaging: The assembly of components that make up a containment system for hazardous materials transport.

## DEFINITIONS (CONT.)

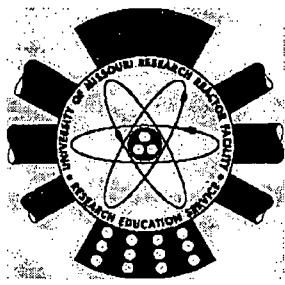
34. Performer: See *Shipping Technician*
35. Primary Hazard: The governing hazard for a *package*.
36. Primary Processed Samples: *Samples* that have been under the continuous control of the *Hot Cell* and Shipping Groups after removal from the reactor pool. These *samples* are shipped without any further processes performed on them.
37. Quality Assurance (QA): Those actions related to control of the physical characteristics and quality of the material or component to predetermined requirements.
38. Quality Event: Operational problem, non-conformance, or conditions adverse to quality that, if not corrected, may lead to an *incident*.
39. Radioactive Contents: A *radioactive material*, together with any contaminated liquids or gases within the *package*.
40. Radioactive Material: DOT defines *radioactive material* as any material containing radionuclides where both the *activity* concentration and the total *activity* in the consignment exceed the values specified in the table 49 CFR 173.436 or values derived according to the instructions in 173.433. NRC defines as material (except special nuclear material) yielded in, or made radioactive by exposure to the radiation *incident* to the process of producing or utilizing special nuclear material.
41. Radiation Level: The radiation dose-*equivalent* rate expressed in millirem(s) per hour or mrem/h.
42. Receivers: see *Consignees*
43. RUR: Reactor Utilization Request. A programmatic process that permits the reactor to be used for neutron irradiation and isotope production in accordance with the Hazard Summary Report. The *RUR* ensures that each *experiment* requested is reviewed to ascertain whether the experimenter possesses the experience and equipment to cope with the expected *radiation level* and whether the irradiated material may be safely used in the particular environment suggested by the experimenter. If the *experiment* is within acceptable limits of the reactor the Reactor Manager then approves it. (**HSR 8.0**)
44. Sample: The chemical or physical makeup of the target material or combination of target and encapsulation.
45. Secondary Processing Groups: Groups that submit *samples* for shipping other than Irradiations Group. Specifically: Analytical Chemistry, Research & Development Radioisotopes, Regulatory Assurance Group, Education and Research, Radiochemical Production and Silicon Group.

## DEFINITIONS (CONT.)

46. **Secondary Processed Samples:** Samples submitted for shipment by groups other than Irradiations Group. These *samples must* utilize FM-27, "In-House Radioactive Shipping Request Form," to transmit *sample* information to the Shipping Group.
47. **Shall:** A term used to denote legally binding requirements to which MURR is committed, for example:
  - Technical Specifications (TS)
  - Hazards Summary Report (HSR)
  - Regulatory Guides
  - American National Standards Institute (ANSI) standards
  - Code of Federal or State Regulations
48. **Shipping Technician:** Is defined as one of the following:
  - ***Trainee:*** Can neither inspect nor perform a task except under the direct supervision of a *Inspector* or *QA Inspector*.
  - ***Performer:*** An individual who has successfully completed the required training for specific tasks.
  - ***Inspector:*** An individual who has successfully completed all required training in shipping tasks applicable to shipment of Type A or lower quantities of *radioactive materials*.
  - ***QA Performer:*** An individual who has successfully completed the required training for specific tasks associated with the Type B shipping program.
  - ***QA Inspector:*** An individual who has successfully completed all required training in all the shipping tasks applicable to shipment of Type B quantities of *radioactive material* under the MURR *Quality Assurance* Program for Type B containers.
  - ***QA Supervisor:*** An individual designated in writing by the Associate Director (RAG) who is responsible for shipments within their assigned areas of byproduct material, waste, or spent fuel. Responsibility includes ensuring that personnel performing shipments under their assigned areas are trained and ensuring that shipment, procurement, inventory control, maintenance, testing, handling, and storage are conducted according to applicable procedures and in compliance with the MURR Type B *QA* Program.
49. **Should:** Not required, but would be highly desirable to accomplish.
50. **SI:** Units of measurement to be used in the transport of dangerous goods are those specified by the *International System (SI)*.
51. **Specific Activity:** The *activity* of the radionuclide per unit mass of that nuclide.

## DEFINITIONS (CONT.)

52. Surface Contaminated Object (SCO): A solid object which is not itself radioactive but which has radioactive material distributed on any of its surfaces.
53. Transfer Cask: Various sizes and configurations of shielded containers used to move radioactive samples from the reactor pool to predetermined handling areas.
54. Transport Index (TI): The dimensionless number placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. *TI* is the dose rate number rounded up to the next tenth mRem/hr at 1 meter from the hottest side.
55. Type A Quantity: A quantity of radioactive material which does not exceed  $A_1$ , for Special form material, or  $A_2$  for normal form material.
56. Type B Quantity: A quantity of material, which is greater than Type A.



RP-HP-110

Revision 4

# MURR

## RADIATION PROTECTION

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RP-HP-110

### SURVEY AND DECONTAMINATION OF RETURNED SHIPPING CONTAINERS

RESPONSIBLE GROUP: Reactor Health Physics

PROCEDURE OWNER: Manuel Díaz

APPROVED BY: Ronald J. Dobey, Jr.  Date 3-26-07

This procedure contains the following:

Pages	1	through	7
Attachments	None	through	
Tables	None	through	
Figures	None	through	
Appendices	None	through	
Check-Off Lists	None	through	

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## SURVEY AND DECONTAMINATION OF RETURNED SHIPPING CONTAINERS

### 1.0 PURPOSE

- 1.1 To establish a standard method for performing the *decontamination* of returned shipping containers used for the shipment of radioactive materials.

### 2.0 SCOPE

- 2.1 Contains procedural steps and precautions necessary to *decontaminate* returned radioactive materials shipping containers.
- 2.2 Establishes methods used for the *decontamination* of various types of containers.
- 2.3 Defines Reactor Health Physics interaction with Shipping Technicians to accomplish the process.

### 3.0 DEFINITIONS

- 3.1 *Decontamination* - The reduction or removal of contaminating radioactive material from a structure, area, object, or person. *Decontamination* may be accomplished by:
  - treating the surface to remove or decrease the *contamination* and / or
  - letting the material stand so that the radioactivity is decreased as a result of natural radioactive decay (Reference 7.1).
- 3.2 *Contamination* - Undesired radioactive material that is deposited on the surface or inside of structures, areas, objects or people (Reference 7.1).

### 4.0 PRECAUTIONS AND LIMITATIONS

- 4.1 Radiation work is only performed by persons informed about the work in compliance with 10 CFR 19.12 and ALARA concerns (Reference 7.2).
- 4.2 If any gross reading is greater than 25 mR / hr, the procedure must be stopped and the Reactor Health Physics Manager must be notified.

## 5.0 SPECIAL TOOLS OR EQUIPMENT

- Applicable hand-held dose rate survey instrument
- End window or pancake probe GM Frisker
- Masslin or soft absorbent paper towels
- Radioactive *contamination* marking tape
- Indelible marker
- Cotton tip swabs
- Preprinted, "Internal / External Contamination Survey" stickers
- Swipe Paper - normally 4.25 Whatman Qualitative Filter Paper
- Rubber gloves
- Applicable size zip-lock type plastic bag
- Radian Wash or equivalent

## 6.0 PROCEDURE

### 6.1 DOT 6M CASK:

NOTE: The BC-4 Swipe Counter, located in the basement, is the preferable instrument for counting contamination swipes. However, any individual swipe that is greater than 1000 cpm on the GM Frisker must not be counted on the BC-4 swipe counter.

NOTE: All gross dose rate surveys are performed with an open window.

CAUTION: If any gross reading is greater than 25 mR / hr, the procedure MUST be stopped and the Reactor Health Physics Manager notified.

6.1.1 WHEN Shipping Technician has removed clamping ring securing the barrel lid, THEN MONITOR dose rate while technician removes lid.

6.1.2 WHEN technician has exposed the top of the DOT 2R container, THEN MONITOR while technician opens 2R container.

## 6.0 PROCEDURE (CONT.)

6.1.3 IF pig is present, THEN

- a. remove pig from cask,
- b. perform normal swipe of outside of pig, AND
- c. IF swipe is greater than 220 dpm, THEN *decontaminate* AND re-swipe until less than 220 dpm.

