



Offsite Shipments of RAM			
SOP NUMBER	SUPERSEDES SOP (IF APPLICABLE)		
EHS-SOP-RAD-601.00			
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1. **Purpose:** The following procedure describes how to prepare RAM packages for shipment off the MU NRC license. Offsite shipments both locally via ground transportation and nationally via FedEx can be performed following this procedure. Both DOT and IATA requirements are covered.
2. **Scope:** Radiation Workers (RW) who ship radioactive packages off the MU NRC Radioactive Materials License (RML) shall follow this procedure to ensure all DOT, NRC, and IATA requirements are being fulfilled.
3. **Definitions:**
 - 3.1 Consignor – the entity shipping the package. In most cases, this will be MU EHS.
 - 3.2 Consignee – the entity receiving the package.
 - 3.3 Department of Transportation (DOT) – DOT regulates the transportation of hazardous materials. The NRC has adopted DOT regulations for Class 7 radioactive materials. Specifically, Title 49 of the Code of Federal Regulations applies to DOT regulations for transport of hazardous materials.
 - 3.4 Emergency response information – information that can be used in the mitigation of an incident involving hazardous materials [49 CFR 172.602].
 - 3.5 Hazmat Employee – Per 49 CFR 171.8, a hazmat employee is a person who, as a result of employment, directly affects hazardous materials transportation safety; loads, unloads, or handles hazardous materials; inspects, marks, maintains, reconditions, repairs, or tests a package that is represented as qualified for use in transporting hazardous material in commerce; prepares hazardous materials for transportation; is responsible for safety of transporting hazardous materials; and operates a vehicle used to transport hazardous materials.
 - 3.6 Labeled Package – Per 10 CFR 20.1906, a labeled package is one that is labeled with a Radioactive White I, Yellow II, or Yellow III label as specified by DOT regulations 49 CFR 172.403 and 172.436-440. Labeled packages are also considered Type A Packages.
 - 3.7 Marking – Includes proper shipping name and UN identification numbers, does not include labels such as White-I, Yellow-II, or Yellow-III.
 - 3.8 Normal Form – means Class 7 (radioactive) which has not been demonstrated to qualify as “special form Class 7 (radioactive) material.
 - 3.9 Radioactive Material – Per 49 CFR 173.403, radioactive material is any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in the table in §173.436 or values derived according to the instructions in §173.433.

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3.10 Transport Index (TI) – the dose rate in mrem/hr at 1 meter from the face of the package with the highest surface reading.

4. Procedure Details:

4.1 Training Requirements

4.1.1 All individuals who may prepare RAM packages for offsite shipment shall have initial radiation safety training from the MU EHS Radiation Safety Staff (RSS) and refresher training at the designated frequency (either annually for medical users or every three years for campus users).

4.1.2 All individuals who handle RAM must be approved as an RW under a Permitted Individual’s RAM permit.


4.1.3 Prior to shipping radioactive materials offsite, DOT-specific training must also be completed and include the following:

4.1.3.1 General awareness and familiarization training designed to provide familiarity with the requirements of 49 CFR Subchapter C (Hazardous materials regulations) and to enable the RW to recognize and identify hazardous materials consistent with the hazard communication standards of 49 CFR Subchapter C [49 CFR 172.704(a)(1)]. This requirement may be fulfilled by taking a DOT Class 7 specific training course and does not have to be provided by EHS as long as a record of completion is on file with EHS RSS.

4.1.3.2 Function-specific training concerning requirements that are specifically applicable to the functions the employee performs [49 CFR 172.704(a)(2)(i)]. This must be provided by an RW at MU depending on the specific DOT functions being performed. For example:

4.1.3.2.1 EHS employees will be transferring RAM packages from campus back to EHS facilities for offsite shipment, so function-specific training will include requirements to transport a RAM package in an EHS vehicle, how to transfer the RAM package back to EHS facilities, and steps to ship RAM packages offsite.

4.1.3.3 Safety training concerning emergency response information requirements; measures to protect the employee from hazards associated with hazardous materials including specific measures implemented to protect employees from exposure; and methods and procedures for avoiding accidents, such as the proper procedures for handling packages containing hazardous materials [49 CFR 172.704(a)(3)]. This requirement may be fulfilled by taking a DOT Class 7

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specific training course as well as receiving function-specific training for transporting RAM.

