LLE NOTICE 6680C

SUBJECT: Radiological Materials Shipment

REFERENCE: (a) LLE INSTRUCTION 6680C

ENCLOSURE: (1) Radiological Materials Shipment Procedure

1. Purpose: To formalize procedures for preparing tritium waste materials for shipment to external vendors, identifying the proper shipping category, communicating with University of Rochester Radiation Safety (RSU) personnel, and documenting the shipping transaction.

2. Background: This instruction is based upon the RSU procedure “Shipping Radioactive Materials” SOP 2.12 and the U.S. D.O.T. CFR 49 Hazardous Materials Regulations.

3. Definition: The radiological materials covered in this instruction include any equipment or materials that contain measurable amounts of tritium either on the surface of or internal to the equipment/material that need to be transported outside the confines of LLE. This includes adsorption beds, getter beds, radioactive water, and contaminated equipment/materials. The scope of this document does not include shipping targets that contain tritium or low-level tritium waste such as gloves, wipes, etc.

4. Discussion: The University and federal government mandate that the shipment of radiological materials closely adhere to agreed-upon shipping standards that protect the safety and security of the public. It is essential that any package containing radiological materials sent or received by the University comply with these standards. The consequences of shipping radiological materials improperly can result in exposure to the public and severe fines and legal action by governmental agencies. Several types of materials/equipment that contain tritium and are used in the Cryogenic and Tritium Facility (C&TF) and the OMEGA Target Chamber Tritium Removal System (TC-TRS) must be periodically shipped to vendors. These materials include adsorption beds, radioactive water, and contaminated equipment/materials. Several important characteristics of the materials to be shipped determine the manner in which they are prepared for shipment: the physical state (solid/liquid); the total tritium activity and concentration; and the inherent hazards of the materials. Some of the radiological materials routinely shipped by C&TF personnel contain other hazards that are addressed by this instruction. For example, nickel and zirconium-iron adsorption beds contain flammable solids that must be shipped as a Class 4 (flammable) material unless tritium activity is high enough to ship it as a Class 7 material.

5. Action: This procedure shall be employed in the shipment of all radiological materials (except targets and low-level waste) that are required for the operation of the C&TF and in the OMEGA TC-TRS. The LLE Radiation Safety Officer must approve any deviations from this procedure.
6. Responsibilities:
   a. C&TF Personnel
      1. Ascertain the activity of the material to be shipped and determine the appropriate shipment category.
      2. Prepare the items(s) for shipment.
      3. Perform measurements of surface radiological contamination.
      4. Prepare all shipping paperwork.
      5. Contact RSU personnel to inspect the package, review the paperwork, and approve the shipment.
      7. Provide copies of shipping documents to the RSU.
   
   b. C&TF Manager
      1. Review and approve all shipments.
      2. Review the paperwork and package preparations to ensure that they comply with the enclosed procedures.
      3. Ensure that all documentation is inserted into the CTHS Radiological Shipment binder.
   
   c. LLE Radiation Safety Officer
      1. Ensure compliance with these procedures.
      2. Approve shipments in the absence of the Tritium Facility Manager.

   Walter T. Shnayda
   LLE Radiation Safety Officer

WTS:
Enc.
# RADIOLOGICAL MATERIALS SHIPPING PROCEDURE

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Part I
General Notes

1000 Units
The University and federal guidelines require that units of activity be reported as “becquerels” and not “curies” on all shipping papers and labels. Curies may be included if desired.

1001 Record Keeping
1. The shipment information, including copies of all paperwork, shall be stored and recorded in the Tritium Facility Radiological Shipment Binder kept by the Cryogenic & Tritium Facility (C&TF) Manager. Information about each shipment must be updated in a log table contained in the binder. Make a new entry in the log table at the completion of each shipment. The table shall contain the following information: date, total estimated activity, identifying # (adsorption bed #, condensate receiver #, instrument #), shipment type (limited quantity or Type A), receiver name and contact, and shipper vendor name. Include swipe surveys of the items to be shipped and surveys of the outside of the shipping container.
2. The receiver’s tritium license must be on file.
3. All DOT-7A Type A container documentation must be kept in the Tritium Facility Radiological Shipment Binder.

1002 Copies of Documentation to RSU and LLE RSO
Copies of the shipment paperwork, including swipe measurement reports, must be sent to the University of Rochester Radiation Safety Unit (RSU) (Box HPH) and the LLE Radiation Safety Officer.

1003 RSU Notification
Prior to each shipment, the RSU must be notified of the intent to ship tritiated materials. LLE must receive explicit approval from the RSU prior to shipment.
1004 Document Structure

The following sub-procedures are contained in this document:

- **Part II**: Procedures for Shipping Drier Beds and Equipment Containing Less Than 22 Ci (Limited Quantity).
- **Part III**: Procedures for Shipping Getter Beds Containing Less Than 22 Ci (Limited Quantity).
- **Part IV**: Procedures for Shipping Drier Beds and Equipment Containing More Than 22 Ci (Type A).
- **Part V**: Procedures for Shipping Getter Beds Containing More Than 22 Ci (Type A).
- **Part VI**: Shipping Radioactive Water.
- **Part VII**: Shipping Limited-Quantity Radioactive Water.
- **Part VIII**: Shipping Type-A Radioactive Water.
Part II
Shipping Drier Beds and Equipment Containing Less Than 22 Ci (Limited Quantity)

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<tr>
<td>2005</td>
<td>Approvals</td>
</tr>
</tbody>
</table>

2000 Scope

1. ___ For existing drier beds and their spares employed on the Tritium Removal Systems.
2. ___ For total packages (equipment and/or beds) containing less than 22 curies (“limited quantity”).
3. ___ For non-flammable materials.