6.1.4 MONITOR dose rate while technician opens pig.

6.1.5 Perform normal swipe of interior of 2R container.

6.1.6 IF swipe is greater than 220 dpm, THEN *decontaminate* AND re-swipe until less than 220 dpm.

6.1.7 Wipe inside of pig using a Masslin or moist paper towel.

6.1.8 IF wipe is greater than 1000 cpm (measured through a glove), THEN *decontaminate* AND re-wipe until less than 1000 cpm.

6.1.9 Wipe inside of pig using a Masslin or moist paper towel.

6.1.10 IF wipe is less than 1000 cpm (measured through a glove), THEN pig can be returned to service.

6.1.11 Fill out applicable information and initial "Internal / External Contamination" sticker AND place on cask.

### 6.2 DOT 20 WC-1 / NORDION / CIS-US:

**NOTE:** The BC-4 Swipe Counter is the preferable instrument for counting *contamination* swipes. However, any individual swipe that is greater than 1000 cpm on the GM Frisker must not be counted on the BC-4 swipe counter.

**NOTE:** All gross dose rate surveys are performed with an open window.

**CAUTION:** If any gross reading is greater than 25 mR / hr, the procedure MUST be stopped and the Reactor Health Physics Manager notified.

## 6.0 PROCEDURE (CONT.)

- 6.2.1 WHEN Shipping Technician has removed nuts securing over-pack lid,  
THEN MONITOR dose rate while technician removes lid.
- 6.2.2 WHEN technician has removed fiberboard THEN perform gross internal  
survey.
- 6.2.3 Perform normal swipe survey on top exterior of DU container.
- 6.2.4 IF swipe is greater than 220 dpm, THEN *decontaminate* AND re-swipe  
until less than 220 dpm.
- 6.2.5 MONITOR dose rate while technician opens DU container.
- 6.2.6 Using caution, remove 2R, etc. container.
- 6.2.7 Perform normal swipe of outside of 2R container.
- 6.2.8 IF swipe is greater than 220 dpm, THEN *decontaminate* and re-swipe until  
less than 220 dpm.
- 6.2.9 MONITOR dose rate while technician opens 2R container.
- 6.2.10 Wipe interior of 2R container with a Masslin or moist paper towel.
- 6.2.11 IF wipe is greater than 1000 cpm (measured through a glove), THEN  
*decontaminate* again AND re-wipe until less than 1000 cpm.
- 6.2.12 WHEN wipe is less than 1000 cpm, THEN 2R container can be returned  
to service.
- 6.2.13 RECORD applicable information and initial “Internal / External  
Contamination” sticker AND place on shipping container.

## 6.0 PROCEDURE (CONT.)

### 6.3 OTHER CASKS:

**NOTE:** The BC-4 Swipe Counter is the preferable instrument for counting *contamination* swipes. However, any individual swipe that is greater than 1000 cpm on the GM Frisker must not be counted on the BC-4 swipe counter.

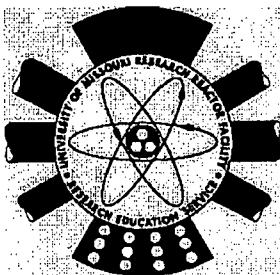
**NOTE:** All gross dose rate surveys are performed with an open window.

**CAUTION:** If any gross reading is greater than 25 mR / hr, the procedure MUST be stopped and the Reactor Health Physics Manager notified.

- 6.3.1 MONITOR dose rate while Shipping Technician opens outer package.
- 6.3.2 MONITOR dose rate while technician opens inner container.
- 6.3.3 Perform normal swipe of exterior of inner container.
- 6.3.4 IF swipe is greater than 220 dpm, THEN *decontaminate* AND re-swipe until less than 220 dpm.
- 6.3.5 Wipe interior of inner container with Masslin or moist paper towel.
- 6.3.6 IF wipe is greater than 1000 cpm (measured through a glove), THEN *decontaminate* again AND re-wipe until less than 1000 cpm.
- 6.3.7 When wipe is less than 1000 cpm, THEN inner container can be returned to service.
- 6.3.8 RECORD applicable information and initial “Internal / External Contamination” sticker AND place on shipping container.

## 7.0 REFERENCES

- 7.1 Nuclear Regulatory Commission, “Glossary of Nuclear Terms”
- 7.2 10 CFR 19.12, “Instruction to Workers”



BPB-SH-002  
Revision 7

MURR  
SHIPPING PROCEDURE

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BPB-SH-002

20WC-1 PACKAGING AND SHIPMENT  
OF TYPE B NON-WASTE RADIOACTIVE MATERIAL

RESPONSIBLE GROUP: Product & Service Operations, Shipping

PROCEDURE OWNER: J. Mike Kilfoil

APPROVED BY: Ronald J. Dobey, Jr. Ronald J. Dobey Date 8/1/06

APPROVED BY: Kenneth W. Brooks Kenneth W. Brooks Date 8/14/06

This procedure contains the following:

Pages	<u>1</u>	through	<u>9</u>
Attachments	<u>1</u>	through	<u>1</u>
Tables	<u>None</u>	through	
Figures	<u>None</u>	through	
Appendices	<u>None</u>	through	
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## **20WC-1 PACKAGING AND SHIPMENT OF TYPE B NON-WASTE RADIOACTIVE MATERIAL**

### **1.0 PURPOSE**

- 1.1 Provide instructions for *packaging* Type B (*DOT 20WC-1*) non-waste *radioactive materials* containers.

### **2.0 SCOPE**

- 2.1 Procedural steps for final *packaging* of a depleted uranium (DU) container containing *radioactive material* in a 2R Shipping Container and 20WC-1 Overpack Container.
- 2.2 This procedure ensures compliance with all applicable regulations prescribed in the following:
  - 10 *Code of Federal Regulations (CFR)* 71, Energy (Reference 9.1)
  - 49 *CFR*, Transportation (Reference 9.2)
  - *International Air Transport Association (IATA)* Dangerous Goods Regulations (Reference 9.3)
  - MURR Type B *Quality Assurance Program* (Reference 9.5)

### **3.0 DEFINITIONS**

- 3.1 Refer to AP-SH-001, “Administrative Procedure” (Reference 9.7) for list of definitions.

### **4.0 RESPONSIBILITIES**

- 4.1 Refer to AP-SH-001, “Administrative Procedure” (Reference 9.7) for list of responsibilities.

## 5.0 PRECAUTIONS AND LIMITATIONS

- 5.1 A package of radioactive material shall not be transported unless it is properly described, classed, marked, packaged and labeled in accordance with 49 CFR 173 or the IATA Manual, and the MURR Type B Quality Assurance Program.
- If the radioactive material exceeds any of the applicable limits of 10 CFR, 49 CFR, or IATA Manual, then the Radioactive Materials/Shipping Manager or Designee must be immediately notified.
  - Radioactive material must not leave MURR until the requirements of 10 CFR, 49 CFR, or IATA Manual have been met.
- 5.2 Survey instrumentation used during the performance of this procedure must have a valid “Calibration Current” sticker displayed.
- 5.3 The Performer of a shipping process and QA Inspector must not be the same individual. Additionally, the QA Inspector must be qualified as a Performer

## 6.0 PREREQUISITES AND INITIAL CONDITIONS

- 6.1 A person participating in any aspect of this procedure must meet the qualifications of a Shipping Technician as defined in AP-SH-001, “Administrative Procedure” (Reference 9.7).
- 6.2 Consignees (receivers) of MURR shipments of radioactive materials are authorized to receive the type, form, and quantity of radioactive material in accordance with the provisions of 10 CFR 71 – Packaging and Transportation of Radioactive Material.
- 6.3 A QA Inspector must review the customer’s Container/Cask and accompanying documentation prior to first use and ensure that the package is part of the MURR Type B QA Program.

**NOTE:** Liquid shipments MUST be made using a 20WC-1 with an external 2R only.

- 6.4 For liquid shipments, ensure external 2R shipping container has been leak checked in accordance with procedure BPB-SH-001, “2R Shipping Container Leak Check” (Reference 9.4).
- 6.5 Torque wrench has a valid “Calibration Current” sticker.

## 7.0 SPECIAL TOOLS AND EQUIPMENT

### 7.1 Tools

- 1-1/8 in. socket (External 2R Container Only)
- 12 in. drive socket extension or *equivalent* (1/2 in.)
- 5/8 in. deep well socket
- 3/4 in. deep well socket
- Manual ratchet
- Material handling equipment capable of lifting a minimum of 500 lbs.
- Pliers or crimping tool
- Rigid Flex-head handle, ½ in. drive (breaker bar)
- Speed handle
- Special 2R lid alignment tool (External 2R Container Only)
- Special 2R positioning rods (2 each) (External 2R Container Only)
- Torque wrench (0 to 75 ft-lbs)
- Wire cutters

### 7.2 Equipment

- Absorbent wiping material
- Luting compound
- Contamination barrier material
- Personal protective equipment
- Radiation survey equipment
- Tamper-Proof Seals

## 8.0 PROCEDURE

**NOTE:** FM-35, "Control Checksheet for Type B USA DOT 20WC-1 Radioactive Materials Shipment" (Attachment 11.4) requires verification of specific actions in this section. FM-35 is written to be used as a stand-alone procedure for preparing 20WC-1 shipments. This procedure provides additional information to complete this process.