4.1.3.4 Security awareness training that provides an awareness of security risks associated with hazardous materials transportation and methods designed to enhance transportation security. This training must also include a component covering how to recognize and respond to possible security threats [49 CFR 172.704(a)(4)]. This requirement may be fulfilled by taking a DOT Class 7 specific training course as well as receiving function-specific training for transporting RAM.

4.1.3.5 In-depth security training as outlined in 49 CFR 172.704(a)(5) is not applicable as MU does not have quantities of RAM requiring a security plan.

4.1.3.6 DOT training must be received once every three years and can be received from a previous employer as long as a current record of the training is obtained [49 CFR 172.704(c)]. The refresher training must cover all DOT topics previously listed, including function-specific training. Acceptance of a DOT training certificate by the RSS assumes that function-specific training has also been received.

4.1.4 Records of DOT training as previously described must be kept for as long as the hazmat employee remains with MU and 90 days thereafter. The record must include the following information:

4.1.4.1 The hazmat employee’s name;

4.1.4.2 The most recent training completion date;


4.1.4.3 A description, copy, or the location of the training materials used to meet the requirements previously outlined;

4.1.4.4 The name and address of the person providing the training; and

4.1.4.5 Certification that the hazmat employee has been trained and tested.

4.2 Labeling, Exceptions, and UN Classifications of Class 7 Packages

4.2.1 To properly assess RAM packages for transport, basic knowledge in DOT labeling and classification for Class 7 packages is required. In general, packages at MU can have a UN ID of either UN2910 or UN2915. UN2910 is an excepted package of limited quantity of radioactive material while UN2915 is a Type A package. Limited quantity packages are excepted from labeling, meaning they do not require labeling, and are not required by regulation to be monitored upon receipt. Conversely, UN2915 Type A packages contain higher quantities of activity and are required to be


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monitored. As stated later in this procedure, MU requires all RAM packages, regardless of UN ID, to be monitored.

- 4.2.2** There are three categories of UN2915 Type A labels: White-I, Yellow-II, or Yellow-III. Labels are assigned based on dose rates at the surface of the package and at 1 meter (also known as the Transport Index) [49 CFR 172.403(c)].

Label Category	Max dose rate on any external surface (mrem/hr)	Max dose rate at 1 meter (mrem/hr)
White-I	≤ 0.5	0
Yellow-II	0.5 < dose rate ≤ 50	0 < TI ≤ 1
Yellow-III	50 < dose rate ≤ 200	1 < TI ≤ 10


- 4.2.3** UN 2910 limited quantity packages are more common at MU. These packages are technically excepted for markings (except the UN number), labeling, shipping papers, and monitoring [49 CFR 173.421, 10 CFR 20.1906]. However, MU requires shipping papers and monitoring of UN 2910 packages to eliminate confusion. Limited quantity packages must meet the dose requirements for a White-I package and have activity limits that are $\leq 10^{-3}A_2$ for normal form packages [49 CFR 173.425 Table 4]. A_2 values for each radionuclide can be found in 49 CFR 173.435. Contact the RSS with any questions regarding packages that are not discussed in this procedure.
- 4.2.4** When assessing packages for labeling requirements, be mindful of the difference between a UN2910 and a UN215 White-I. Both have the same dose rate requirements, but the activity limits for the UN2910 are lower. To determine if a package is a UN2910 limited quantity or a UN2915 Type A package based on activity only, use the spreadsheet found in Appendix A “Shipment Worksheet.”
- 4.2.5** Some packages may be exempt from DOT regulations. The Shipment Worksheet Spreadsheet can be used to determine if the activity to be shipped meets the limits of an exempt quantity. Per the definition of radioactive material and exemption value in 49 CFR 173, an exempt quantity must be exempt by either the consignment activity limit or activity concentration; the activity limit or concentration does not have to meet both to be considered exempt.
- 4.2.5.1** When using the Appendix A Shipment Worksheet, ensure that all radionuclides present in the package are listed. The worksheet will perform a sum of fractions to determine the package classification.

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- 4.2.6 Once the package has been classified, the RW can begin to prepare paperwork for the offsite shipment.
- 4.2.7 If the package needs to be transported back to EHS for offsite shipment, follow the working guide “Transfer packages from campus to EHS.”

