PROPER SEGREGATION AND DISPOSAL OF LOW-LEVEL RADIOACTIVE WASTES (LLRW) AT THE UNIVERSITY OF MICHIGAN

OCCUPATIONAL SAFETY AND ENVIRONMENTAL HEALTH (OSEH)
PROPER SEGREGATION AND DISPOSAL
OF LOW-LEVEL RADIOACTIVE WASTES (LLRW)
AT THE UNIVERSITY OF MICHIGAN

October, 2009

OCCUPATIONAL SAFETY AND ENVIROMENTAL HEALTH (OSEH)

LLRW COLLECTION REQUESTS
734-763-4568

Hazardous Materials Management (HMM)
North Campus Transfer Facility
1655 Dean Road
Ann Arbor, MI 48109-2159
734-763-4568

Radiation Safety Service (RSS)
Campus Safety and Security Building
1239 Kipke Drive
Ann Arbor, MI 48109-1010
734-764-6200
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>4</td>
</tr>
<tr>
<td>GENERAL GUIDELINES FOR LLRW</td>
<td>5</td>
</tr>
<tr>
<td>SOLID LLRW</td>
<td>5</td>
</tr>
<tr>
<td>LOW-LEVEL RADIOACTIVE SHARPS</td>
<td>5</td>
</tr>
<tr>
<td>LIQUID LLRW</td>
<td>7</td>
</tr>
<tr>
<td>LIQUID SCINTILLATION VIALS</td>
<td>9</td>
</tr>
<tr>
<td>STOCK VIALS</td>
<td>10</td>
</tr>
<tr>
<td>LEAD SEGREGATION AND DISPOSAL</td>
<td>10</td>
</tr>
<tr>
<td>PATHOLOGICAL RADIOACTIVE WASTE PACKAGING AND DISPOSAL</td>
<td>11</td>
</tr>
<tr>
<td>RADIOACTIVE CONTAMINATION AND EXPOSURE CONTROL FOR WASTE CONTAINERS</td>
<td>12</td>
</tr>
<tr>
<td>LOW-LEVEL RADIOACTIVE WASTE (LLRW) MANIFEST</td>
<td>13</td>
</tr>
<tr>
<td>PROPER LABELING OF CONTAINERS OF LLRW</td>
<td>13</td>
</tr>
<tr>
<td>PROPER COMPLETION OF LLRW MANIFEST</td>
<td>14</td>
</tr>
<tr>
<td>CALL-IN PROCEDURE FOR COLLECTION OF LLRW</td>
<td>16</td>
</tr>
<tr>
<td>PROPER STORAGE OF WASTE CONTAINERS</td>
<td>17</td>
</tr>
<tr>
<td>LLRW WHICH CONTAINS CHEMICALS (RADIOACTIVE/CHEMICALS)</td>
<td>17</td>
</tr>
<tr>
<td>APPENDIX 1:EXAMPLE MANIFEST AND CONTAINER LABELS</td>
<td>18</td>
</tr>
<tr>
<td>SAMPLE LLRW MANIFEST—FRONT</td>
<td>19</td>
</tr>
<tr>
<td>SAMPLE LLRW MANIFEST—BACK</td>
<td>20</td>
</tr>
<tr>
<td>EXAMPLE CONTAINER LABELS</td>
<td>21</td>
</tr>
<tr>
<td>LABEL FOR FIBER DRUMS</td>
<td>22</td>
</tr>
<tr>
<td>CONTAINER TYPES AVAILABLE THROUGH OSEH</td>
<td>23</td>
</tr>
</tbody>
</table>
The University of Michigan - Department of Occupational Safety & Environmental Health (OSEH) will collect and process the various forms of radioactive waste generated at the University of Michigan provided the waste is properly segregated, packaged and identified according to the methods detailed in this brochure.

Disposal of the various forms of low-level radioactive waste (LLRW) is complex, extremely difficult, and very costly. Waste minimization and segregation are critical to reducing costs, ensuring regulatory compliance, maintaining a safe work place, and protecting the environment. All radioactive waste generators must adhere to the waste minimization and waste segregation guidelines established by OSEH.