- 8.1 NOTIFY Reactor Health Physics (HP) to conduct radiological surveys during the assembly process.
- 8.2 ENSURE by visual inspection that the 2R shipping container cavity does not contain foreign material.

**CAUTION:** The DU shield weighs approximately 200 lbs. Use appropriate material handling equipment when removing the DU shielding.

- 8.3 Attach material handling equipment to DU shield lifting eye.
- 8.4 HP Technician:
  - a. If not already performed, MONITOR *radiation level* on DU shield as it is lowered into the 2R Shipping Container.
  - b. Work at a safe distance to maintain exposures As Low As Is Reasonably Achievable (ALARA).
  - c. Follow facility guidelines for *radiation level* limits.
- 8.5 Working quickly to comply with ALARA, carefully lower DU into the wooden overpack.
- 8.6 Remove lifting device from the eye on the DU shield and move material handling equipment out of the immediate work area.

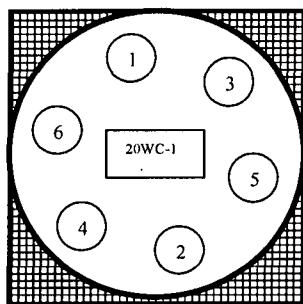
## 8.0 PROCEDURE (CONT.)

- 8.7 ENSURE DU shield lid bolts are torqued to 15 ft-lbs.
- 8.8 ENSURE luting compound applied to 2R threads (if applicable).
  - 8.8.1 For liquid shipments, torque the 2R lid to 75 ft-lbs.
- 8.9 Install 2R lid
- 8.10 Carefully, place 20WC-1 lid onto bottom portion of 20WC-1 over-pack.
  - a. Use care to align holes in 20WC-1 lid with all-thread rods.
  - b. Use alignment mark on bottom portion of 20WC-1 to aid with the proper alignment, if necessary.

NOTE: A gap between the top and bottom portions may indicate foreign material on the mating surface of the 20WC-1 overpack.

- 8.11 ENSURE 20WC-1 lid is properly seated and there are no gaps between top and bottom portions of over-pack.
- 8.12 ENSURE each all-thread rod has a flat washer and hex locknut, or *equivalent* locking device.
- 8.13 Using an alternating pattern, torque each nut on the 20WC-1 lid to 15 ft-lbs.

Example: Typical torque pattern.



## 8.0 PROCEDURE (CONT.)

**NOTE:** A tamper-proof seal is required on any 20WC-1 shipping container containing radioactive material. Seals are optional on empty 20WC-1 shipping containers.

8.14 Place a tamper-proof seal on end of one all-thread rod.

**NOTE:** All *packages* left in the staging area *must* have a radiation symbol and maximum contact dose rate clearly visible on the *package*.

8.15 ENSURE all previous shipping labels have been removed from the 20WC-1 surface.

- a. PLACE *package* in final staging area awaiting courier pickup only after completion of shipping documentation and Final *Package* Checkout.
- b. ENSURE work area is posted with appropriate radiation signs to warn other personnel.

8.16 Follow facility procedures and regulatory requirements to ship the 20WC-1.

## 9.0 REFERENCES

- 9.1 10 *CFR* 71, Energy
- 9.2 49 *CFR*, Transportation
- 9.3 *International Air Transport Association (IATA) Dangerous Goods Regulations*
- 9.4 BPB-SH-001, "2R Shipping Container Leak Check"
- 9.5 MURR Type B *Quality Assurance* Program
- 9.6 AP-SH-001, "Administrative Procedure"
- 9.7 DOT Package Specification

**10.0 RECORDS**

- 10.1 FM-35, "Control Checksheet for Type B USA DOT 20WC-1 Radioactive Materials Shipment"

**11.0 ATTACHMENTS**

- 11.1 FM-35, "Control Checksheet for Type B USA DOT 20WC-1 Radioactive Materials Shipment"

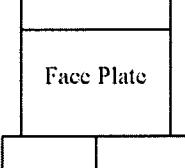
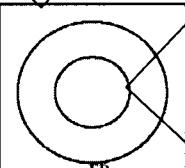
FM-35  
Revision 9

## CONTROL CHECKSHEET FOR TYPE B USA DOT 20WC-1 RADIOACTIVE MATERIALS SHIPMENT

*Performer and QA Inspector cannot be the same individual. All QA Supervisors, QA Inspectors and Performers have the authority to stop unsatisfactory work in order to comply with federal regulations and MURR Shipping procedures. All items or components found to be in nonconformance by procedure, inspection, testing or operation are to be immediately reported to the appropriate Shipping QA Supervisor.*

Affix shipment preprinted identification label here.

(Shipment Destination, Isotope(s), MURR Identification Number(s) and Activity)

QA Inspector (Initials)	Performer (Initials)	Step No.	Action / Verification
N/A	_____	1.	Performed leak test of inner shipping container (for liquid shipments only).
N/A	_____	2.	RECORD the following information: Inner Container Serial Number: _____
N/A	_____	3.	Overpack Serial Number: _____
N/A	_____	4.	ENSURE absorbent material is placed in DU Container. (For liquid shipments only)
N/A	_____	5.	Overpack sample information and Inner Cask sample information are correct and in agreement with each other.
N/A	_____	6.	Luting compound applied to 2R Inner Shipping Container threads.
N/A	_____	7.	ENSURE gasket / o-ring is installed in Inner Shipping Container lid.
N/A	_____	8.	Inner Shipping Container gasket condition: (circle one) <input checked="" type="radio"/> Satisfactory <input type="radio"/> Replaced If replaced, update the appropriate cask history folder. (Proper gasket is identified in Technical Drawing.)
N/A	_____	9.	Sample materials inserted into cask.
N/A	_____	10.	DU shield bolts torqued to 15 ft-lbs. (QA Calibration Required)
N/A	_____	11.	2R lid torqued to 75 ft-lbs (for 20WC-1 containers with a 2R external to the DU). (QA Calibration Required)
N/A	_____	12.	Tamper-proof seal placed on end of one all-thread rod.
N/A	_____	13.	RECORD 20WC-1 Overpack dose rates. (QA Calibration Required)
 			
TI: _____			
N/A	_____	14.	20WC-1 Overpack is <6600 dpm/ 300 cm <sup>2</sup> βγ & <660 dpm/ 300 cm <sup>2</sup> α.
N/A	_____	15.	Correct shipping name and UN Number label (RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE UN2916) affixed on opposite sides of container. (Include "RQ" before or after if applicable)
N/A	_____	16.	Gross weight plainly and indelibly marked on outside of 20WC-1 Overpack container.
N/A	_____	17.	"TYPE B" is plainly and indelibly marked on outside of 20WC-1 Overpack container.
N/A	_____	18.	"TREFOIL" is plainly and indelibly marked on outside of 20WC-1 Overpack container.
N/A	_____	19.	Specification / certification is plainly and indelibly marked on outside of 20WC-1 Overpack container.

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QA Inspector (Initials)	Performer (Initials)	Step No.	Action/Verification
_____	_____	20.	The information for this shipment is recorded on FM-44, "MURR Request for Radioisotope Shipment." <ul style="list-style-type: none"> <li>a. License number, issuing agency and expiration date specified.</li> <li>b. VERIFY that isotope and activity is approved per Precautions and Limitations of AP-SH-001, "Radioactive Materials Shipping."</li> <li>c. Shipping address is correct.</li> </ul>
_____	_____	21.	Emergency Response Information Sheet(s) are attached to the Shipper's Declaration/Straight Bill of Lading.
N/A	_____	22.	All appropriate entries made in the Cask History Log.
_____	_____	23.	Primary hazard labels verified, in place on opposite sides of the container and appropriate for the dose rate measurements. NOTE: Performer is to list information from each label. (The performer must not be the shipper releasing the container.)
		Category:	_____
		Isotope(s):	_____
		Activity:	_____
		TI:	_____
_____	_____	24.	The appropriate subsidiary risk and handling label(s) have been placed adjacent to the primary hazard labels. (List) (Include RQ if applicable)
_____	_____	25.	Shipment Waybill(s), address label and container preprinted identification label agree and are affixed to package.
N/A	_____	26.	Sodium Iodide Spectrum completed.
N/A	_____	27.	Consignee notified of shipment prior to release to carrier.
N/A	_____	28.	All steps in the procedure have been initiated by a properly authorized individual.
Shipment approved for release by: _____ QA Inspector Signature _____ Date _____			
Package and paperwork reviewed for accuracy by: _____ Health Physics Signature _____ Date _____			
This package is category Yellow III and requires vehicle placards. (Circle one) Yes / No			
Shipment accepted by: _____ Courier Signature _____ Date _____			

**SERVICE APPLICATIONS: QA/QC PROGRAM: USA DOT 20WC-1****1.0 PURPOSE AND SCOPE**

The purpose of this QA/QC Procedure is to ensure that the purchasing, testing, use, repair, handling, shipping, storing, inspection, and maintenance of USA DOT 20WC-1 shipping container complies with 10CFR71.