2001 Packaging Instructions

1. ___ Verify that the receiver (vendor) has a valid tritium license. A copy of this license must be on file. NSSI has such licenses on file.
2. ___ Contact Radiation Safety prior to assembling the package and request to ship a package containing tritium. Arrange a time for them to inspect the package.
3. ___ Secure any beds by fully closing the hand valves, removing the handles, and capping the VCR ends with plugs. Affix the handles to the bed so that they are not lost.
4. ___ Swipe the items (bed/equipment) prior to packaging. The outside of the items must be below 1000 dpm/100 cm².
   ___ (a) Print three copies of the equipment swipe map and LSC report.
5. ___ Place the beds in two large, heavy-duty “ziplock”-type bags.
6. ___ Affix a “Radioactive” label to the outside of the bag.
7. ___ Using a suitable container, place a plastic liner inside and fill half with vermiculite (course grade #4). For heavy items, such as large drier beds, secure in a wooden crate.
8. ___ Swipe the final package (box and items) prior to shipment. The outside of the crate must be below 1000 dpm/100 cm².
   ___ (a) Print three copies of the equipment swipe map and LSC report.
9. ___ Fill the box with vermiculite (course grade #4).
10. ___ Do not seal the crate until the RSU representative can inspect it.
11. ___ Ensure that RSU personnel survey the crate (when ready for shipment) with an ion-chamber-type meter. The reading must be below 0.5 mrem/hour.
Enclosure (1)
LLEINST 6680C
6 April 2012

2002 Documentation
1. ___ Include a drawing of the item to be shipped showing the location and measurement of surface activity in the crate.
2. ___ Include a swipe map of the outside of the box.
3. ___ Complete Secs. 1001 through 1003.

2003 Labels (Outside Packaging)
1. ___ Attach UN label (see Fig. II.1). Write in 2910. Ensure that all labels are grouped together, not overlapping, and in the same orientation with respect to the text.
2. ___ Attach label listing receiver and shipper names and addresses (see Fig. II.2).
   ___ (a) Ship to NSSI: Fig. II.2.
   ___ (b) Ship to RSU: Fig. II.3.

Fig. II.1: UN2910 Label.
Ship From:
Laboratory for Laser Energetics
University of Rochester
250 East River Road
Rochester, NY  14623-1299

Ship To:
Robert Gallagher
NSSI/ Sources and Services
5711 Etheridge Street
Houston, TX  77234

Fig. II.2: NSSI Address Label.

Ship From:
Laboratory for Laser Energetics
University of Rochester
250 East River Road
Rochester, NY  14623-1299

Ship To:
University of Rochester Radiation Safety
477C Elmwood Avenue
Rochester, NY  14620

Fig. II.3: RSU Address Label.

2004  Shipping (FedEx – Air)
1. ___ Send via FedEx using a standard (non-dangerous goods) airbill.
2. ___ Mark the box “Yes, Shipper’s declaration not required” in the “Special Handling” section.
3. ___ Enter the text “UN#2910” under “Your Internal Billing Reference” in Sec. 2.
4. ___ Include the following text in the airbill: “Radioactive Material Excepted Package Limited Quantity of Material”.

7
2005 Approvals

1. ___ C&TF Manager.
2. ___ RSU representative (IATA shipping training).
Part III
Shipping Small Getter Beds Containing Less Than 22 Ci (Limited Quantity)

Note: Because of the flammable nature of ZrFe (zirconium iron) and nickel media, these materials are classified as Class 4.1 and 4.2 flammable solids. These require special packaging and documentation. The instructions below must be explicitly followed. The International Air Transport Association (IATA) has developed many of the rules governing the air shipment of hazardous materials. According to the 47th Edition, both nickel and ZrFe getter beds can be shipped by air using the instructions below. Note that according to IATA, the beds themselves qualify as “IP3”-type inner-metal packagings. The fiberboard boxes described below are qualified outer packagings. The maximum amount of ZrFe and nickel that can be shipped this way is 5.0 and 1.0 kg, respectively.

3000 Scope
1. ___ For getter beds, employed on the tritium removal systems, that possess flammable materials (nickel and zirconium iron).
   ___ (a) For Ni beds that contain no more than 1.0 kg media.
   ___ (b) For ZrFe beds that contain no more than 5.0 kg of media.
   ___ (c) For larger beds, contact the Facility Manager. These will need to be shipped by ground transportation.
2. ___ For total packages containing less than 22 curies (“limited quantity”).

3001 Packaging Instructions
1. ___ Verify that the receiver (vendor) has a valid tritium license. A copy of this license must be on file. NSSI has such license, on file.
2. ___ Contact Radiation Safety prior to assembling the package and request to ship a package containing tritium. Arrange a time for them to inspect the package.
3. ___ Secure any beds by fully closing the hand valves, removing the handles, and capping the VCR ends with plugs. Affix the handles to the bed so that they are not lost.
4. ___ Swipe the items (bed/equipment) prior to packaging. The outside of the items must be below 1000 dpm/100 cm². Make three copies of the swipe map and printout.
5. ___ Place the beds in two large, heavy-duty “ziplock”-type bags.
6. ___ Affix a “Radioactive” label on the outside of the bag.
7. ___ Use a UN fiberboard box to ship the beds. Specifically, use a 4GV40N box from Cargopak Corporation (Raleigh, NC 27615 www.cargopak.com).
8. ___ Assemble the box and seal the bottom of the box carefully with 3-in.-wide tape. Heavy Duty 3-in. Fiber Reinforced Kraft Tape (Cargopack part # RTAPE) is preferred.
9. ___ Insert a plastic liner (Cargopak part #GL1645 or similar) in the box.
10. ___ Fill the box partially with course grade #4 Vermiculite (Cargopak part #CP-VERM-4) then place the bed(s) atop it. Add more Vermiculite to secure the bed but don’t cover it until it is inspected by Radiation Safety. Place no more than two beds per box and do not mix types (Nickel and ZrFe).
11. ___ Do not place more than 5.0 kg of ZrFe or 1.0 kg of Ni per box. Verify the mass in the beds prior to loading the box. This information is available from the Facility Manager.
12. ___ After Radiation Safety personnel inspect the package, fill up the remaining space above the bed(s) with Vermiculite. Close the bag securely.
13. ___ Measure the total weight of the package, required for the shipper.
14. ___ Swipe the final package (crate + items) prior to shipment. The outside of the crate must be below 1000 dpm/100 cm². Make three copies of the swipe map and printout.
15. ___ Place the documentation (Sec. 3002) into a large envelope and place the envelope in the box.
16. ___ Seal up the box with the packing tape.
17. ___ Ensure that RSU surveys the crate (when ready for shipment) with an ion-chamber-type meter. The reading must be below 0.5 mrem/hour. Ensure that UR RSU personnel write down the reading on the radiological swipe map and initial it.