Failure to adhere to the segregation and disposal procedures outlined by OSEH will result in:

1. Radioactive waste being returned to the laboratory of origin for repackaging

   OR

2. Laboratory personnel repackaging the radioactive waste at OSEH.

Thank you for your cooperation in complying with the following OSEH protocols for the proper segregation and disposal of radioactive wastes at the University of Michigan. Please contact Occupational Safety and Environmental Health (763-4568) should you have any questions regarding these protocols.
GENERAL GUIDELINES FOR LLRW

- Ensure compliance with Low-Level Radioactive Waste (LLRW) Manifest (refer to page 13).
- Only OSEH can dispose of LLRW generated at The University of Michigan.
- Employ waste minimization techniques at all times.
- Maintain a record of each radionuclide, activity (µCi), any chemicals constituents, and the date each radionuclide is placed into an OSEH-approved waste container. NOTE: Radionuclide activity estimates must be accurate (within an order of magnitude).
- Inform OSEH-HMM prior to collection if the contact exposure rate of a waste container exceeds 50 mrem/hour.

**TABLE OF ACCEPTABLE SEGREGATION CATEGORIES FOR LLRW**

<table>
<thead>
<tr>
<th>LONG-LIVED ISOTOPES</th>
<th>( &gt; 90 days half-life)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATEGORY A</td>
<td>H-3 and/or C-14</td>
</tr>
<tr>
<td>CATEGORY B</td>
<td>Na-22, Cl-36, Ca-45, Co-57, Co-58, Fe-59, Co-60, Ni-63, Sr-90, Tc-99, Sn-113, and/or Cs-137, etc. (excluding H-3 and C-14)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTERMEDIATE-LIVED ISOTOPES</th>
<th>( &gt; 14 days - Less than or equal to 90 days half-life)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATEGORY C</td>
<td>S-35, P-33, Sc-46, Cr-51, Sr-85, Rb-86, Ru-103, and/or Ce-141, etc.</td>
</tr>
<tr>
<td>CATEGORY D</td>
<td>I-125, P-33, Sc-46, Cr-51, Sr-85, Rb-86, Ru-103, and/or Ce-141, etc.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SHORT-LIVED ISOTOPES</th>
<th>(&lt; 14 days half-life)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATEGORY E</td>
<td>P-32, C-11, F-18, Na-24, Br-82, Y-90, Nb-95, Tc-99m, In-111, I-131, and/or Tl-201, etc.</td>
</tr>
</tbody>
</table>

**USE A SEPARATE CONTAINER FOR EACH CATEGORY**

*OSEH may require further segregation as necessary for safe handling.

**SOLID LLRW**

Solid radioactive wastes generally should consist of dry contaminated laboratory materials, equipment, and supplies such as paper, unbroken glass, and plastic products.

OSEH-HMM provides 7.5 gallon and 28 gallon yellow fiber drums (see page 23) for solid low-level radioactive waste (LLRW) disposal.

Segregate solid radioactive wastes by radionuclide(s). Please see the Table of Acceptable Segregation Categories for LLRW. (Use a separate drum for each category).
Solid Llrw (cont)

- Ensure yellow fiber waste drum is lined with large plastic bag prior to discarding solid wastes into fiber drum
- Affix completed Container Label to the designated location (i.e. vinyl label) on upper side of the large yellow fiber drums (lower side of small fiber drums) immediately upon calling in for waste pick-up.

### Do Not

- Discard radioactive material as normal trash.
- Use translucent or opaque bags (e.g. Biohazard waste bags, etc.) to discard radioactive wastes into yellow fiber drums. (Note: use clear bags only).
- Deface or write directly on OSEH yellow fiber drums. (Note: drums are reused).
- Overfill and/or underfill yellow fiber drums.
- Discard the following materials into OSEH yellow fiber drums:
  - (a) Non-radioactive wastes (e.g. paper towels, boxes, etc);
  - (b) Stock vials or other containers which contain standing liquids (>0.5 ml/container);
  - (c) LSC vials (empty or full);
  - (d) Lead, leaded-materials, or large contaminated metal objects (Note: request a special collection);
  - (e) Chemicals or chemically soaked materials;
  - (f) Biological wastes (e.g. carcasses, blood, tissue, organs, urine, feces, bedding, etc).

### Low-Level Radioactive Sharps

By definition, sharps are those objects which represent a puncture or laceration hazard. Such objects include, but are not limited to, the following: syringe needles (capped or uncapped), razor blades, scalpel blades, xacto knife blades, sharp metal objects, capillary pipettes, and broken glass objects.

All radioactive sharps MUST be disposed of into 1-gallon or 5-gallon plastic white pails (see page 23), sealed plastic bottles, or other approved sharps containers.

NOTE: Cardboard boxes are not acceptable for sharps containment.

The containers must be securely closed (i.e. snapped in place) so that there will be no leakage of radioactive material under conditions normally incident to transportation.