**2.0 PRECAUTIONS AND LIMITATIONS**

Refer to Service Applications Departmental Administrative-Shipping Procedure, MURR-SAS-00.

**3.0 MATERIALS AND EQUIPMENT**

*NOTE: All maintenance materials and supplies shall be stored in a specified locked Quality Control location and designated as such.*

*Access to this location shall be restricted to approved individuals.*

## 3.1 DOT 7A Inner Cask

## 3.1.1 DOT 7A Inner Cask Lid Gasket.

## 3.1.2 Reference Drawing MURR # 1294.

## 3.1.3 DOT 7A Inner Cask Lid Hold Down Bolts.

**4.0 DEFINITIONS**

Refer to Service Applications Departmental Administrative-Shipping Procedure, MURR-SAS-00.

**5.0 RESPONSIBILITIES**

Refer to Service Applications Departmental Administrative-Shipping Procedure, MURR-SAS-00.

**6.0 QC CONTROL PROGRAM FOR DOT 7A INNER CASK****6.1 QC for DOT 7A Inner Cask Lid Gasket**

## 6.1.1 Per Quality Assurance Plan: All Procurement Documents must contain the following statement:

*The University of Missouri has the right of access to the Suppliers' Facilities and Records for Source Inspection and Audit.*

- 6.1.2 To order a DOT 7A Inner Cask Lid Gasket, prepare the Purchase Order with the following specifications:
    - Material: Neoprene.
    - Thickness: 1/8 inch.
    - 60/70 Shore Durometer.
    - Include along with the Purchase Order, MURR reference Drawing number 1294 for dimensions.
  - 6.1.3 The Control Lot Number for tracking purposes shall be the purchase order number followed by a dash and the year (e.g., C12345-95).
  - 6.1.4 Initiate and maintain a QC Packet containing a copy of the purchase order indicating the Control Lot Number.
  - 6.1.5 Upon receipt of the ordered gasket(s), perform an Acceptance Inspection using the Quality Control Inspection for DOT 7A Inner Cask Lid Gasket (Attachment 1).
  - 6.1.6 Perform the Acceptance Criteria; Steps 1 through 4.
  - 6.1.7 Sign and Date; Indicating the Acceptance Criteria is true.
  - 6.1.8 Upon acceptance of the gasket(s), complete the QC Document; Top Portion of Attachment 1, by inserting the following data:
    - Control Lot #,
    - Accepted by,
    - Date.
  - 6.1.9 Fold the QC Document (Attachment 1) as indicated by the fold lines so that the data of Step 6.1.8 is clearly visible; place a copy of the QC Document into a poly bag along with each of the accepted gasket(s).
  - 6.1.10 Heat seal the poly bag and store in the approved QC Storage location.
  - 6.1.11 Rejected gaskets must be discarded or returned to the manufacturer at the discretion of the Service Applications-Section Leader.
  - 6.1.12 Upon completion of the gasket task, record the gasket change out in the Cask Log Book.
  - 6.1.13 Place the Gasket QC Sheet into the Shipment Folder.
- 6.2 QC for DOT 7A Inner Cask Lid Hold Down Bolt**
- 6.2.1 Per Quality Assurance Plan; All procurement documents must contain the following statement:

*The University of Missouri has the right of access to the suppliers' facilities and records for Source Inspection and Audit.*

- 6.2.2 To order DOT 7A Inner Cask Lid Hold Down Bolts, prepare the Purchase Order with the following specifications:
  - Grade 8 or 8A 304 Stainless Steel,
  - 3/8 inch by 16 bolt,
  - 1/2 inch to 1 inch length.
- 6.2.3 The Control Lot Number for tracking purposes shall be the purchase order number followed by a dash and the year (e.g., C12345-95).
- 6.2.4 Initiate and maintain a QC Packet containing a copy of the purchase order indicating the Control Lot Number.
- 6.2.5 Upon receipt of the ordered bolt(s), perform an Acceptance Inspection using the Quality Control Inspection for DOT 7A Inner Cask Lid Hold Down Bolt (Attachment 2).
- 6.2.6 Perform the Acceptance Criteria; Steps 1 through 3.
- 6.2.7 Sign and Date; Indicating the Acceptance Criteria is true.
- 6.2.8 Upon acceptance of the bolt(s), complete the QC Document; Top portion of Attachment 2, by inserting the following data:
  - Control Lot #,
  - Accepted by,
  - Date.
- 6.2.9 Fold the QC Document (Attachment 2) as indicated by the fold lines so that the data of Step 6.2.8 is clearly visible; place a copy of the QC Document into a poly bag along with the accepted bolts.
- 6.2.10 Heat seal the poly bag and store in the approved QC Storage location.
- 6.2.11 Upon completion of the task, record the change out in the Cask Log Book.
- 6.2.12 Forward the QC Sheet to the QA Supervisor for filing in the appropriate cask file.
- 6.2.13 Rejected bolts must be discarded or returned to the manufacturer at the discretion of the Service Applications-Section Leader.

#### ATTACHMENTS

- A. Quality Control Inspection: Control Check Sheet for DOT 7A Inner Cask Lid Gasket (Attachment 1).
- B. Quality Control Inspection: Control Check Sheet for DOT 7A Inner Cask Hold Down Bolt (Attachment 2).

MURR-SAS-00007

Service Applications QA/QC Program: USA DOT 7A Inner Cask

**REFERENCES**

- A. 10CFR71.
- B. ANSI No. N323-1978.
- C. SA-QA-10.

Rev. 0.2

SA M

RM Wm

Date: 04 April 1997

MURR-SAS-00007

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CONTROL CHECK SHEET USE PROCEDURE

QUALITY CONTROL INSPECTION:  
CONTROL CHECK SHEET FOR DOT 7A INNER CASK LID GASKET

Acceptance Criteria:

1. You are an Approved Inspector for this procedure.
2. Verified: Gasket material is black neoprene by reference to Shipping Documents and visual inspection.
3. Verified: Gasket contains no cracks or cuts.
4. Verified: Gasket size and thickness meets specifications of MURR Drawing number 1294.

All the above Acceptance Criteria is true:

\_\_\_\_\_  
Signature/Date

FOLD LINE

QC CONTROLLED PART:	_____	
DOT 7A INNER CASK LID GASKET	_____	
Control Lot #	_____	F
	_____	O
	_____	L
	_____	D
Accepted by:	_____	L
	_____	I
	_____	N
	_____	E
Date:	_____	
	_____	
	_____	
	_____	
	_____	

QUALITY CONTROL INSPECTION:  
CONTROL CHECK SHEET FOR DOT 7A INNER CASK LID HOLD DOWN BOLT

Acceptance Criteria:

1. You are an Approved Inspector for this procedure.
2. Verified: Bolt material is Grade 8 or 8A Stainless Steel by reference to Shipping Documents and visual inspection.
3. Verified: Bolt is  $\frac{3}{8}$  by 16;  $\frac{1}{2}$  inch to 1 inch length.