4.3 Preparing a UN2910 Limited Quantity Package

- 4.3.1 Use the Appendix C form “Control Checklist for Limited Quantities” to prepare the package. This form is a checklist that lists all requirements for shipping a limited quantity package offsite.
- 4.3.2 Prior to shipping any radioactive material offsite, RWs must verify that the recipient’s radioactive materials license is on file. EHS must attempt to retrieve the most current copy of the consignee’s license. If an amendment to the license is received, save the copy on file with EHS. Review the license to ensure that the consignee can receive the radionuclide(s), quantities, and form to be shipped. If they cannot, then do not ship the package.
- 4.3.3 Verify that the shipping container to be used has strong outer packaging. Do not use packaging material that shows apparent signs of damage or degradation. Packages must meet general design requirements [49 CFR 173.410]. Before each shipment of Class 7 radioactive material, the offeror must ensure the packaging is proper and in unimpaired condition; closure devices are installed, secured, and free of defects; neutron absorbers, if required, are present; and instructions for preparing the package have been followed [49 CFR 173.475].
- 4.3.4 Verify that the sample being placed in the shipping container is the correct sample and matches the information entered in the Shipment Worksheet Spreadsheet.
- 4.3.5 For shipment of sealed sources, perform a leak test of each source and save the leak test results on file with EHS. If removable contamination >5 nCi is identified, report the contamination results immediately to the RSS and do not ship the source.
 - 4.3.5.1 If the RAM to be shipped is not a sealed source, then swipe the sample container to ensure no removable contamination is present. Contact the RSS if elevated levels of removable contamination are found in quantities greater than those listed in the Radiation Safety Manual.
- 4.3.6 Place a “Radioactive” marking on the inner packaging. If there is no inner packaging, place a “Radioactive” marking on the outer surface of the package [49 CFR 173.421(d)].

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- 4.3.7** Once the package is sealed securely, generate a shipping label and place it in a conspicuous location on the package. The shipping label should include the following information:
- 4.3.7.1** Consignor name and address – Use either the Radiation Safety Officer’s (RSO) name or the name of the EHS RW preparing the package who is responsible for correspondence during and after shipment. If an individual who is not an employee of EHS is approved to ship packages offsite, list the Permitted Individual responsible for the package.
 - 4.3.7.2** Consignee name and address [49 CFR 172.301(d)].
 - 4.3.7.3** Emergency phone number – For EHS packages, list the EHS daytime phone number. List the Chemtrec 24-hour number if the package will not be shipped locally.
- 4.3.8** Measure the dose rate on all sides of the container with a detector that reads in dose rate and record the highest reading found. Measure the dose rate at 1 meter from the same side with the highest surface reading. Record a background dose rate reading along with the surface and 1 meter readings [49 CFR 172.403].
- 4.3.8.1** An appropriate detector is an ion chamber with a tissue equivalency to convert from exposure rate to dose rate. If an ion chamber is not available, an energy-compensated Geiger-Mueller (GM) detector with an open window will satisfy the requirements. GMs can also have a tissue equivalent filter to convert from exposure rate to dose rate. Whenever a GM is used for measuring dose rate, the meter should be one that has been exposure calibrated, not pulse calibrated.
 - 4.3.8.2** When measuring background, make sure not to stand near other sources which could give a false background reading.
 - 4.3.8.3** If a dose rate > 0.5 mR/hr is found on any surface, then the package cannot be classified as a limited quantity.
 - 4.3.8.4** If the dose rate at 1 meter is greater than the background, then the package cannot be classified as a limited quantity.
 - 4.3.8.5** Note that in all instances through the DOT regulations, doses and dose rates are listed in mrem and mrem/hr. This procedure assumes that 1 R equals 1 rem.
 - 4.3.8.6** Record the meter serial number and calibration date.
- 4.3.9** Label the package with the appropriate UN label and proper shipping name [49 CFR 172.301(a)]. Proper shipping names can be found in 49 CFR 172.101. Only one UN label is required on the package in a conspicuous place. The UN number must be at


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least 12 mm in height [49 CFR 172.301(a)(1)]. While most excepted packages handled by EHS are UN2910 limited quantities, other types of excepted packages may include:

- 4.3.9.1** UN2908 – Previously held RAM but does not currently
- 4.3.9.2** UN2909 – Items manufactured from natural or depleted uranium
- 4.3.9.3** UN2911 – Excepted package of instruments
- 4.3.10** Swipe the package on at least three sides using moderate pressure, representative of 300 cm² [49 CFR 173.443(a)(1)(i)]. Measurements must be taken in the most appropriate locations to yield a representative assessment of the removable contamination levels.
 - 4.3.10.1** Run the swipe in an appropriate radiation detector to determine removable contamination. Verify that radiation detection equipment has been calibrated within the past year and is operating properly. Record the serial number and calibration date of the equipment.
 - 4.3.10.2** Confirm that the results are in accordance with the following [49 CFR 173.443 Table 9, 10 CFR 71.87(i)]


Contaminant	Maximum permissible limits	
	DPM/cm ²	Total DPM for 300 cm ²
Beta and gamma emitters and low toxicity alpha emitters	240	72,000
All other alpha emitting radionuclides	24	7200

- 4.3.10.3** If removable contamination greater than the limits listed in the previous step is found, contact the RSO for assistance.
- 4.3.11** Remove or deface any labels on the package that contradict the newly placed labels and markings.
- 4.3.12** If the package is not a Reportable Quantity (RQ) or a hazardous waste shipment, then shipping papers following the description for RAM in 49 CFR 172.203(d) or passenger aircraft certification for research or medical use materials in 49 CFR 172.204(c)(4) are not required.


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- 4.3.13** Prepare a memo certifying that the package is a limited quantity using Appendix D Certification of Limited Quantity of RAM Memo.
- 4.3.14** If shipping via FedEx, create an airway bill with FedEx.com or use a paper copy of an airway bill. FedEx is the only approved hazardous materials shipper for EHS. USPS will not accept hazardous materials, and EHS only uses UPS for shipping radiation meters such as GMs which may have check sources attached. If shipping locally via ground transportation, prepare a Bill of Lading using the template in Appendix K Bill of Lading. The proper shipping name must be listed on the airway bill if shipping internationally to meet IATA requirements.
- 4.3.15** For limited quantities of radioactive materials, attach the Appendix F Emergency Response Guide (ERG) 161.
 - 4.3.15.1** Emergency response requirements described in 49 CFR 172 do not apply to hazardous materials that are excepted from shipping paper requirements (i.e. Appendix H Declaration of Dangerous Goods Form) [49 CFR 172.600(d)] [49 CFR 172.604(d)(1)]. However, EHS will continue to include the ERG 161 to convey hazardous materials information.
- 4.3.16** EHS uses Chemtrec to track hazardous materials shipments in transportation. Chemtrec serves as a 24-hour emergency response number. Before shipping any radioactive package, fill out Appendix E Chemtrec Form for UN2910 packages and Appendix B Chemtrec Document Submission Form. Send a copy of each form to sds@chemtrec.com.
- 4.3.17** Attach a FedEx packaging pouch to the container. Place two copies of the signed Appendix D Certification of Limited Quantity of RAM Memo and Appendix F ERG 161 for UN2910 in the packaging pouch. If shipping a sealed source, include a copy of the leak test results as well.
- 4.3.18** Sign the checklist as the shipper and coordinate a pickup with the courier.
- 4.3.19** When the courier arrives, obtain a signature on the checklist.
- 4.3.20** Save all paperwork prepared as part of the shipment on file with EHS. This would include any appendix forms used, the signed checklist, leak test results, and the FedEx Airway Bill.
- 4.3.21** Once EHS receives notification that the package has been received by the destination, then the inventory can be removed from the records.