OSEH-HMM will provide pails to your laboratory for SHARPS ONLY. Please DO NOT discard other forms of hazardous or low-level radioactive wastes into these pails.
LOW-LEVEL RADIOACTIVE SHARPS (Cont)

Segregate radioactive sharps by radionuclide(s). Please see the Table of Acceptable Segregation Categories for LLRW. (Use a separate pail for each category).

To avoid potential injury to OSEH-Hazardous Materials Management personnel, sharps are NOT to be placed into the OSEH yellow radioactive waste fiber drums for disposal. Sharp objects discovered in the yellow fiber drums will result in the fiber dorm being returned to laboratory of origin for proper segregation and repackaging.

NOTE: Place Container Label around handle of pail and affix the two adhesive ends together. (See picture of proper labeled pail on page 23).

LIQUID LLRW

OSEH-HMM will provide 4 or 20 liter plastic waste jugs for low-level liquid radioactive wastes upon request (see page 23).

I. Segregate low-level liquid radioactive wastes by type:
   (1) Aqueous (water only)
   (2) Liquid Scintillation Cocktail (LSC) fluid
   (3) Chemicals / Solvents

   DO NOT combine the above separate liquid waste categories in the same waste jug.

II. Segregate low-level liquid radioactive wastes by radionuclide(s).

   Please see the Table of Acceptable Segregation Categories for LLRW. (Use a separate jug for each category).

GUIDELINES FOR LIQUID LLRW

- Use a funnel to decant liquid radioactive wastes into jugs to prevent external contamination.
- First and second washes of reusable contaminated lab equipment should be discarded into OSEH jugs. Third and subsequent rinses may be discarded down sink drains if a sample’s count rate is < 3 times background.
- Ensure biological (blood & urine), toxic or carcinogenic liquid radioactive wastes are made innocuous (i.e. bleach, Lysol detergent, other methods), non-toxic or otherwise neutralized prior to OSEH-HMM collection.
  NOTE: Special handling instructions or precautions should be given to OSEH personnel when requesting waste collections containing biological, toxic or carcinogenic material.
- Avoid acidic solutions of radioiodine waste; acidity enhances volatile nature of radioiodines.
- Place approximately 500 ml of sodium thiosulfate (Na₂S₂O₃) in waste jugs containing I⁻₁₂₅ or I⁻₁₃₁; sodium thiosulfate binds free or volatile radioiodine and reduces volatility.
LIQUID LLRW (cont)

- Refer to section entitled **LLRW Which Contains Chemicals (Radioactive/Chemical)**.
- Ensure jugs are filled to scribed line on container, but no higher, prior to requesting OSEH-HMM collection. Special requests will be considered for partially filled jugs.
- Ensure waste jugs are not leaking and free of external contamination prior to OSEH-HMM collection.
- Ensure caps are tightened securely on waste jugs prior to OSEH-HMM collection.
- Insert Container Label through handle and affix the two adhesive ends together so that information is legible to OSEH personnel. (See picture of proper labeled jugs on page 23).

**NOTE:** To ensure accurate reporting of radionuclidic activity content, jugs of liquid radioactive waste should be sampled and analyzed by lab personnel prior to OSEH collection.

---

**DO NOT**

- discard liquid radioactive wastes down sink drains.
- fill waste jug beyond fill line scribed on jug (i.e. approximately 3” below cap).
- use any container, or jug cap, other than those provided by OSEH.
- write directly on OSEH waste jugs. (Note: jugs are cleaned, surveyed, re-labeled and re-used).
- discard solid material (e.g. pipette tips, needles, filter paper, biological material, etc.) into liquid waste jugs.
- discard strong acids or bases (>1N) into OSEH plastic waste jugs. (Note: contact OSEH-HMM for special handling or processing of acidic or caustic liquids).
- remove cap from waste jug containing volatile radioiodine or S-35 labeled methionine/cysteine unless performed in an OSEH–approved exhaust hood.
- store uncapped waste jugs of volatile radioiodines or S-35.
- use glass or other containers for wastes unless approved by OSEH.
- mix bleach with radioiodines. (Note: bleach enhances volatile nature of radioiodines).