All the above Acceptance Criteria is true:

\_\_\_\_\_  
Signature/Date

FOLD LINE

QC CONTROLLED PART: DOT 7A	<input type="checkbox"/>
INNER CASK LID HOLD DOWN BOLT.	<input type="checkbox"/>
Control Lot # _____	<input type="checkbox"/> F <input type="checkbox"/> O <input type="checkbox"/> L <input type="checkbox"/> D
Accepted by: _____	<input type="checkbox"/> L <input type="checkbox"/> I <input type="checkbox"/> N <input type="checkbox"/> E
Date: _____	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>



BPB-SH-005  
Revision 5

MURR

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SHIPPING PROCEDURE

BPB-SH-005

DOT 6M PACKAGING OF TYPE B NON-WASTE RADIOACTIVE MATERIAL

RESPONSIBLE GROUP: Product & Service Operations, Shipping

PROCEDURE OWNER: J. Mike Kilfoil

APPROVED BY: Ronald J. Dobey, Jr. Ronald J. Dobey Jr. Date 12-4-07

APPROVED BY: Kenneth W. Brooks Kenneth W. Brooks Date 11-19-07

This procedure contains the following:

Pages	1	through	6
Attachments	1	through	1
Tables	None	through	
Figures	None	through	
Appendices	None	through	
Check-Off Lists	None	through	

## TABLE OF CONTENTS

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6.0 PREREQUISITES AND INITIAL CONDITIONS.....	4
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8.0 PROCEDURE.....	5
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## DOT 6M PACKAGING OF TYPE B NON-WASTE RADIOACTIVE MATERIAL

### 1.0 PURPOSE

- 1.1 Provide instructions for *packaging* of USA *DOT 6M* Type B non-waste radioactive materials containers.

### 2.0 SCOPE

- 2.1 Procedural steps for the final *packaging* of the *DOT 6M* container.
- 2.2 This procedure ensures compliance with all applicable regulations, including:
  - 10 *Code of Federal Regulations (CFR)* 71, Energy (Reference 9.1)
  - 49 *CFR*, Transportation (Reference 9.2)
  - *International Air Transport Association (IATA)* Dangerous Goods Regulations (Reference 9.3)
  - MURR Type B *Quality Assurance (QA)* Program (Reference 9.4)

### 3.0 DEFINITIONS

- 3.1 Refer to AP-SH-001, “Administrative Procedure” (Reference 9.6) for list of definitions.

### 4.0 RESPONSIBILITIES

- 4.1 Refer to AP-SH-001, “Administrative Procedure” (Reference 9.6) for list of definitions.

### 5.0 PRECAUTIONS AND LIMITATIONS

- 5.1 A *package* of radioactive material shall not be transported unless it is properly described, classed, marked and labeled in accordance with 49 *CFR* 173 or the *IATA* Manual, and the MURR Type B QA Program.
  - If the radioactive material package exceeds any of the applicable limits of 10 *CFR*, 49 *CFR*, or *IATA* Manual, then the Manager of Radioactive Materials Shipping or Designee *must* be immediately notified.
  - Radioactive material *must* not leave MURR until the requirements of 10 *CFR*, 49 *CFR*, or *IATA* manual have been met.
- 5.2 Survey instrumentation used during the performance of this procedure *must* have a valid “Calibration Current” sticker displayed.

## 5.0 PRECAUTIONS AND LIMITATIONS (CONT.)

- 5.3 The *Performer* of a shipping process and the *QA Inspector* must not be the same individual. Additionally, the *QA Inspector* must be qualified as a *Performer*.

## 6.0 PREREQUISITES AND INITIAL CONDITIONS

- 6.1 A person participating in any aspect of this procedure *must* meet the qualifications of a *Shipping Technician* as defined in AP-SH-001, "Administrative Procedure" (Reference 9.6).
- 6.2 *Consignees (receivers)* of MURR shipments of *radioactive materials* are authorized to receive the type, form, and quantity of *radioactive material* in accordance with the provisions of 10 CFR 71, *Packaging and Transportation of Radioactive Material*.
- 6.3 A *QA Inspector* *must* review the customer's container and accompanying documentation prior to first use and ensure that the *package* is part of the MURR Type B *QA Program*.
- 6.4 Cask has been prepared in accordance with RP-HP-110, "Survey and Decontamination of Returned Shipping Containers" (Reference 9.5).
- 6.5 ENSURE all previous shipping labels have been removed from the surface of the container.

## 7.0 SPECIAL TOOLS OR EQUIPMENT

### 7.1 Tools

- Speed wrench
- 15/16" Socket

### 7.2 Equipment

- Luting compound
- Personal protective equipment
- Radiation survey equipment
- Tamper proof seal

## 8.0 PROCEDURE

NOTE:

FM-74, "Control Checksheet for Type B USA DOT 6M Radioactive Materials Shipment" (Attachment 11.1) requires verification of specific actions in this section. FM-74 is written to be used as a stand alone procedure for preparing DOT 6M shipments. This procedure provides additional information to complete this process.

- 8.1 ENSURE 2R cavity does not contain foreign material.
- 8.2 ENSURE luting compound applied to 2R threads.
- 8.3 NOTIFY Reactor Health Physics to conduct radiological surveys on inner shipping container prior to its loading into the 2R.
- 8.4 Working quickly to comply with ALARA, carefully lower inner shipping container into 2R.
- 8.5 Secure screw top lid onto 2R.
- 8.6 ENSURE centering media is in place.

NOTE:

If the closure ring does not sit snugly against the lid then tap the closure ring with a nonmetallic hammer until tight.

- 8.7 Secure lid with closure ring.
- 8.8 Place a tamper proof seal around locking bolt.

NOTE:

All *packages* left in the staging area *must* have a radiation symbol and a maximum contact dose rate clearly visible on the package.

- 8.9 Place *package* in final staging area awaiting courier pickup only after completion of shipping documentation and final *package* checkout.
- 8.10 ENSURE work area is posted with appropriate radiation signs to warn other personnel.
- 8.11 Follow facility procedures and regulatory requirements to ship the *DOT 6M*.

## **9.0 REFERENCES**

- 9.1 10 CFR 71, Energy
- 9.2 49 CFR, Transportation
- 9.3 International Air Transport Association (IATA) Dangerous Goods Regulations
- 9.4 MURR Type B *Quality Assurance Program*
- 9.5 RP-HP-110, "Survey and Decontamination of Returned Shipping Containers"
- 9.6 AP-SH-001, "Administrative Procedure"
- 9.7 DOT Package Specification

## **10.0 RECORDS**

- 10.1 FM-74, "Control Checksheet for Type B USA DOT 6M *Radioactive Materials Shipment*"

## **11.0 ATTACHMENTS**

- 11.1 FM-74, "Control Checksheet for Type B USA DOT 6M *Radioactive Materials Shipment*"

**CONTROL CHECKSHEET FOR TYPE B USA DOT 6M  
RADIOACTIVE MATERIALS SHIPMENT**

*Performer and QA Inspector cannot be the same individual. All QA Supervisors, QA Inspectors and Performers have the authority to stop unsatisfactory work in order to comply with federal regulations and MURR Shipping procedures. All items or components found to be in nonconformance by procedure, inspection, testing or operation are to be immediately reported to the appropriate Shipping QA Supervisor.*

Affix shipment preprinted identification label here.

(Shipment Destination, Isotope(s), MUUR Identification Number(s) and Activity)

QA Inspector (Initials)	Performer (Initials)	Step No.	Action / Verification
N/A		1.	Record Container Serial Number: _____
N/A		2.	Inner shield identified per HC-PSO-002, "Hot Cell Preparation of Radioactive Material for Shipment."
		3.	Container sample information and inner shield label agree.
		4.	Luting compound applied to 2R Container threads.
		5.	Sample materials inserted into cask.
		6.	Lid secured on 2R container.
		7.	Centering media in place.
		8.	Lid bolted securely.
		9.	Security seal in place.
		10.	Record highest dose rate and transport index in mR/h. (QA Calibration Required)
		Side	Dose Rate _____
		TI	_____
		11.	DOT 6M is <6600 dpm/ 300 cm <sup>2</sup> βγ & <660 dpm/ 300 cm <sup>2</sup> α.
		12.	Correct shipping name and UN Number label (RADIOACTIVE MATERIAL, TYPE B(U) PACKAGE UN2916) affixed on opposite sides of container. (Include "RQ" before or after if applicable)
N/A		13.	"TYPE B" is plainly and indelibly marked on outside of container.
N/A		14.	"TREFOIL" is plainly and indelibly marked on outside of container.
N/A		15.	Specification / certification is plainly and indelibly marked on outside of DOT 6M container.
N/A		16.	All appropriate entries made in the cask history log.
N/A		17.	Place package in staging area prior to completion of BP-SH-052.