3002 Documentation

1. ___ Include the following information in the crate:
   ___ (a) A copy of the MSDS for the flammable material;
   ___ (b) A copy of the swipe survey map of the bed;
   ___ (c) A copy of the swipe survey map of the outside of the box; and
   ___ (d) A Shipper’s Declaration of Dangerous Goods (refer to Sec. 3003).
2. ___ Perform Secs. 1001 through 1003.
Shipper’s Declaration of Dangerous Goods

0. See forms in Redwood/TargetFab/Radshipping.
1. Refer to Figs. III.1 and III.2, provided as examples.
2. Use the on-line form for Declaration of Dangerous Goods. This is available at http://www.fedex.com. Digital copies from the Facility Manager are also available.
3. Enter in the “Air Waybill” number. This is the number on the actual shipping form (see Sec. 3005). This section will need to be completed first.
4. Fill in the shipper and consignee information, provide your name and use the rest of the information shown in the figures.
5. Complete the “Transport Details” section as follows:
   ___ (a) Cross out “Passenger and Cargo Aircraft”.
   ___ (b) Provide accurate and concise airport destination and departure names.
6. Cross out “Radioactive” under the “Shipment Type” section in the middle section of the document. The package is NOT considered radioactive; it is “excepted quantity”.
7. Complete the “Nature and Quantity of Dangerous Goods” section using Table III.1 exactly as shown.
8. Complete the “Quantity and Type of Packing” column.
   ___ (a) Enter as “One Fiberboard box X” and the quantity of flammable material (i.e., “1 Fiberboard box X 2.4 kg”).
9. Type exactly as shown “I declare that all of the applicable air transport requirements have been met”
10. Provide a 24-hour contact phone number in the section at the bottom of the form. DO NOT ENTER A PAGER NUMBER. A live voice is required! The cell phone needs to be constantly monitored by someone knowledgeable about the hazards of the material contained in the package.
11. Complete the “Name and Title of Signatory” at the bottom right of the form. Type the name and title for the RSU representative who will be signing the form as shown in Figs. III.1 and III.2, lower right-hand corner. Confirm who will be signing the form from RSU prior to completion of the form.
12. Print six copies of the Declaration of Dangerous Goods form (one for the crate, three for the airbill, one for RSU, and one for C&TF records) using a color printer.
13. Ensure that the RSU representative signs ALL copies of the Declaration of Dangerous Goods form after inspecting the package.
**SHIPPER’S DECLARATION FOR DANGEROUS GOODS**

*(Provide at least three copies to the airline.)*

**Shippers’ Name:** Roger Janes
**Laboratory for Laser Energetics**
**250 East River Road**
**Rochester, NY 14623**

**Air Waybill No.:** 794715789816
**Page 1 of 1 Pages**
**Shipper’s Reference Number:** (optional) 527250

**Consignee:** NIST/Services and Sources (R. Gallagher)
**5711 Etheridge Street**
**Houston, TX 77087**

**Two complete and signed copies of this Declaration must be handed to the operator.**

**WARNING:**

Failure to comply with all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.

**Airport of Departure:** ROC

**Airport of Destination:** Houston, TX

**Shipment type:** (must be completed and checked):
- NON RADIOACTIVE
- X

**NATURE AND QUANTITY OF DANGEROUS GOODS**

<table>
<thead>
<tr>
<th>UN No.</th>
<th>Proper Shipping Name</th>
<th>Class of Goods (Subclass)</th>
<th>Packaging Group</th>
<th>Quantity and type of packaging</th>
<th>Packing Instruction</th>
<th>Authorization</th>
</tr>
</thead>
<tbody>
<tr>
<td>30859</td>
<td>Metal Powder, flammable, n.o.s. (Zirconium iron), Radioactive Material, excepted package - limited quantity of material</td>
<td>4.1</td>
<td>II</td>
<td>1 Fiberboard Box X 5.0 kg</td>
<td>448</td>
<td>A3</td>
</tr>
</tbody>
</table>

**Additional Handling Information**

I declare that all of the applicable air transport requirements have been met.

**I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national Governmental Regulations. I declare that all of the applicable air transport requirements have been met.**

Name/Title of Signatory:
Valerie Grason/Radiation Safety/Techn. Place and Date:
Univ. of Rochester, Roch, NY 5409

**Signature:** (A typed signature may be used if the origin and destination are in the United States or its territories.)

**Emergency Telephone Number:** 509-555-9191

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**Fig. III.1: Declaration of Dangerous Goods—ZrFe Beds.**
**Fig. III.2: Shippers Declaration of Dangerous Goods—Nickel Beds.**
### Table III.1

<table>
<thead>
<tr>
<th>UN or ID#</th>
<th>Proper Shipping Name</th>
<th>Class or Division</th>
<th>Packing Group</th>
<th>Qty and Type of Packing</th>
<th>Packing Instruction</th>
<th>Authorization</th>
</tr>
</thead>
<tbody>
<tr>
<td>UN3089</td>
<td>Metal powder, flammable, n.o.s. (zirconium iron), radioactive material, excepted package–limited quantity of material</td>
<td>4.1</td>
<td>II</td>
<td>1 Fiberboard Box X</td>
<td>5.0 kg</td>
<td>448</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UN2881</td>
<td>Metal catalyst, dry (nickel powder), radioactive material, excepted package–limited quantity of material</td>
<td>4.2</td>
<td>II</td>
<td>1 Fiberboard Box X</td>
<td>1.0 Kg</td>
<td>473</td>
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</table>

#### 3004 Labels (Outside Packaging)

1. **Affix the following labels to the outside of the package:**
   - (a) Flammable labels (Use the labels below for each type of bed included in the package).
     - (i) ZrFe: Diamond “Flammable Solid (4.1)” – see Fig. III.3.
     - (ii) Ni: Diamond “Spontaneous Combustible (4.2)” – see Fig. III.4.
   - (b) “Cargo Only” label – see Fig. III.5.
   - (c) UN description label.
     - (i) Print labels listing appropriate UN description (large font 30 pt).
     - (ii) Refer to Figs. III.6 and III.7.
   - (d) Label listing receiver and shipper names and addresses – see Fig. II.2.