Note: OSEH may choose not to collect waste jugs or may return jugs to the laboratory of origin for reprocessing if any of the following unacceptable conditions are noted:

1. External contamination detected on jugs;
2. Radionuclide(s), activity, or chemical content in the waste jugs are inconsistent with those identified by the waste generator;
3. Bi-phasic mixture of liquids in waste jug;
4. Cap on jug is not an OSEH–approved cap;
5. Solid material discovered in jug (e.g. pipette tips, filter paper, needles, biological material, etc.);
6. Jugs filled beyond scribed line;
7. Jugs bloated (positive pressure) or crumpled (negative pressure);
8. Writing or defacing noted on jug surface and not on Container Label.
LIQUID SCINTILLATION VIALS

FILLED LIQUID SCINTILLATION COCKTAIL (LSC) VIALS

OSEH-HMM will collect filled or partially-filled liquid scintillation vials containing OSEH-approved non-hazardous or biodegradable scintillation fluid provided the vials are sorted, packaged and prepared according to the methods described below. (Contact OSEH to obtain a current list of acceptable non-hazardous or biodegradable scintillation fluids).

NOTE: Toluene and xylene-based scintillation fluids are prohibited from use at The University of Michigan unless authorization has been received from OSEH. Contact OSEH-HMM for specific collection instructions.

EMPTY LSC VIALS

- OSEH-HMM will collect empty scintillation vials as well as filled vials.
- Indicate activity as < 10 µCi when requesting collection of empty vials.
- Use the vial disposal procedure detailed below to dispose of empty and full scintillation vials.

I. Segregate vials by radionuclidic content

Please see the Table of Acceptable Segregation Categories for LLRW. (Use a separate box for each category).

II. Segregate vials by type: Glass or Plastic

DO NOT mix plastic or glass vials in same box or tray.

NOTE: OSEH recommends the use of glass vials as opposed to plastic wherever possible.

GUIDELINES FOR LIQUID SCINTILLATION VIALS

- Ensure scintillation vial caps are fastened securely and not leaking prior to packaging in trays and boxes.
- Store vials within the cardboard vial flats (trays).
- Insert absorbent material or pad in base of original vial box.
- Pack vial flats containing scintillation vials into box.
- Seal box securely with tape. (Use lab, duct or making tape).
- Record on the top of all boxes of LSC vials either Plastic or Glass.
- Ensure boxes of scintillation vials are not saturated or leaking scintillation fluid prior to OSEH-HMM collection.
- OSEH-HMM may choose not to accept boxes of vials phoned-in as ≥ 1,000 µCi.
- Affix Container Label to top of LSC vial box.
LIQUID SCINTILLATION VIALS (cont)

DO NOT

- dispose of commercially prepared liquid scintillation standards with other scintillation vial wastes. (Note: request a special collection).
- discard scintillation fluid or radionuclides down sink drains.
- tape the tops of scintillation vials.
- discard other forms of radioactive waste (eg. gloves, syringes, paper, pads, etc.) in with vials.
- discard scintillation vials (empty or full) into yellow fiber waste drums.
- discard "hot" commercial stock vials with scintillation vials.
- use radioactive material tape to seal boxes of scintillation vials. (Note: use lab, masking or duct tape).

STOCK VIALS

Stock vials are glass or plastic vials which hold the concentrated radioactive isotope(s) originally given to authorized users.

Stock vials must be properly packaged in sturdy boxes containing sufficient absorbent padding to inhibit shifting of contents and to soak up any potential residual liquid spills.

NOTE: Please ensure stock vials are sealed securely.

Affix Container Label to top of box.

LEAD SEGREGATION AND DISPOSAL

OSEH will collect lead/leaded objects (e.g. lead pigs, sheet lead, lead bricks, etc.) for disposal.

Lead pigs must be placed in a sturdy box, taped securely shut, and marked "LEAD PIGS". This also includes lead impregnated objects, such as the plastic containers that New England Nuclear uses to ship stock vials in.

All lead objects must be smeared for removable contamination and, if necessary, decontaminated prior to collection.

It is not necessary to manifest lead objects for disposal, however, the lead objects must be placed with any other radioactive waste awaiting collection. Please request a special pick-up if you have lead bricks and/or sheet lead you wish to dispose of.
Pathological radioactive wastes include: contaminated animal carcasses, organs, blood, tissue, urine, feces, bedding, etc.

**GUIDELINES FOR PATHOLOGICAL RADIOACTIVE WASTE**

- Pathological wastes must be completely frozen to be accepted by OSEH personnel.
- Remove all sharps (e.g. needles, razors, scalpels, etc.) and metallic objects from carcasses before freezing and subsequent OSEH collection.
- Radioactive blood, tissue, urine, etc. must be made innocuous or rendered non-toxic prior to OSEH collection (e.g. bleach, detergent, other methods). WARNING: Radioiodines or other volatile radionuclides may become airborne when bleach is added.
- Double-bag animal carcasses in strong (4 mil) plastic bags.
- Outer bag or wrapper should be a yellow opaque bag available from OSEH.
- Contact OSEH for authorization to use the walk-in freezer located in MSRB-II (Rm A592). Key-use required for entry.
- OSEH must be notified in writing should an Authorized User desire to store radioactive pathological material in an animal freezer under the authorization of another individual or department.
- Contact OSEH if a radioactive storage freezer is filled to capacity, breaks down, or otherwise becomes ineffective in completely freezing animal carcasses, blood, etc..
- Attach OSEH-provided yellow waste tag with the following instruction: radionuclide(s), activity of each radionuclide (µCi), chemical or biohazardous material (if applicable), date packaged, description of waste (e.g. rats, dog, mice, pig, bedding, blood, feces, etc.), names of contact person and Authorized User, and phone number(s).