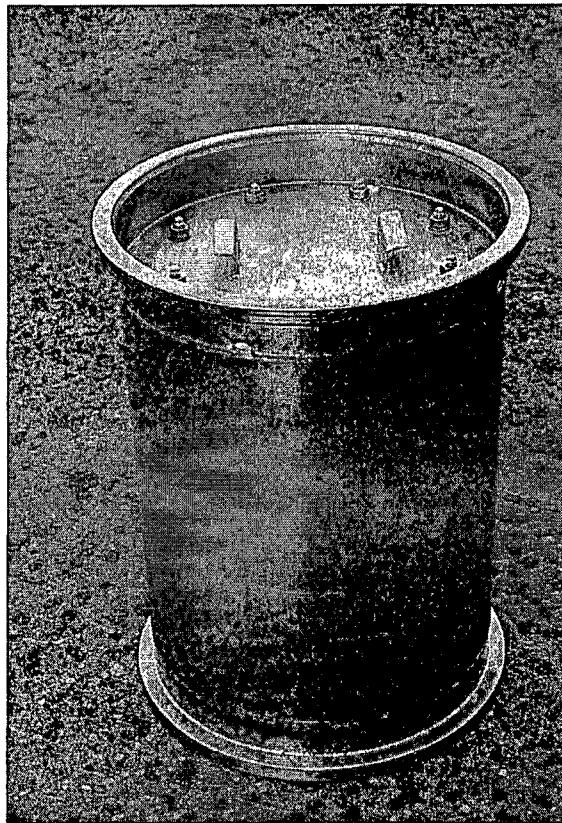
(Attached to Procedure: BPB-SH-005)

# Appendix B

*Specification Sheets for the SAFKEG-LS and SAFKEG-HS Type B Multi-Radioisotope Package Designs*

# **Package Design No 3979A**

## **Package Name - Safkeg-LS**



### **Package Type**

Re-usable Type B package for the shipment of solid and liquid radioactive materials.

### **Certification**

The Safkeg-LS package is being certified by the USNRC as a B(U) Package - the package meets all the requirements of 10CFR71 and the IAEA Regulations for the Safe Transport of Radioactive Material, TS-R-1.

### **Description**

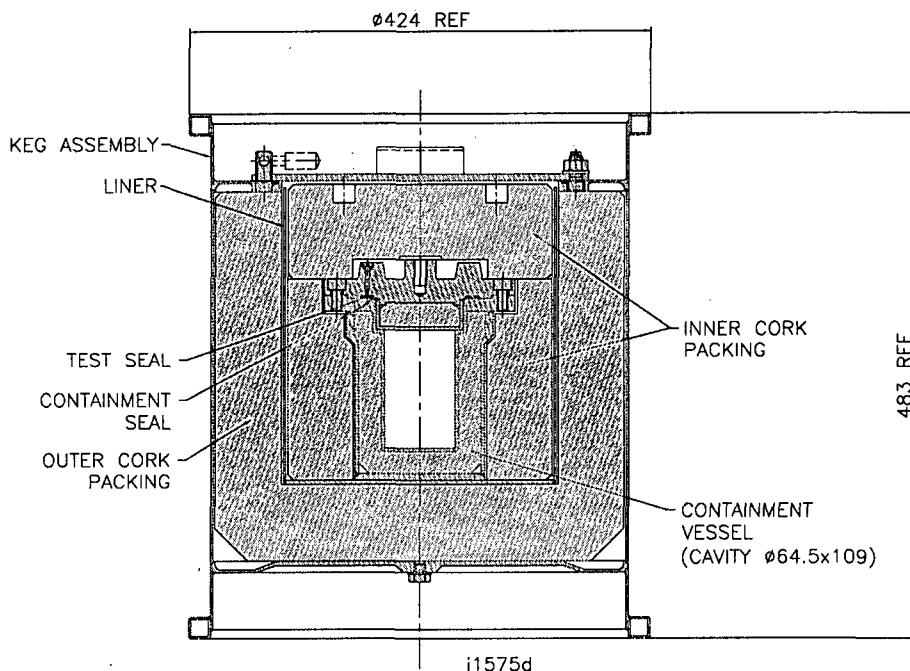
The Safkeg-LS package is designed to be robust and simple to use. The package consists of a stainless steel outer keg which carries a stainless steel and lead shielding pot within cork packing.

The outer keg is fabricated in stainless steel and having a flange type lid fastened by studs and nuts.

The shielding pot is a lead filled vessel having a fabricated stainless steel shell and cavity walls and having a flange type lid fitted with double O-ring seals and fastened by screws.

### **Containment**

The containment system is the shielding pot with the containment being provided by the welded stainless cavity walls and the flange closure fitted with double O-ring seals. The pot lid is provided with a test point for leakage testing the containment system in accordance with ANSI N14.5.



## Approved Contents

The contents are solid or liquid radioactive materials carried in suitable primary containers to prevent contamination of the shielding pot.

The shielding pot may be fitted with additional shielding where required.

The radioactive contents are limited by the shielding and contents maximum heat output of 15 W.

## Physical Data

Safkeg-LS Package	Outer Keg		Inner Cork Packing		Inner Shielding Pot	
External Diameter	16.69"	424 mm			6.89"	175 mm
External Height	19.45"	494 mm			7.99"	203 mm
Internal Diameter	9.68"	246 mm			2.54"	64.5 mm
Internal Height	11.26"	286 mm			4.29"	109 mm
Tare Weight	77.3 lb	35.1 kg	8.6 lb	3.9 kg	47.6 lb	21.6 kg

[May 08]

Weight of empty package - 134 lb (61 kg).

Maximum weight of Safkeg-LS package (including contents) - 149 lb (68 kg).

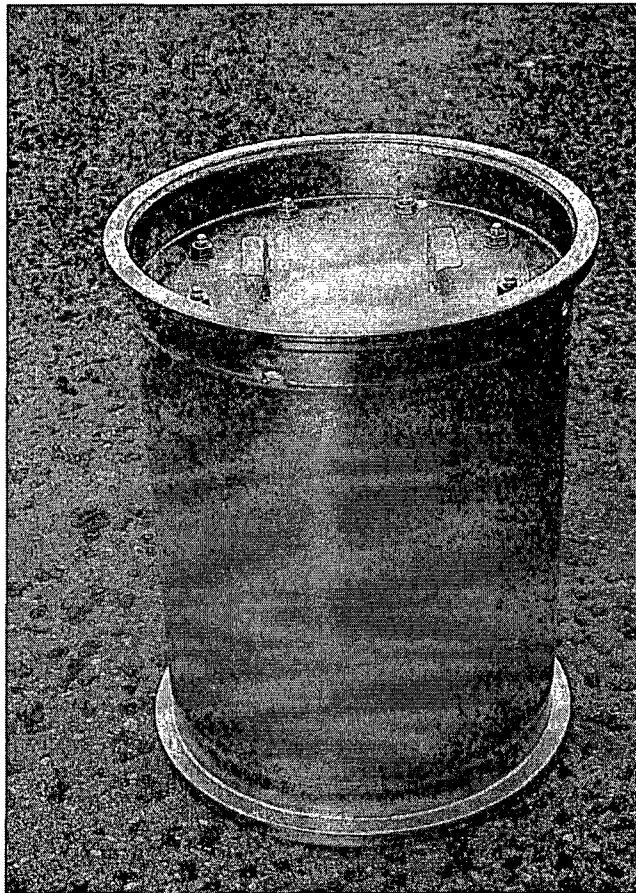
## Further Information

Contact: Don Edling [dedling@insightbb.com](mailto:dedling@insightbb.com) Telephone: 502-896-8597  
 Bob Vaughan [bob.vaughan@croftltd.com](mailto:bob.vaughan@croftltd.com) Telephone: +44 1865 407740

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 Web site: [www.croftltd.com](http://www.croftltd.com)

# **Package Design No 3977A**

## **Package Name - Safkeg-HS**



### **Package Type**

Re-usable Type B package for the shipment of solid and liquid radioactive materials.

### **Certification**

The Safkeg-HS package is being certified by the USNRC as a B(U) Package - the package meets all the requirements of 10CFR71 and the IAEA Regulations for the Safe Transport of Radioactive Material, TS-R-1.