2. **Place ONE set of labels on TOP of the package and ONE set of labels on one side of the package. Ensure that all labels are grouped together, not overlapping, and in the same orientation with respect to the text.**

3. **Take care to not cover the UN marking on the fiberboard box. This must be visible.**
4. **Affix an adhesive plastic sleeve for the FedEx shipping label to the top of the box (Sec. 3005).**
Fig. III.3: Class 4.1 Flammable Solids Label.

Fig. III.4: Class 4.2 Spontaneous Combustible Materials Label.
Metal powder, flammable, n.o.s. (zirconium iron), radioactive material, excepted package—limited quantity of material Class 4.1, UN3089, PG II

Fig. III.6: Metal Powder Label.
Metal catalyst, dry
(nickel powder),
radioactive material,
excepted package—
limited quantity of
material Class 4.2,
UN2881, PG II

Fig. III.7: Metal Catalyst Label.

3005 Shipping (FedEx Dangerous Goods Airbill)
2. ___ Refer to Fig. IV.3 in Sec. 4005 that displays the FedEx page.
3. ___ Enter all relevant information.
4. ___ Ensure the following:
   ___ (a) Select “Service Type” and “Priority Overnight”.
   ___ (b) Provide package weight and dimensions.
   ___ (c) Enter LLE’s reference number under “Bill Transportation To”.
5. ___ Click on “Special Services”:
   ___ (a) Under “signatory options” choose “adult signature required”.
   ___ (b) Next, click on “Dangerous Goods”.
   ___ (c) Click on “Email Notification”.
   ___ (d) Check email address.
   ___ (e) Check personal message for accuracy.
6. ___ Check your entries and then proceed to print out shipping label. The label will display a “TRK #.” This is the Air Waybill #. Enter this on the Declaration of Dangerous Goods form (Sec. 3003).
7. ___ Insert the Shipping Label in the plastic sleeve on the fiberboard box.
8. ___ Place three copies of the signed Declaration of Dangerous Goods in the sleeve.
3006 Approvals

1. ___ C&TF Manager.

2. ___ RSU representative. Only the RSU representative can sign the FedEx Dangerous Goods Airbill and Shipper’s Declaration of Dangerous Goods (requires IATA shipping training).
Part IV
Shipping Drier Beds and Equipment Containing More Than 22 Ci (Type A)

4000 Scope
1. ___ For existing drier beds and their spares, employed in the Tritium Removal Systems.
2. ___ For total packages containing more than 22 curies (Type A).
3. ___ Non-flammable materials.

4001 Packaging Instructions
1. ___ Complete Sec. 2001 where “DOT-7A Type A drum” replaces “suitable container”.
2. ___ Documentation for the DOT-7A Type A drum must be on file.
3. ___ Secure the bed(s)/equipment in a DOT-7A Type A drum (referred hereafter as the “drum”).
   ___ (a) Secure the beds to the drum to prevent movement during shipping.
   ___ (b) Place cushioning material around the bed to prevent movement.

4002 Documentation
1. ___ Include the following information in the drum:
   ___ (a) A copy of the swipe survey map of the bed, and
   ___ (b) A Shipper’s Declaration of Dangerous Goods (see Sec. 4003).
2. ___ Perform Secs. 1001 through 1003.

4003 Shipper’s Declaration of Dangerous Goods
0. ___ See forms in Redwood/TargetFab/Radshipping.
1. ___ Refer to Fig. IV.1.
2. ___ Type all information; do not handwrite unless making corrections.
   ___ (a) An online form is available at http://www.fedex.com.
3. ___ Complete the “Transport Details” section as follows:
   ___ (a) Cross out “Passenger and Cargo Aircraft”.
   ___ (b) Enter the correct airport names for arrival and departure.
4. ___ Cross out “NON-RADIOACTIVE” under the “Shipment Type” section in the middle of the document. The package is considered RADIOACTIVE.
Fig. IV.1: Shipper’s Declaration of Dangerous Goods.

5. ___ Complete the “Nature and Quantity of Dangerous Goods” section using Table IV.1.
   ___ (a) Under ‘Quantity and Type of Packaging’ enter the text “One Type A package” and then list the quantity of tritium in “TBq” followed by “H-3”.
   ___ (b) Under ‘Packing Inst.’ enter the text ‘White-I’ followed by the dimensions of the Type A package (diameter × height) in inches.
Table IV.1

<table>
<thead>
<tr>
<th>Proper Shipping Name</th>
<th>Class or Division</th>
<th>UN #</th>
<th>Packing Group</th>
<th>Packing Inst.</th>
<th>Authorization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radioactive material, Type-A package non-special form, non-fissile or fissile-excepted [Hydrogen-3 (tritium) mixed with an inert material]</td>
<td>7</td>
<td>UN2915</td>
<td>II</td>
<td>White-I</td>
<td>___ diam.‘’</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>___ height’’</td>
<td></td>
</tr>
</tbody>
</table>

6. ___ Provide a 24-hour contact phone number in the section at the bottom of the form. DO NOT ENTER A PAGER NUMBER. A live voice is required!

7. ___ Complete the “Name and Title of Signatory” at the bottom right of the form. Type the name and title for the RSU representative in the form as shown in Fig. IV.1, lower right-hand corner. Confirm who will be signing the form from RSU prior to completion of the form.

8. ___ Ensure that the RSU representative signs the form after inspecting the package.

9. ___ Make four copies (one for inside the crate, three for the airbill).

4004 Labels (Outside Packaging)

Affix the following labels to the outside of the package:

1. ___ Place one set of labels grouped together on the sidewall of the drum. Place a second set of labels grouped together on the top lid of the drum. Ensure that all labels are grouped together, not overlapping, and in the same orientation with respect to the text.

2. ___ Transport labels—two Radioactive White-I labels listing the contents as “Hydrogen-3 (tritium)” and the total activity in becquerels (Bq) on opposite sides.
   ___ (a) Label available from RSU

3. ___ Label listing proper shipping name. (see Fig. IV.2).

4. ___ Label listing receiver and shipper names and addresses (see Fig. II.2).