---

**DO NOT**

- dispose of plastic cages as pathological waste. (Note: empty contents of animal cages into pathological waste bags or 4 mil thick plastic bags and decontaminate cages).
- discard pathological wastes into yellow waste drum.
- freeze pathological wastes in glass containers. (Note: use plastic only).
- discard metal objects (e.g. needles, scalpels, cans, etc.) with pathological material or animal carcasses.
- discard (≥ 5.0 mCi of I-125 and/or I-131 in a single bag or container of pathological waste.
RADIOACTIVE CONTAMINATION AND EXPOSURE CONTROL FOR WASTE CONTAINERS

Removable radioactive contamination on the exterior of all LLRW containers shall be kept as low as practicable.

Laboratory personnel are responsible for:

1. Testing for the presence of external contamination on all waste containers;
2. Removing contamination from the exterior of all waste containers to the limits in the table below;
3. Maintaining a copy of all records of smear test results;
4. Informing OSEH-HMM prior to collection of waste if the contact exposure rate of any waste container exceeds 50 mrem/hour.

TABLE 10—REMOVABLE EXTERNAL RADIOACTIVE CONTAMINATION—WIPE LIMITS

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Maximum permissible limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta-gamma emitting radionuclides; all radionuclides with half-lives less than ten days; natural uranium; natural thorium; uranium-235; uranium-238; thorium-232; thorium-228 and thorium-230 when contained in ores or physical concentrates.</td>
<td>$10^{-5}$</td>
</tr>
<tr>
<td>All other alpha emitting radionuclides</td>
<td>$10^{-6}$</td>
</tr>
</tbody>
</table>

[49 CFR 173.443 Table 10]

REMOVAL OF EXTERNAL CONTAMINATION FROM WASTE CONTAINERS

Every laboratory which generates radioactive waste is responsible for decontaminating the exterior of waste containers to the safe levels listed in the table above. The following contamination testing procedures are required for each type of waste container:

**SOLIDS**

7.5 gallon and 28 gallon yellow fiber drums are to be smeared (wipe-tested) on the side and bottom of the drum.

**SHARPS**

Sharps containers must be smeared on the handle, top (lid), bottom, and sides of the container.

**LIQUIDS**

4L and 20L jugs must be smeared on the cap, handle, sides, and bottom of the container.

**SCINTILLATION VIALS and STOCK VIALS**

The boxes containing the vials are to be smeared on all four sides as well as on the top and bottom.

NOTE: The boxes containing the vials must be properly sealed and have no visible damage so that no leaking of radioactive and/or hazardous material occurs from the box.
LEAD OBJECTS

All lead/leaded objects and lead impregnated materials must be smeared on all sides.

A completed signature on the Low-Level Radioactive Waste (LLRW) Manifest indicates to OSEH personnel that the testing for external container contamination has been completed as required.

LOW-LEVEL RADIOACTIVE WASTE (LLRW) MANIFEST

The LLRW Manifest (see page 19) is designed to provide for simple and accurate identification of the type, quantity, possible chemical components, and radioactivity level of waste being handled.

Each generator of LLRW is require to:

1. Properly label each container of waste to be picked up by OSEH-HMM using the Container Labels provided;
2. Completely fill out the LLRW Manifest for each designated pick-up of LLRW;
3. Call OSEH-HMM for collection of LLRW, indicating quantity and location of waste;
4. Store waste in a safe, accessible, and easily identifiable location for OSEH personnel to inspect for completeness and transport.

I. PROPER LABELING OF CONTAINERS OF LLRW

A. Every container of LLRW (including, but not limited to, the following: 4L and 20L plastic jugs for liquid wastes; boxes for LSC vials and stock vials; 7.5 gallon and 28 gallon yellow fiber drums for solid wastes; and sharps containers) must be labeled with a Container Label which incorporated the following information.