### **Description**

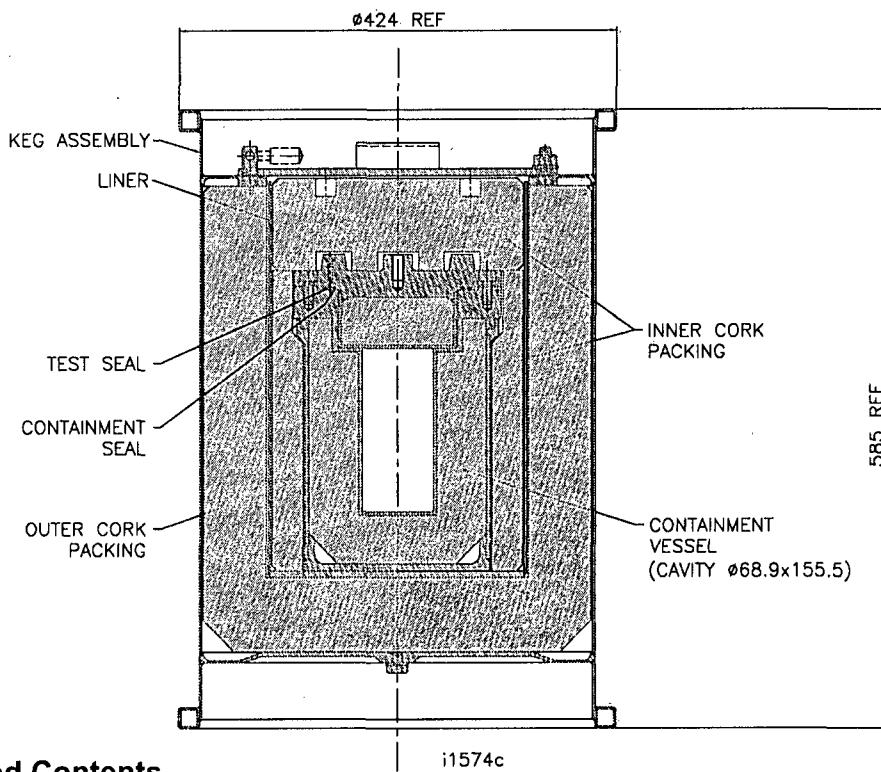
The Safkeg-HS package is designed to be robust and simple to use. The package consists of a stainless steel outer keg which carries a stainless steel and DU shielding pot within cork packing.

The outer keg is fabricated in stainless steel and having a flange type lid fastened by studs and nuts.

The shielding pot is a DU filled vessel having a fabricated stainless steel shell and cavity walls and having a flange type lid fitted with double O-ring seals and fastened by screws.

### **Containment**

The containment system is the shielding pot with the containment being provided by the welded stainless cavity walls and the flange closure fitted with double O-ring seals. The pot lid is provided with a test point for leakage testing the containment system in accordance with ANSI N14.5.



## Approved Contents

The contents are solid or liquid radioactive materials carried in suitable primary containers to prevent contamination of the shielding pot.

The shielding pot may be fitted with additional shielding where required.

The radioactive contents are limited by the shielding and contents maximum heat output of 15W.

## Physical Data

Safkeg-HS Package	Outer Keg		Inner Cork Packing		Inner Shielding Pot	
External Diameter	16.69"	424 mm			7.87"	200 mm
External Height	23.03"	585 mm			11.85"	301 mm
Internal Diameter	9.68"	246 mm			2.71"	68.9 mm
Internal Height	14.76"	375 mm			6.12"	155.5 mm
Tare Weight	90 lb	40.9 kg	8.6 lb	3.9 kg	234.3 lb	106.5 kg

[May 08]

Weight of empty package - 333 lb (152 kg).

Maximum weight of Safkeg-HS package (including contents) - 356 lb (162 kg).

## Further Information

Contact: Don Edling [dedling@insightbb.com](mailto:dedling@insightbb.com) Telephone: 502-896-8597  
 Bob Vaughan [bob.vaughan@croftltd.com](mailto:bob.vaughan@croftltd.com) Telephone: +44 1865 407740

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 Web site: [www.croftltd.com](http://www.croftltd.com)

# Appendix C

*Project Plan and Timeline for MURR Type B Package Replacement Project*

*Croft Associates, Ltd.*

ID	Task Name	Duration	Start	Finish	Predecessors	July
						6/18
1	<b>Design review and optimization</b>	43 days	Mon 9/3/07	Wed 10/31/07		
2	Stage 1	43 days	Mon 9/3/07	Wed 10/31/07		
3	<b>Keg prototype</b>	194 days	Thu 11/1/07	Tue 7/29/08		
4	Prototype manufacture	69 days	Thu 11/1/07	Tue 2/5/08		
5	Keg prototype manufacture	69 days	Thu 11/1/07	Tue 2/5/08	2	
6	<b>Testing</b>	110 days	Wed 2/27/08	Tue 7/29/08	5	
7	Keg prototype 9m drop tests #1, 2 & 3 at normal temps	1 day	Wed 2/27/08	Wed 2/27/08		
8	Keg prototype 9m drop test #4 at -40C with accel	1 day	Wed 5/28/08	Wed 5/28/08	7	
9	Keg prototype 1.2m & 9m drop test #5 & 6 at -40C with accel	2 days	Mon 7/14/08	Tue 7/15/08	8	
10	Compile test report	10 days	Wed 7/16/08	Tue 7/29/08	9	
11	<b>Contents definition for LS &amp; HS</b>	226 days	Mon 9/3/07	Mon 7/14/08		
12	Data collection	100 days	Mon 9/3/07	Fri 1/18/08		
13	Report CTN 2008/01 Issue A	30 days	Mon 1/28/08	Sat 3/8/08	14	
14	Determination of insert dimensions	10 days	Mon 9/3/07	Fri 9/14/07		
15	Report CTN 2008/01 Issue B	50 days	Mon 3/17/08	Fri 5/23/08		
16	Revised insert dimensions	10 days	Mon 5/26/08	Fri 6/6/08	15	
17	Report CTN 2008/01 Issue C	20 days	Tue 6/17/08	Mon 7/14/08	16	
18	<b>Tungsten Inserts for LS and HS</b>	51 days	Mon 6/23/08	Mon 9/1/08		
19	Complete outline drawings	10 days	Mon 6/23/08	Fri 7/4/08	16	
20	Complete manufacturing drawings	20 days	Mon 7/7/08	Fri 8/1/08	19	
21	Manufacture prototypes	20 days	Tue 8/5/08	Mon 9/1/08	20	
22	<b>SAFKEG LS</b>	622 days	Mon 9/3/07	Tue 1/19/10		
23	Complete manufacturing drawings	77 days	Thu 14/08	Fri 5/30/08	2	
24	Compile manufacturing specs	21 days	Mon 6/2/08	Mon 6/30/08	23	
25	<b>LS Prototype manufacture</b>	65 days	Mon 6/2/08	Fri 8/29/08		
26	Prototype manufacture	65 days	Mon 6/2/08	Fri 8/29/08	23	
27	<b>Analysis</b>	96 days	Mon 7/14/08	Mon 11/24/08		
28	Stress analysis - final for SARP	30 days	Mon 7/14/08	Fri 8/22/08	23	
29	Shielding analysis - final for SARP	30 days	Mon 7/14/08	Fri 8/22/08	23	
30	Thermal analysis - final for SARP	30 days	Tue 10/14/08	Mon 11/24/08	33	
31	<b>Testing</b>	30 days	Tue 9/2/08	Mon 10/13/08		
32	LS steady state thermal test	15 days	Tue 9/2/08	Mon 9/22/08	26,10,21	
33	LS NCT & HAC drop tests + 800C thermal test	15 days	Tue 9/23/08	Mon 10/13/08	32	
34						
35	<b>LS SARP compilation</b>	406 days	Mon 9/3/07	Mon 3/23/09		
36	Generating data for the SARP	140 days	Mon 9/3/07	Fri 3/14/08		
37	Drafting SARP Chapters	65 days	Mon 8/25/08	Fri 11/21/08	28,29,36,17	
38	Add test data to SARP	10 days	Mon 11/24/08	Fri 12/5/08	37,33	
39	Add thermal calc results to SARP	10 days	Mon 12/6/08	Fri 12/19/08	30,38	
40	SARP supporting docs + add to SARP	30 days	Mon 12/22/08	Fri 1/30/09	39	
41	Assemble complete SARP	10 days	Mon 2/2/09	Fri 2/13/09	40	
42	Croft review of complete SARP	15 days	Mon 2/16/09	Fri 3/6/09	41	
43	MURR review of complete SARP	15 days	Mon 2/16/09	Fri 3/6/09	41	
44	Final revisions	10 days	Mon 3/9/09	Fri 3/20/09	43	
45	Submission of SARP to NRC at Rev 0	1 day	Mon 3/23/09	Mon 3/23/09	44	
46	<b>LS SARP review by the NRC and update</b>	216 days	Tue 3/24/09	Tue 1/19/10		
47	NRC-1st review and issue of RFI	100 days	Tue 3/24/09	Mon 8/10/09	45	
48	Croft response to RFI	35 days	Tue 8/11/09	Mon 9/28/09	47	
49	NRC-2nd review and issue of RFI	40 days	Tue 9/29/09	Mon 11/23/09	48	
50	Croft response to RFI	20 days	Tue 11/24/09	Mon 12/21/09	49	
51	NRC-Compile SER & CoC	20 days	Tue 12/22/09	Mon 1/18/10	50	
52	NRC-Issue of CoC	1 day	Tue 1/19/10	Tue 1/19/10	51	
53	<b>SAFKEG HS</b>	657 days	Mon 9/3/07	Tue 3/9/10		
54	Complete manufacturing drawings	152 days	Thu 11/1/07	Fri 5/30/08	2	
55	Compile manufacturing specs	21 days	Mon 6/2/08	Mon 6/30/08	54	
56	<b>HS prototype</b>	140 days	Mon 6/2/08	Fri 12/12/08		
57	DU procurement	110 days	Mon 6/2/08	Fri 10/31/08	54	
58	Prototype manufacture - parts	65 days	Tue 7/1/08	Mon 9/29/08	55,61,63	
59	Prototype manufacture - assembly	30 days	Mon 11/3/08	Fri 12/12/08	57,58	
60	<b>Analysis</b>	338 days	Wed 11/21/07	Fri 3/6/09		
61	Preliminary Stress analysis	129 days	Wed 11/21/07	Mon 5/19/08		
62	Stress analysis - final for SARP	30 days	Mon 7/14/08	Fri 8/22/08	2,8,61	
63	Preliminary Shielding analysis	60 days	Wed 11/21/07	Tue 2/12/08		
64	Shielding analysis - final for SARP	30 days	Mon 7/14/08	Fri 8/22/08	2,14,63	
65	Thermal analysis - final for SARP	30 days	Mon 1/26/09	Fri 3/6/09	67,68	
66	<b>Testing</b>	30 days	Mon 12/15/08	Fri 1/23/09		
67	HS steady state thermal test	15 days	Mon 12/15/08	Fri 1/2/09	59,10,21	
68	HS NCT & HAC drop tests + 800C thermal test	15 days	Mon 1/5/09	Fri 1/23/09	67	
69	<b>HS SARP compilation</b>	441 days	Mon 9/3/07	Mon 5/11/09		
70	Generating data for the SARP	247 days	Mon 9/3/07	Tue 8/12/08		
71	Drafting SARP Chapters	65 days	Mon 8/25/08	Fri 11/21/08	62,64,13,70	
72	Add test data to SARP	10 days	Mon 1/5/09	Fri 1/16/09	67,71	
73	Add thermal calc results to SARP	10 days	Mon 3/9/09	Fri 3/20/09	72,65	
74	SARP supporting docs + add to SARP	30 days	Mon 11/24/08	Fri 1/2/09	71	
75	Assemble complete SARP	10 days	Mon 3/23/09	Fri 4/3/09	74,73	
76	Croft review of complete SARP	15 days	Mon 4/6/09	Fri 4/24/09	75	
77	MURR review of complete SARP	15 days	Mon 4/6/09	Fri 4/24/09	75	
78	Final revisions	10 days	Mon 4/27/09	Fri 5/8/09	77,76	
79	Submission of SARP to NRC at Rev 0	1 day	Mon 5/11/09	Mon 5/11/09	78	
80	<b>HS SARP review by the NRC and update</b>	216 days	Tue 5/12/09	Tue 3/9/10		
81	NRC-1st review and issue of RFI	100 days	Tue 5/12/09	Mon 9/28/09	79	
82	Croft response to RFI	35 days	Tue 9/29/09	Mon 11/16/09	81	