5. ___ “Cargo Only” label.
   ___ (a) Drum Designation Label. The text must read “USA DOT-7A Type A”. Letters must be 1/2 in. tall.
   ___ (b) Gross Weight Label. The gross weight of the drum must be measured and listed in kg. The text must read “Gross Weight ___ kg”. Letters must be 1/2 in. tall.
Radioactive material, Type-A package non-special form, non-fissile or fissile-excepted [Hydrogen-3 (tritium) mixed with an inert material], Class 7, UN2915, PG II, _____ becquerels

Fig. IV.2: Proper Shipping Name for Part IV.

4005 Shipping (FedEx Dangerous Goods Airbill)

1. Note: The weight of the drum and package will be >150 lbs due to the drum itself. Therefore, FedEx freight service will be required. Because it is a Class 7 material, FedEx 1 Day Freight will be required.

2. Prepare the shipment:
   (a) Locate a standard shipping pallet for the drum.
   (b) Weigh the pallet and compute total weight.

3. Determine the date that you wish to ship the drum.

4. Arrange a booking number through FedEx:
   (a) Call FedEx Express Service @ 1-800-332-0807.
   (b) Tell them that you wish to ship a DOT-7A Type A drum of Class 7 material weighing >150 lbs using overnight Express Service.
   (c) Request a booking number.
   (d) Declare the date that you wish to ship.

5. Complete a FedEx shipment request online:
   (a) Go to the FedEx “Prepare Shipment” page at [http://www.fedex.com](http://www.fedex.com).
       You will need to have already set up an account. See Fig. IV.3 (Attachment #4).
   (b) Complete the webpage, making allowances for the recipient and other items listed below.
(c) Under “Billing Details” include the reference number shown, #137759462.

(d) Under “Your reference” include “UN2915” and include the Target Fabrication internal account number (this changes year to year).

(e) Complete “Package and Shipment Details” as shown, making allowances for package weight and dimensions as necessary:

(i) Use the information provided in Fig. IV.3 for Service Type, Packaging Type.
(ii) Enter dimensions for the drum as shown and enter the weight of the drum.
(iii) Enter “booking number” and ship date that was supplied by FedEx in Step 4(c) above.

(f) Enter “Email Notifications” information.

(i) Include recipient, sender, LLE Radiation Safety Officer, and UR Radiation Safety Representative.

(g) Enter “Special Services” information:

(i) Click box for “dangerous goods”.
(ii) Click box for “inaccessible”.
(iii) Choose “Class 7 – Radioactive Material, White-I”.

(h) Do a final check of the information on the screen.

(i) Proceed by clicking on the “SHIP” button at the bottom of the screen. This will bring up a new screen displaying the shipping label. The Air Waybill number will be displayed. This is the number that is needed for the top right of the Declaration of Dangerous Goods.

(j) Print the label on your local printer.

(k) Place the label in a FedEx plastic pouch and affix to the top of the drum.

(l) Band the drum to the pallet when all documentation is on the drum.

4006 Security

1. Ensure that the RSU representative affixes a security seal to the outside of the drum lip once the drum is sealed.

4007 Approvals

1. C&TF Manager.

2. RSU representative. Only the RSU representative can sign the FedEx Dangerous Goods Airbill and Shipper’s Declaration of Dangerous Goods (requires IATA shipping training).
Fig. IV.3. FedEx Shipment Request.
Part V
Shipping Getter Beds Containing More Than 22 Ci (Type A)

<table>
<thead>
<tr>
<th>5000</th>
<th>Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>5001</td>
<td>Packaging Instructions</td>
</tr>
<tr>
<td>5002</td>
<td>Documentation</td>
</tr>
<tr>
<td>5003</td>
<td>Shipper’s Declaration of Dangerous Goods</td>
</tr>
<tr>
<td>5004</td>
<td>Labels (Outside Packaging)</td>
</tr>
<tr>
<td>5005</td>
<td>Shipping (FedEx Dangerous Goods Airbill)</td>
</tr>
<tr>
<td>5006</td>
<td>Approvals</td>
</tr>
</tbody>
</table>

5000 Scope
1. For existing getter beds and their spares, employed in the tritium removal systems, containing flammable materials.
2. For total packages containing more than 22 curies (Type A).

5001 Packaging Instructions
1. Complete Sec. 2001 where “DOT-7A Type A drum” replaces “suitable container”.
2. Documentation for the DOT-7A Type A drum must be on file.
3. Secure the bed(s)/equipment in a DOT-7A Type A drum (referred hereafter as the “drum”).
   (a) Secure the beds to the drum to prevent any movement during shipping.
   (b) Place cushioning material around the bed to prevent movement.

5002 Documentation
1. Include the following information in the drum:
   (a) A copy of the swipe survey map of the bed, and
   (b) A Shipper’s Declaration of Dangerous Goods (see Sec. 4003).
2. Perform Secs. 1001 through 1003.
3. Include a recent (last three years) MSDS for the flammable material in the documentation in the drum.

5003 Shipper’s Declaration of Dangerous Goods
0. See forms in Redwood/TargetFab/Radshipping.
1. Refer to Fig. V.1.
2. Type all information; do not handwrite unless making corrections.
   (a) An online form is available at http://www.fedex.com.
3. Complete the “Transport Details” section as follows:
   (a) Cross out “Passenger and Cargo Aircraft”.
   (b) Provide accurate and concise airport destination and departure names.
4. Cross out “NON-RADIOACTIVE” under the section titled “Shipment Type”. The package is considered RADIOACTIVE.
Fig. V.1: Shipper’s Declaration of Dangerous Goods.
5. Complete the “Nature and Quantity of Dangerous Goods” section using Table V.1.
   (a) Under “Quantity and Type of Packing” enter the text “One Type A Package” and then list the quantity of tritium in “TBq” followed by “H-3”.
   (b) Under “Packing Inst.” enter the text “White-I” followed by the dimensions of the Type A package (diameter × height) in inches.