1. MANIFEST #
   (e.g. R-00001 which is pre-printed on the upper right corner of the LLRW Manifest form).

   Note: Every container of waste that is recorded on the LLRW Manifest must be labeled with the corresponding Manifest number (R-_____) on that form.

2. CONTAINER #

   SOLIDS
   Indicate the Drum # (i.e. SD-5364 or LD-5125) which is unique to each fiber drum, corresponding to the listing on the LLRW Manifest.
LOW-LEVEL RADIOACTIVE WASTE (LLRW) MANIFEST (cont)

**SHARPS**
Indicate the Container # (1-4) corresponding to the listing on the LLRW Manifest form.

**LIQUIDS**
Indicate the Jug # (1-8) corresponding to the listing on the LLRW Manifest form.

**SCINTILLATION VIALS**
Indicate the Box # (1-5) corresponding to the listing on the LLRW Manifest form.

3. **DATE**
Please list the date that each individual container is filled. (month/day/year)

4. **ISOTOPE / ACTIVITY**
Please list all isotopes present along with corresponding activities in units of microcuries (µCi).

B. Once this information is recorded on the Container Label (see page 21), remove the adhesive tabs (ends only) off the back of the label and affix the adhesive to the following locations for each type of container:

**FIBER DRUMS**
Affix label to **designated site** (i.e. vinyl label on upper side of large yellow fiber drums and on lower side of small yellow fiber drums).

**SHARPS PAILS**
Place label around handle and affix the two adhesive ends together.

**PLASTIC JUGS**
Insert label through handle and affix the two adhesive ends together.

**LSC & STOCK VIAL BOXES**
Affix label to top of box.

NOTE: If any container of LLRW prepared for pick-up is not properly labeled, as outlined in the above guidelines, OSEH personnel will not collect the materials.

II. **PROPER COMPLETION OF THE LLRW MANIFEST**
Every container of waste called in to OSEH-HMM for collection must be recorded on the LLRW Manifest.

NOTE: If there is not enough room on the form for all waste container that are to be collected, use an additional Manifest form and be sure to record the correct Manifest number (R-_______) on the Container Label corresponding to that container listed on the Manifest.
Once the waste containers are full and/or ready to be collected by OSEH-HMM, comply with the following instructions in completing the LLRW Manifest:

**SOLIDS (SECTION A)**
1. Record the Drum Number for each yellow fiber drum of waste (e.g. SD-5364 for small drums, or LD-5125 for large drums) which is found on the side of the yellow fiber drums.
2. Volume: Large drums = 28 gallons; Small drums = 7.5 gallons. Please circle applicable volume.
3. Record the Isotope(s) and corresponding Activity(s) (µCi) of the waste within each individual fiber drum.

**LIQUIDS (SECTION B)**
1. Volume: OSEH-approved liquid containers are either 4L or 20L in volume. Please indicate, to the nearest liter, the volume of liquid within each individual container.

   NOTE: The majority of containers used for liquid radioactive waste are 4L in volume.

2. Record the Isotope(s) and corresponding Activity(s) (µCi) of the liquid waste within each individual container.
3. For radioactive liquids containing chemicals or a mixture of water and a chemical (e.g. acids, bases, ethanol, methanol, chloroform, formaldehyde, acetonitrile, phenol, etc.; no matter how dilute) - See Reverse side of form.
   (a) If the chemical present in the jug is listed on the back of the LLRW manifest please enter the corresponding number code and indicate the approximate chemical concentration in % within the spaces provided on the front of the manifest.
   (b) If the chemical present in the jug is not listed on the back of the LLRW Manifest please enter the number code 99 and the approximate chemical concentration in % within the spaces provided on the front of the manifest, and list the chemical name within the space provided on the back of the manifest.

   Note: Please list in same order as listed on front.

**SCINTILLATION VIALS (SECTION C)**
1. Record the Isotope(s) and corresponding Activity(s) (µCi) for each individual box.
2. Circle P if vials are Plastic or circle G if the vials are Glass.
3. Identify the type of LSC fluid (cocktail) that is in the vials.

**SHARPS / STOCK VIALS (SECTION D)**
1. Record the Isotope(s) and corresponding Activity(s) for each container.
2. Check the appropriate column to indicate Sharps or Stock Vials.

**AUTHORIZED USER**
The name of the individual who has been authorized by OSEH to use the radioactive material.
LOW-LEVEL RADIOACTIVE WASTE (LLRW) MANIFEST (cont)

PHONE
The telephone number of the laboratory in which the waste is located.

ROOM NUMBER / BUILDING
Place where the waste is located.

DATE
The date that the material is called in for collection. (month / day / year)

COMPLETED BY
The name of the individual that was responsible for filling out the LLRW Manifest. Please PRINT.