The Gantt chart illustrates the timeline and dependencies for a project across several months. The chart is organized into four main phases:

- January Phase:** Starts on 10/22 and ends on 1/14. Key tasks include 10/31, 11/1, 1/18, and 1/28.
- April Phase:** Starts on 2/25 and ends on 4/7. Key tasks include 2/5, 2/27, 3/8, 3/17, and 5/26.
- May Phase:** Starts on 5/1 and ends on 5/28. Key tasks include 5/28, 5/29, 5/30, and 6/1.
- June Phase:** Starts on 6/1 and ends on 6/17. Key tasks include 6/2, 6/18, and 6/19.

Arrows indicate dependencies between tasks, such as 10/31 leading to 11/1, and 1/18 leading to 1/28. Other dependencies are shown between tasks in the April, May, and June phases.

The Gantt chart illustrates the timeline for various tasks across five months:

- October:** Tasks include 9/22, 10/13, 10/14, 10/29, and 10/31.
- November:** Tasks include 11/3, 11/13, 11/21, 11/24, 11/29, and 11/31.
- December:** Tasks include 12/5, 12/6, 12/8, 12/12, 12/15, 12/19, 12/22, 12/26, 1/2, 1/5, 1/6, 1/16, 1/23, 1/26, and 1/30.
- January:** Tasks include 1/2, 1/3, 1/6, 1/16, 1/23, 1/26, 1/30, 2/2, 2/13, 2/16, 2/16, 2/18, 2/21, 2/24, 2/26, 2/28, 3/1, 3/2, 3/4, 3/6, 3/9, 3/10, 3/12, 3/13, 3/15, 3/18, 3/20, 3/23, 3/24, 3/26, 3/28, 3/30, 3/31, 4/1, 4/3, 4/6, 4/6, 4/8, 4/10, 4/12, 4/14, 4/16, 4/18, 4/20, 4/22, 4/24, 4/26, 4/28, 4/30, 5/1, 5/3, 5/5, 5/7, 5/9, 5/11, and 5/12.
- February:** Tasks include 2/1, 2/2, 2/3, 2/4, 2/5, 2/6, 2/7, 2/8, 2/9, 2/10, 2/11, 2/12, 2/13, 2/14, 2/15, 2/16, 2/17, 2/18, 2/19, 2/20, 2/21, 2/22, 2/23, 2/24, 2/25, 2/26, 2/27, 2/28, 2/29, 2/30, 2/31, 3/1, 3/2, 3/3, 3/4, 3/5, 3/6, 3/7, 3/8, 3/9, 3/10, 3/11, 3/12, 3/13, 3/14, 3/15, 3/16, 3/17, 3/18, 3/19, 3/20, 3/21, 3/22, 3/23, 3/24, 3/25, 3/26, 3/27, 3/28, 3/29, 3/30, 3/31, 4/1, 4/2, 4/3, 4/4, 4/5, 4/6, 4/7, 4/8, 4/9, 4/10, 4/11, 4/12, 4/13, 4/14, 4/15, 4/16, 4/17, 4/18, 4/19, 4/20, 4/21, 4/22, 4/23, 4/24, 4/25, 4/26, 4/27, 4/28, 4/29, 4/30, 4/31, 5/1, 5/2, 5/3, 5/4, 5/5, 5/6, 5/7, 5/8, 5/9, 5/10, 5/11, and 5/12.
- March:** Tasks include 3/1, 3/2, 3/3, 3/4, 3/5, 3/6, 3/7, 3/8, 3/9, 3/10, 3/11, 3/12, 3/13, 3/14, 3/15, 3/16, 3/17, 3/18, 3/19, 3/20, 3/21, 3/22, 3/23, 3/24, 3/25, 3/26, 3/27, 3/28, 3/29, 3/30, 3/31, 4/1, 4/2, 4/3, 4/4, 4/5, 4/6, 4/7, 4/8, 4/9, 4/10, 4/11, 4/12, 4/13, 4/14, 4/15, 4/16, 4/17, 4/18, 4/19, 4/20, 4/21, 4/22, 4/23, 4/24, 4/25, 4/26, 4/27, 4/28, 4/29, 4/30, 4/31, 5/1, 5/2, 5/3, 5/4, 5/5, 5/6, 5/7, 5/8, 5/9, 5/10, 5/11, and 5/12.
- April:** Tasks include 4/1, 4/2, 4/3, 4/4, 4/5, 4/6, 4/7, 4/8, 4/9, 4/10, 4/11, 4/12, 4/13, 4/14, 4/15, 4/16, 4/17, 4/18, 4/19, 4/20, 4/21, 4/22, 4/23, 4/24, 4/25, 4/26, 4/27, 4/28, 4/29, 4/30, 4/31, 5/1, 5/2, 5/3, 5/4, 5/5, 5/6, 5/7, 5/8, 5/9, 5/10, 5/11, and 5/12.
- May:** Tasks include 5/1, 5/2, 5/3, 5/4, 5/5, 5/6, 5/7, 5/8, 5/9, 5/10, 5/11, and 5/12.

The figure consists of two main horizontal bars representing project timelines. The top bar spans from August 24 to April 3, with major milestones at 10/5, 11/16, 12/28, and 2/8. The bottom bar provides a detailed view of the period from September 29 to January 19, showing specific tasks and dates.

**Top Timeline (August 24 to April 3):**

- 8/24
- 10/5
- 11/16
- January
- 12/28
- 2/8
- 3/22

**Bottom Timeline (September 29 to January 19):**

- 9/29
- 9/28
- 11/23
- 11/24
- 12/21
- 12/22
- 1/18
- 1/19