Table V.1

<table>
<thead>
<tr>
<th>Proper Shipping Name</th>
<th>Class or Division</th>
<th>UN or ID No.</th>
<th>Packing Group</th>
<th>Packing Inst.</th>
<th>Authorization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radioactive material, Type-A package non-special form, non-fissile or fissile-excepted [Hydrogen-3 (tritium) mixed with a metal powder (zirconium iron), flammable n.o.s.]. Class 7 (subsidiary hazard Class 4.1).</td>
<td>Class 7 (subsidiary class 4.1)</td>
<td>UN2915 II</td>
<td>II</td>
<td>White-I diam.” × height”</td>
<td></td>
</tr>
<tr>
<td>Radioactive material, Type-A package non-special form, non-fissile or fissile-excepted [Hydrogen-3 (tritium) mixed with a metal catalyst, dry (nickel catalyst)]. Class 7 (subsidiary hazard Class 4.2).</td>
<td>Class 7 (subsidiary class 4.2)</td>
<td>UN2915 II</td>
<td>II</td>
<td>White-I diam.” × height”</td>
<td></td>
</tr>
</tbody>
</table>

6. Provide a 24-hour contact phone number in the section at the bottom of the form. DO NOT ENTER A PAGER NUMBER. A live voice is required!

7. Complete the “Name and Title of Signatory” at the bottom right of the form. Type the name and title for the RSU representative in the form as shown in Fig. V.1, lower right-hand corner. Confirm who will be signing the form from RSU prior to completion of the form.

8. Ensure that the RSU representative signs the form after inspecting the package.

9. Make six copies, one to include with drum, three to include with airbill, one for RSU, and one for C&TF records.

10. Ensure that the RSU representative signs ALL copies of the Declaration of Dangerous Goods form after inspecting the package.
5004  **Labels (Outside Packaging)**

Affix the following sets of labels: Place ONE set of labels on TOP of the package and ONE set of labels on one side of the package. The Transport label and Flammable labels must be next to each other (within 6 in. of each other). Ensure that all labels are grouped together, not overlapping, and in the same orientation with respect to the text.

1. ___ Transport Label – Radioactive White-I listing the contents as “Hydrogen-3 [tritium]” and the total activity in becquerels (Bq).
   ___ (a) Label available from RSU.

2. ___ Label listing proper shipping name (see Figs. V.2 and V.3).

3. ___ Label listing receiver and shipper names and addresses (see Fig. II.2).

4. ___ Cargo-only label.

5. ___ Drum Designation Label. The text must read “USA DOT-7A Type A”. Letters must be 1/2 in. tall.

6. ___ Gross Weight Label. The gross weight of the drum must be measured and listed in Kg. The text must read “Gross Weight ____ Kg”. Letters must be 1/2 in. tall.

7. ___ Flammable labels: (Use the labels below for each type of bed included in the package.).
   ___ (a) ZrFe beds: Diamond “Flammable Solid (4.1)” red striped (see Fig. III.3).
   ___ (b) Ni beds: Diamond “Spontaneous Combustible (4.2)” (see Fig. III.4).

8. ___ Remove all other labels and markings.

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**Radioactive material, Type-A package non-special form, non-fissile or fissile-exceptioned [Hydrogen-3 (tritium) mixed with a metal powder, flammable (zirconium iron) n.o.s.], Class 7 (subsidiary hazard Class 4.1), UN2915, PG II, ____ becquerels (mixed with 10 kg of Class 4.1 material)**

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*Fig. V.2: ZrFe Beds.*
Radioactive material, Type-A package non-special form, non-fissile or fissile-exceptioned, [Hydrogen-3 (tritium) mixed with a metal catalyst, dry (nickel catalyst)], Class 7 (subsidiary hazard Class 4.2), UN2915, PG II, _____ becquerels (mixed with 2 kg of Class 4.2 material)

Fig. V.3: Ni Beds.

5005 Shipping (FedEx Dangerous Goods Airbill)

1. ___ Note: The weight of the drum and package will be >150 lbs due to the drum itself. Therefore, FedEx freight service will be required. Because it is a Class 7 material, FedEx 1 Day Freight will be required.

2. ___ Prepare the shipment:
   ___ (a) Locate a standard shipping pallet for the drum.
   ___ (b) Weigh the pallet and compute total weight.
   ___ (c) Measure width, height, and depth dimensions of package.

3. ___ Determine the date that you wish to ship the drum.

4. ___ Arrange a booking number through FedEx:
   ___ (a) Call FedEx Express Service @ 1-800-332-0807.
   ___ (b) Tell them that you wish to ship a DOT-7A Type A drum of Class 7 material weighing >150 lbs using overnight Express Service.
   ___ (c) Provide them with dimensions of the shipment.
   ___ (d) Request a booking number.
   ___ (e) Declare the date that you wish to ship.
5. Complete a FedEx shipment request online:
   (a) Go to the FedEx “Prepare Shipment” page at http://www.fedex.com. You will need to have already set up an account. See Fig. IV.3 (Attachment #4).
   (b) Complete the webpage, making allowances for the recipient and other items listed below.
   (c) Under “Billing Details” include the reference number shown, #137759462.
   (d) Under “Your reference” include “UN2915” and include the Target Fabrication internal account number (this changes year to year).
   (e) Complete “Package and Shipment Details” as shown, making allowances for package weight and dimensions as necessary:
      (i) Use the information provided in Fig. IV.3 for Service Type, Packaging Type.
      (ii) Enter dimensions for the drum as shown and enter the weight of the drum.
      (iii) Enter “booking number” and ship date that was supplied by FedEx in Step 4(c) above.
   (f) Enter “Email Notifications” information
      (i) Include recipient, sender, LLE Radiation Safety Officer, and UR Radiation Safety Representative.
   (g) Edit the “personal message” to describe the package being shipped.
   (h) Enter “Special Services” information:
      (i) Click box for “dangerous goods”.
      (ii) Click box for “inaccessible”.
      (iii) Choose “Class 7 – Radioactive Material, White-I”.
   (i) Do a final check of the information on the screen.
   (j) Proceed by clicking on the “SHIP” button at the bottom of the screen. This will bring up a new screen displaying the shipping label. The Air Waybill number will be displayed. This is the number that is needed for the top right of the Declaration of Dangerous Goods.
   (k) Print the label on your local printer.
   (l) Place the label in a FedEx plastic pouch and affix to the top of the drum.
   (m) Band the drum to the pallet when all documentation is on the drum.