SIGNATURE
Your signature indicates that testing for external container contamination has been completed as required and that contamination has been removed to safe levels.

III. CALL-IN PROCEDURE FOR COLLECTION OF LLRW
Once the containers are properly labeled and the Manifest has been completed, call OSEH at 763-4568 and report the following information:

(1) Authorized User’s Name.
(2) Phone number of the laboratory in which the waste is located.
(3) Room number and Building where the waste is located.
(4) Number of containers of each type of waste and description of the type of waste container. (e.g. 6—4L liquid jugs, 2—20L liquid jugs, 1 small drum and 2 large drums of solid waste, 4 boxes of scintillation vials, 1 box of stock vials, and 2 sharps pails).
(5) Replacement container needs.
(6) Any special handling instructions required. Please inform OSEH at this time if the contact exposure rate of any waste container exceeds 50 mrem/hour.

IV. PROPER STORAGE OF WASTE CONTAINERS
Waste containers must be stored in a safe, secure, and easily identifiable location within your laboratory room for OSEH personnel to inspect for completeness and transport.

Note: It is recommended that the waste be stored in an area which will limit laboratory personnel exposure. Also, use shielding whenever possible. (Contact Radiation Safety Service at 764-6200 for recommended shielding methods).

Important—Once waste is ready to be picked up by OSEH-HMM, be sure to place LLRW Manifest in immediate proximity to the waste containers. (i.e. place manifest on top of waste containers prepared for shipment so that the manifest is in plain view).

Please see the example manifest and corresponding container labels in Appendix 1.
Radionuclide user are **strongly encouraged** NOT to generate LLRW combined with chemicals at The University of Michigan. Segregate radioactive waste from chemicals whenever possible. **DO NOT** combine chemicals and radioactive wastes in the same container unless the combination is an inherent part of your experimental protocols.

Isolate chemical wastes from all forms of pure aqueous or solid forms of radioactive wastes. Minimize the volumes of unavoidable chemical LLRW at all times. The generation of chemical LLRW by merely mixing chemical and radioactive wastes together in the same container as a means of waste disposal (after-use mixing) is **unacceptable and prohibited**. Contact OSEH-HMM for guidance and recommendations.

Should your research activities involve the unavoidable generation of chemical LLRW, please ensure:

1. this waste remains concentrated and is properly segregated from other water-based radioactive wastes;
2. the waste volume is kept to an absolute minimum;
3. to properly notify OSEH-HMM as to the waste type, volume, and quantity (% chemical by volume) prior to waste collection.
APPENDIX 1: EXAMPLE MANIFEST AND CONTAINER LABELS

SAMPLE LLRW MANIFEST—FRONT ................................................................. 19

SAMPLE LLRW MANIFEST—BACK ............................................................. 20

EXAMPLE CONTAINER LABELS ................................................................. 21

LABEL FOR FIBER DRUMS ................................................................. 22

LLWR WASTE CONTAINERS AVAILABLE THROUGH OSEH ...................... 23
**LOW-LEVEL RADIOACTIVE WASTE (LLRW) MANIFEST**

Radioactive material, low specific activity (LSA-II), 7, UN3321
University of Michigan, Occupational Safety and Environmental Health (OSEH)
North Campus Transfer Facility, 1655 Dean Road, Ann Arbor, MI 48109-2159, (734)763-4568

[SD = 7.5 gal., LD = 28 gal.]

### SOLIDS

<table>
<thead>
<tr>
<th>S</th>
<th>E</th>
<th>RQ</th>
<th># on Drum</th>
<th>Size gallon (Circle)</th>
<th>Isotope</th>
<th>Activity (kBq)</th>
<th>Activity (uCi)</th>
<th>Isotope</th>
<th>Activity (kBq)</th>
<th>Activity (uCi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>LD-5125</td>
<td>7.5</td>
<td>28</td>
<td>H-3</td>
<td>(200)</td>
<td>C-14</td>
<td>(120)</td>
<td>( )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>SD-5364</td>
<td>7.5</td>
<td>28</td>
<td>S-35</td>
<td>(130)</td>
<td>P-33</td>
<td>(50)</td>
<td>Cr-51</td>
<td>(35)</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>LD-5394</td>
<td>7.5</td>
<td>28</td>
<td>P-32</td>
<td>(90)</td>
<td>( )</td>
<td>( )</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### LIQUIDS