4.4 Preparing UN2915 Package

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- 4.4.1 Use Appendix G “Control Checklist for Type A Packages” to prepare the package. This form is a checklist that lists all requirements for shipping a limited quantity package offsite.
- 4.4.2 Prior to shipping any radioactive material offsite, RWs must verify that the recipient’s radioactive materials license is on file. EHS must attempt to retrieve the most current copy of the consignee’s license. If an amendment to the license is received, save the copy on file with EHS. Review the license to ensure that the consignee can receive the radionuclide(s), quantities, and form to be shipped. If they cannot, then do not ship the package.
- 4.4.3 Verify that the sample being placed in the shipping container is the correct sample and matches the information entered in the Shipment Worksheet Spreadsheet.
- 4.4.4 For shipment of sealed sources, perform a leak test of each source and save the leak test results on file with EHS. If removable contamination >5 nCi is identified, report the contamination results immediately to the RSS and do not ship the source.
 - 4.4.4.1 If the RAM to be shipped is not a sealed source, then swipe the sample container to ensure no removable contamination is present. Contact the RSO if elevated levels of removable contamination are found in quantities greater than those listed in the Radiation Safety Manual.
- 4.4.5 For Type A packages, the container must have a package certification. Verify that the package certification is on file with EHS. If not, contact the vendor for a copy and save it. Package certifications must be on file for two years after a shipment [49 CFR 178.350]. Before each shipment of Class 7 radioactive material, the offeror must ensure the packaging is proper and in unimpaired condition; closure devices are installed, secured, and free of defects; neutron absorbers, if required, are present; and instructions for preparing the package have been followed [49 CFR 173.475].
- 4.4.6 The package must be marked with the proper shipping name and UN identification number [49 CFR 172.301(a)]. This information can be found in 49 CFR 172.101. The UN number must be at least 12 mm in height [49 CFR 172.301(a)(1)].
- 4.4.7 The packaging manufacturer must be included on 7A, Type A packages [49 CFR 178.350(c)]. The letters “TYPE A” must be at least 12 mm high [49 CFR 172.310(b)].
- 4.4.8 The package must be marked with an “Up” orientation for liquids in non-bulk packages [49 CFR 172.312(c)(7)].
- 4.4.9 Ensure that the package has the exact wording present on one side of the container: “USA DOT 7A TYPE A” [49 CFR 172.310(c)].

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- 4.4.10** Ensure that the package has the exact working present on opposite sides of the package: “RADIOACTIVE MATERIAL, TYPE A PACKAGE, UN2915” [49 CFR 172.310(c)].
- 4.4.11** Apply security seal as applicable on the item. Security seal could be tape or wire seals. If shipping a source that has a vendor return kit, the return kit instructions and materials may include security tape. If return kit instructions do not specify to use security tape, this step can be skipped. The phrase “security seal” can also be written across the packaging tape to represent a security seal if needed [49 CFR 173.412(a)].
- 4.4.12** Once the package is sealed securely, generate a shipping label and place in a conspicuous location on the package. The shipping label should include the following information:
 - 4.4.12.1** Consignor name and address – Use either the RSO’s name or the name of the EHS RW preparing the package who is responsible for correspondence during and after shipment. If an individual who is not an employee of EHS is approved to ship packages offsite, list the Permitted Individual responsible for the package.
 - 4.4.12.2** Consignee name and address [49 CFR 172.301(d)]
 - 4.4.12.3** Emergency phone number – For EHS packages, list the EHS daytime phone number. List the Chemtrec 24-hour number if the package will not be shipped locally.
- 4.4.13** Measure the dose rate on all sides of the container with a detector that reads in dose rate and record the highest reading found. Measure the dose rate at 1 meter from the same side with the highest surface reading. Record a background dose rate reading along with the surface and 1 meter readings on the checklist [49 CFR 172.403].
 - 4.4.13.1** An appropriate detector is an ion chamber with a tissue equivalency to convert from exposure rate to dose rate. If an ion chamber is not available, an energy-compensated Geiger-Mueller (GM) detector with an open window will satisfy the requirements. GMs can also have a tissue equivalent filter to convert from exposure rate to dose rate. Whenever a GM is used for measuring dose rate, the meter should be one that has been exposure calibrated, not pulse calibrated.
 - 4.4.13.2** When measuring background, make sure not to stand near other sources which could give a false background reading.

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4.4.14 Based on the dose rates collected, determine the UN2915 category (White-I, Yellow-II, or Yellow-III). Fill out two category labels and place them on opposite sides of the package (not the bottom) near the marked proper shipping name [49 CFR 172.403(b)].

4.4.14.1 Fill in the maximum activity of the radionuclide(s) in Bq. The courier will reject any package that does not use SI units.

4.4.14.2 List all radionuclides present on the package [49 CFR 173.403].

4.4.14.3 If applicable, fill out the TI. Make sure to only use one decimal place for the TI. If more than one decimal place is written, the courier will reject the package. For example, if the dose rate at 1 meter is 0.16, the TI will be 0.2 [49 CFR 172.403(g)(3)]. The TI cannot be greater than 10 except for exclusive-use shipments [49 CFR 173.441(b)].