5006 Security
1. Ensure that the RSU representative affixes a security seal to the outside of the drum lip once the drum is sealed.

5007 Approvals
1. C&TF Manager.
2. RSU representative. Only the RSU representative can sign the FedEx Dangerous Goods Airbill and Shipper’s Declaration of Dangerous Goods (requires IATA shipping training).
Part VI
Shipping Radioactive Water

6000  General Limits for Shipping Radioactive Water (Tritiated Water)

Radioactive water generated by the TC-TRS and the Room 157 TRS will fall into one of three categories (see Table VI.1). Procedures for Type-A quantities are found in Part VII, and procedures for shipping limited-quantity water are found in Part VIII.

- **Part VII Type-A Quantity**: quantities up to 1080 Ci.
- **Part VIII Limited Quantity**: Quantities and concentrations between the disposable limit and Type-A quantity (see Table VI.1).
- **Disposable Water**: The disposable limit is $<1 \times 10^{-2} \mu\text{Ci/ml} (<22,000 \text{ dpm/ml})$ as described in Sec. 3011 of the “LLE Radiological Controls Manual,” LLEINST 6610C. Refer to LLEINST 6610C for disposal guidelines.

<table>
<thead>
<tr>
<th>Category</th>
<th>Concentration Limits (mCi/ml)</th>
<th>Total Activity Limits (Ci)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>None</td>
<td>1080</td>
</tr>
<tr>
<td>Limited Quantity</td>
<td>$&lt;0.1$</td>
<td>1000</td>
</tr>
<tr>
<td>Limited Quantity</td>
<td>$0.1 &lt; \text{Conc.} &lt; 1.0$</td>
<td>100</td>
</tr>
<tr>
<td>Limited Quantity</td>
<td>$&gt;1$</td>
<td>1</td>
</tr>
<tr>
<td>Disposable</td>
<td>$&lt;1 \times 10^{-5}$ (&lt;22,000 dpm/ml)</td>
<td></td>
</tr>
</tbody>
</table>
Part VII
Shipping Limited-Quantity Radioactive Water

7000 Scope
Refer to Table VI.1 in Part VI.

7001 Primary Shipping Container
The water will be contained within the approved primary shipping containers. These include (a) ~8-liter stainless steel containers modified to connect to the Room 157 TRS and (b) 5 gal plastic carboys. No ad hoc vessels should be used.

1. ___ Confirm the activity of the water. The activity of the water should be sampled twice prior to collection in the vessels. If the activity varies by more than 10%, a third measurement is required.

2. ___ Confirm the mass of the water. This should be determined by measuring the mass of the filled container and subtracting the weight of the empty container, which is listed on the side of the container. The primary shipping containers should be filled to no more than 7.0 kg in order to leave room for expansion. The primary shipping container has a label on the outside noting this limit.

3. ___ Swipe the filled container on the outside prior to shipment. Confirm that the activity does not exceed 1000 dpm per 100 cm². If it does, the container must be decontaminated prior to shipment by wiping the outside of the container, per standard protocol (LLEINST 6610C), and resampling per protocol.

4. ___ Close all valves and remove their handles.

5. ___ Affix handles to the container.

6. ___ Affix a “Radioactive” label to the outside of the primary container noting the concentration, mass of water, and total activity.
7002 Secondary Shipping Container

1. If shipping to an outside vendor, the secondary container shall be a DOT-7A Type A container.
2. If transferring to RSU, the secondary container shall be a fiberboard drum supplied by RSU.

7003 Packaging the Primary Container Within the Secondary Container

1. Calculate the minimum amount of adsorbent (silica gel) required to adsorb two times the mass of water being shipped. This minimum amount must be added to the secondary container. More may be required to fill around the container. Use the following formula:
   ___ (a) Mass silica gel (#) = 3 \times 2 \times \text{mass of water being shipped (#)}.
2. Add a 4-in. to 6-in. layer of silica gel to the bottom of the container.
3. Place the primary shipping container(s) right side up on top of the silica gel.
4. Fill the space between the containers with the silica gel until it completely covers the tops of the containers AND until all the silica gel calculated above has been added. The silica gel will prevent the primary container from shifting side to side.
5. Add packing material (Styrofoam) to take up ALL the space between the primary container and silica and the top of the secondary container.
6. Add the envelope containing shipping information (Sec. 7004) on top of the packing material.
7. Swipe the outside of the secondary shipping container. The outside shall be no more than 1000 dpm/100 cm².
8. Ensure that a representative of the RSU inspects and surveys the secondary container (when ready for shipment) with an ion-chamber-type meter. The reading must be below 0.5 mrem/hour.
9. DO NOT PUT THE COVER ON THE SECONDARY CONTAINER UNTIL the University Radiation Safety Unit (RSU) representatives inspect the contents.
10. Install the cover on the secondary container and seal tightly after inspection by the RSU.

7004 Documentation

1. Include the following information inside the drum:
   ___ (a) A copy of swipe sample of primary shipping container;
   ___ (b) A copy of swipe sample of secondary shipping container; and
   ___ (c) C&TF data sheet signed by the C&TF manager.
2. Perform Secs. 1001 through 1003.
7005 **Labels (Outside Packaging)**

1. ___ Attach UN2910 label (see Fig. II.1). Ensure that all labels are grouped together, not overlapping, and in the same orientation with respect to the text.

2. ___ Affix a label listing receiver and shipper names and addresses (see Fig. II.2).
   ___ (a) If shipping to an outside vendor, use Fig. II.2 on p. 7.
   ___ (b) If transferring to RSU, use Fig. II.3 on p. 7.

7006 **Shipping**

1. ___ If shipping to an outside vendor, see C&TF Manager.

2. ___ If transferring to RSU, contact RSU for pickup at ext. 5-3781.

7007 **Approvals**

1. ___ C&TF Manager.