<table>
<thead>
<tr>
<th>S</th>
<th>E</th>
<th>RQ</th>
<th>Vol (L)</th>
<th>Isotope</th>
<th>Activity (kBq)</th>
<th>Activity (uCi)</th>
<th>Activity (kBq)</th>
<th>Activity (uCi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>1</td>
<td>4</td>
<td>0.3</td>
<td>C-14</td>
<td>(30)</td>
<td>H-3</td>
<td>(110)</td>
<td>00</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>4</td>
<td>0.9</td>
<td>P-32</td>
<td>(90)</td>
<td>( )</td>
<td>27</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
<td>2.1</td>
<td>I-125</td>
<td>(210)</td>
<td>P-33</td>
<td>(60)</td>
<td>00</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>4</td>
<td>1.5</td>
<td>P-32</td>
<td>(150)</td>
<td>( )</td>
<td>00</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>4</td>
<td>1.5</td>
<td>P-32</td>
<td>(150)</td>
<td>( )</td>
<td>51</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>4</td>
<td>0.6</td>
<td>S-35</td>
<td>(60)</td>
<td>P-33</td>
<td>(15)</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>20</td>
<td>0.2</td>
<td>I-125</td>
<td>(240)</td>
<td>( )</td>
<td>00</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>20</td>
<td>0.1</td>
<td>P-32</td>
<td>(115)</td>
<td>( )</td>
<td>00</td>
<td>100</td>
</tr>
</tbody>
</table>

### SCINTILLATION VIALS

<table>
<thead>
<tr>
<th>S</th>
<th>E</th>
<th>RQ</th>
<th>Box #</th>
<th>Isotope</th>
<th>Activity (kBq)</th>
<th>Activity (uCi)</th>
<th>Activity (kBq)</th>
<th>Activity (uCi)</th>
<th>Identify Scintillation Cocktail</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>1</td>
<td>H-3</td>
<td>20</td>
<td>C-14</td>
<td>(170)</td>
<td>( )</td>
<td>( )</td>
<td>Biosafe NA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>P-32</td>
<td>160</td>
<td>( )</td>
<td>( )</td>
<td>Scintiverse BD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>S-35</td>
<td>75</td>
<td>( )</td>
<td>( )</td>
<td>Scintiverse BD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>P-32</td>
<td>160</td>
<td>( )</td>
<td>( )</td>
<td>Ecolume (+)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PLEASE PRINT**

Authorized User: John Smith
Room#/Building: A100 MSRB III
Completed By: John Doe

*Signature: John Doe*

*Signature indicates that each container has been swiped for external contamination (staple a copy of survey results to manifest).*
INSTRUCTIONS TO IDENTIFY CHEMICALS IN LIQUIDS

1. If chemical is listed below, please enter corresponding number code and approximate chemical concentration in % by volume in section B on the front side of the manifest.

2. If chemical constituents are not listed below, Please enter number code 99 and approximate concentration in % by volume in section B on the front side of the manifest, and list chemical name(s) and concentration(s) in Section E below.

<table>
<thead>
<tr>
<th>Jug #</th>
<th>CODE 99 CHEMICAL NAMES(S), % BY VOL.</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Lead acetate</td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>
EXAMPLE CONTAINER LABELS

FIRST SOLID DRUM LISTED ON SAMPLE MANIFEST

<table>
<thead>
<tr>
<th>Manifest #: R-00001</th>
<th>Radioactive</th>
<th>Activity (mCi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container #: LD-5125</td>
<td>H-3</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>C-14</td>
<td>120</td>
</tr>
</tbody>
</table>

Second Liquid Jug Listed on Sample Manifest

<table>
<thead>
<tr>
<th>Manifest #: R-00001</th>
<th>Radioactive</th>
<th>Activity (mCi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container #: 2</td>
<td>P-32</td>
<td>90</td>
</tr>
</tbody>
</table>

Third Scintillation Vial Box Listed on Sample Manifest

<table>
<thead>
<tr>
<th>Manifest #: R-00001</th>
<th>Radioactive</th>
<th>Activity (mCi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container #: P-BOX-3</td>
<td>S-35</td>
<td>75</td>
</tr>
</tbody>
</table>

University of Michigan
1085 Dean Road
Ann Arbor, MI 48109-2155
Phone: (734)763-4544
Emergency Contact (24 hours): (734)763-1131
LLRW WASTE CONTAINERS AVAILABLE THROUGH OSEH

Left, 28 gallon large drum. Right, 7.5 gallon small drum.

Left, 4 liter liquid jug. Right, 20 liter liquid jug.

Left, 1 gallon sharps pail. Right, 5 gallon sharps pail.

Contact OSEH HMM at 763-4568 to order supplies.