4.4.14.4 Dose rates at the package surface cannot exceed 200 mrem/hr. If this is exceeded, then the package must be shipped as an “Exclusive Use” [49 CFR 173.441] Packages exceeding the limits of 200 mrem/hr at the surface or a TI greater than 10 cannot be shipped by aircraft.


4.4.14.5 Record the meter serial number and calibration.

4.4.15 Swipe the package on at least three sides using moderate pressure, representative of 300 cm² [49 CFR 173.443(a)(1)(i)]. Measurements must be taken in the most appropriate locations to yield a representative assessment of the removable contamination levels.


4.4.15.1 Run the swipe in an appropriate radiation detector to determine removable contamination. Verify that radiation detection equipment has been calibrated within the past year and is operating properly.

4.4.15.2 Confirm that the results are in accordance with the following [49 CFR 173.443 Table 9, 10 CFR 71.87(i)]

Contaminant	Maximum permissible limits	
	DPM/cm ²	Total DPM for 300 cm ²
Beta and gamma emitters and low toxicity alpha emitters	240	72,000
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- 4.4.15.3** If removable contamination greater than the limits listed in the previous step is found, contact the RSO for assistance.
- 4.4.16** Remove or deface any labels on the package that contradict the newly placed labels and markings.
- 4.4.17** Indicate if the package has additional risk associated with the material.
 - 4.4.17.1** Reportable Quantity (RQ) – Limits for a RQ can be found in 49 CFR 172.101 Appendix A, Table 2. Requirements for Reportable Quantities can be found in 49 CFR 172.324(b). “RQ” must appear either before or after the basic description on the shipping papers [49 CFR 172.203(c)(2)].
 - 4.4.17.2** Cargo Aircraft Only (CAO) – Labels for CAO are used when the material is not used for research or medical services. CAO is also used when the TI is > 3. For passenger aircraft shipments with passengers on board, the TI must be < 3 [49 CFR 173.448(e)]. Any radioactive material on board must be for research or medical use [49 CFR 173.448(f)].
 - 4.4.17.3** If other hazards are present, contact the RSO and/or Hazardous Materials Manager.
- 4.4.18** Prepare Appendix H Declaration of Dangerous Goods Form. Appendix H is not needed for Excepted Packages, so some fields have been pre-filled out for a UN2915 package. Print and sign two copies, and place both in the FedEx pouch.
 - 4.4.18.1** Description of the “form” of the material must be included. For special form, indicate “special form.” For normal form, indicate the physical or chemical form such as solid, liquid, sealed, etc. [49 CFR 172.203(d)(2)]. Make sure that all sealed sources are indicated in the EHS system as such.
 - 4.4.18.2** Name of each radionuclide as listed in 49 CFR 173.435. See 49 CFR 173.433(f) for mixtures of radionuclides [49 CFR 172.203(d)(1)].
 - 4.4.18.3** The maximum activity in SI units (Bq, GBq, MBq) [49 CFR 172.203(d)(3)].
 - 4.4.18.4** Category of label applied to shipment (i.e. White-I) [49 CFR 172.203(d)(4)].
 - 4.4.18.5** TI if applicable [49 CFR 172.203(d)(5)].
 - 4.4.18.6** “Cargo Aircraft Only” on shipping paper if on package [49 CFR 172.203(f)].
 - 4.4.18.7** For IATA shipments, include the package dimensions for Yellow-II and Yellow-III. Also include the statement “All packaged in one (description of

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package type)” if applicable. Also include the statement “I declare that all the applicable air transport requirements have been met.”