2. ___ RSU representative.
Part VIII
Shipping Type-A Radioactive Water

| 8000 | Scope |
| 8001 | Primary Shipping Container |
| 8002 | Secondary Shipping Container (DOT-7A Drum) |
| 8003 | Packaging the Primary Container Within the Drum |
| 8004 | Shipper’s Declaration of Dangerous Goods |
| 8005 | Documentation |
| 8006 | Labels (Outside Packaging) |
| 8007 | Shipping (FedEx Dangerous Goods Airbill) |
| 8008 | Approvals |

8000 Scope
Refer to Table VI.1 in Part VI.

8001 Primary Shipping Container
Perform Sec. 7001.

8002 Secondary Shipping Container (DOT-7A Drum)
Perform Sec. 7002.

8003 Packaging the Primary Container Within the Drum
Perform Sec. 7003.

8004 Shipper’s Declaration of Dangerous Goods
1. ___ Refer to Fig. VIII.1.
2. ___ Type all information; do not handwrite unless making corrections. An online form is available at http://www.fedex.com.
3. ___ Complete the “Transport Details” section as follows:
   ___ (a) Cross out “Passenger and Cargo Aircraft”.
   ___ (b) Enter the correct airport names for arrival and departure.
4. ___ Cross out “NON-RADIOACTIVE” under the “Shipment Type” section in the middle part of the document. The package is considered RADIOACTIVE.
Fig. VIII.1: Shipper’s Declaration of Dangerous Goods (Radioactive Water).
5. Complete the “Nature and Quantity of Dangerous Goods” section as shown in Fig. VIII.1.

6. Provide a 24-hour contact phone number in the section at the bottom of the form. **DO NOT ENTER A PAGER NUMBER. A live voice is required!**

7. Complete the “Name and Title of Signatory” at the bottom right of the form. Type the name and title for the RSU representative in the form as shown in Fig. VIII.1, lower right-hand corner. Confirm who will be signing the form from RSU prior to completion of the form.

8. Make six copies, one for inside the drum, three for the airbill, one for the RSU, and one for C&TF records.

9. Ensure that the RSU representative signs all copies after inspecting package.

### 8005 Documentation

1. Include the following information inside the drum:
   - (a) A copy of swipe sample of primary shipping container;
   - (b) A copy of swipe sample of secondary shipping container;
   - (c) Shipper’s Declaration of Dangerous Goods (Fig. VIII.1);
   - (d) A copy of the receiver’s tritium license; and
   - (e) A copy of the measurement of activity and total mass of water.

2. Perform Secs. 1001 through 1003.

3. Include C&TF data sheet signed by C&TF Manager.

### 8006 Labels (Outside Packaging)

1. Affix the following labels to the outside of the drum:
   - (a) Transport label: two White-I labels listing the contents as “Hydrogen-3 (tritium)” and the total activity in becquerels (Bq) on opposite sides of the drum. Labels are available from the RSU personnel. Ensure that all labels are grouped together, not overlapping, and in the same orientation with respect to the text.
   - (b) Label listing receiver and shipper names and addresses (see Fig. II.2).
   - (c) Label for proper shipping name in Fig. VIII.2.
   - (d) “Cargo Only” label.
   - (e) Drum designation label. The text must read “USA DOT-7A Type A”. Letters must be 1/2-in. tall.
   - (f) Gross weight label. The gross weight of the drum must be measured and listed in kg. The text must read “Gross Weight ____kg”. Letters must be 1/2-in. tall.

2. Remove all other labels and markings.
Radioactive material, Type-A package non-special form, non-fissile or fissile-excepted
[Hydrogen-3 (tritium)], Class 7, UN2915, PG II, _____ becquerels

Fig. VIII.2: Radioactive Material Label.

8007 Shipping (FedEx Dangerous Goods Airbill)

1. ___ Note: The weight of the drum and package will be >150 lbs due to the drum itself. Therefore, FedEx freight service will be required. Because it is a Class 7 material, FedEx 1 Day Freight will be required.

2. ___ Prepare the shipment:
   ___ (a) Locate a standard shipping pallet for the drum.
   ___ (b) Weigh the pallet and compute total weight.
   ___ (c) Measure width, height, and depth dimensions of package.

3. ___ Determine the date that you wish to ship the drum.

4. ___ Arrange a booking number through FedEx:
   ___ (a) Call FedEx Express Service @ 1-800-332-0807.
   ___ (b) Tell them that you wish to ship a DOT-7A Type A drum of Class 7 material weighing >150 lbs using overnight Express Service.
   ___ (c) Provide them with dimensions of the shipment.
   ___ (d) Request a booking number.
   ___ (e) Declare the date that you wish to ship.

5. ___ Complete a FedEx shipment request online:
   ___ (a) Go to the FedEx “Prepare Shipment” page at http://www.fedex.com. You will need to have already set up an account. See Fig. IV.3 (Attachment #4).
   ___ (b) Complete the webpage, making allowances for the recipient and other items listed below.
   ___ (c) Under “Billing Details” include the reference number shown, #137759462.
(d) Under “Your reference” include “UN2915” and include the Target Fabrication internal account number (this changes year to year).

(e) Complete “Package and Shipment Details” as shown, making allowances for package weight and dimensions as necessary:

(i) Use the information provided in Fig. IV.3 for Service Type, Packaging Type.

(ii) Enter dimensions for the drum as shown and enter the weight of the drum.

(iii) Enter “booking number” and ship date that was supplied by FedEx in Step 4(c) above.

(f) Enter “Email Notifications” information

(i) Include recipient, sender, LLE Radiation Safety Officer, and UR Radiation Safety Representative.

(g) Edit the “personal message” to describe the package being shipped.

(h) Enter “Special Services” information:

(i) Click box for “dangerous goods”.

(ii) Click box for “inaccessible”.

(iii) Choose “Class 7 – Radioactive Material, White-I”.

(i) Do a final check of the information on the screen.

(j) Proceed by clicking on the “SHIP” button at the bottom of the screen. This will bring up a new screen displaying the shipping label. The Air Waybill number will be displayed. This is the number that is needed for the top right of the Declaration of Dangerous Goods.

(k) Print the label on your local printer.

(l) Place the label in a FedEx plastic pouch and affix to the top of the drum.

(m) Band the drum to the pallet when all documentation is on the drum.

8008 Security

1. Ensure that the RSU representative affixes a security seal to the outside of the drum lip once the drum is sealed.

8009 Approvals

1. C&TF Manager.

2. RSU representative. Only the RSU representative can sign the FedEx Dangerous Goods Airbill and Shipper’s Declaration of Dangerous Goods (requires IATA shipping training).