- 4.4.18.8** Total number and type of packages
- 4.4.18.9** For passenger aircraft, print a certificate stating that “This shipment contains radioactive material intended for use in, or incident to, research, or medical diagnosis or treatment” [49 CFR 172.204(c)(4)].
- 4.4.18.10** Shipper’s certification: “This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.” [49 CFR 172.204(a)]. A similar statement is already listed in Appendix H.
- 4.4.18.11** Legible signature of hazmat employee [49 CFR 172.204(d)].
- 4.4.18.12** Shipper and receiver information.
- 4.4.18.13** Emergency response number.
- 4.4.19** For UN2915 Type A packages, attach Appendix J Emergency Response Guide (ERG) 163. The following describes emergency response requirements for UN 2915 packages. Emergency response requirements can be found in 49 CFR 172.600 and 602. MU assumes that the information in ERG 163 is sufficient to cover all emergency response requirements except for the emergency response telephone number which can be found on the Appendix H Declaration of Dangerous Goods Form as well as the shipping label on the package.
 - 4.4.19.1** Information must be immediately available.
 - 4.4.19.2** Information must include the basic description and technical name of the hazardous material, immediate hazards to health, risks of fire or explosion, immediate precautions to be taken in the event of an accident or incident, initial methods for handling spills or leaks in the absence of fire, and preliminary first aid measures [49 CFR 172.602(a)].
 - 4.4.19.3** Information must be printed legibly in English, available for use away from the package containing hazardous material, and presented either on a shipping paper, in another document (such as a Safety Data Sheet), or an emergency response guidance document (ERG) [49 CFR 172.602(b)].
 - 4.4.19.4** MU typically uses the ERG for emergency response information which is readily available on the internet. When using the ERGs, make sure to use the

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most recent version. They are typically updated every four years (2016, 2020, etc.).

- 4.4.19.5** MU must provide a numeric emergency response telephone number, including the area code, for use in an emergency involving hazardous material. This can be found on the paperwork generated by EHS. The number must be monitored at all times when the hazardous material is in transportation. The number must also be of a person who is either knowledgeable of the hazardous material being shipped and has comprehensive emergency response and incident mitigation information for that material, or has immediate access to a person who possesses such knowledge. Since EHS only receives and delivers packages during business hours, the main EHS number (573) 882-7018 is listed on the shipping paperwork as well as the emergency Chemtrec number which is monitored 24 hours [49 CFR 172.604(a)].
- 4.4.19.6** The emergency response number must be easily identified on the shipping paperwork [49 CFR 172.604(a)(3)].
- 4.4.20** Attach a FedEx packaging pouch to the container. Place two signed copies of Appendix H Declaration of Dangerous Goods Form and two copies of ERG 163 for UN2915 in the packaging pouch. If shipping a sealed source, include a copy of the leak test results as well.
- 4.4.21** EHS uses Chemtrec to track hazardous materials shipments in transportation. Chemtrec serves as a 24-hour emergency response number. Before shipping any radioactive package, fill out Appendix I Chemtrec Form for UN2915 packages and Appendix B Chemtrec Document Submission Form. Send a copy of each form to sds@chemtrec.com.
- 4.4.22** If shipping via FedEx, create an airway bill with FedEx.com or use a paper copy of an airway bill. FedEx is the only approved hazardous materials shipper for EHS. USPS will not accept hazardous materials, and EHS only uses UPS for shipping radiation meters such as GMs which may have check sources attached. If shipping locally via ground transportation, prepare Appendix K Bill of Lading. The Bill of Lading has similar information to a Declaration of Dangerous Goods form.
- 4.4.23** Sign the checklist as the shipper and coordinate a pickup with the courier.
- 4.4.24** When the courier arrives, obtain a signature on the checklist.
- 4.4.25** Save all paperwork prepared as part of the shipment on file with EHS. This would include any appendix forms used, the signed checklist, leak test results, and the FedEx Airway Bill.

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4.4.26 Once EHS receives notification that the package has been received by the destination, then the inventory can be removed from the records.

4.5 Notifying the DOT in the Event of an Incident

4.5.1 If an incident occurs as previously defined, EHS must notify the DOT within 12 hours of the occurrence by calling the National Response Center on (800) 424-8802 or (202) 267-2675. The report must include the following information [49 CFR 171.15(a)]:

4.5.1.1 Name of reporter;

4.5.1.2 Name and address of person represented by reporter;

4.5.1.3 Phone number where reporter can be contacted;

4.5.1.4 Date, time, and location of incident;

4.5.1.5 Extent of injury, if any;

4.5.1.6 Class 7 radioactive materials, proper shipping name, and quantity of hazardous materials involved; and

4.5.1.7 Type of incident and nature of hazardous material involved and whether a continuing danger to life exists at the scene.

4.5.2 In the event an incident occurs, MU must make a written report within 30 days of the incident as outlined in 49 CFR 171.16.

5. References:

5.1 10 CFR 20.1906

5.2 10 CFR 71

5.3 49 CFR 171

5.4 49 CFR 172


5.5 49 CFR 173

5.6 Radiation Safety Manual

5.7 MU NRC RML and tie downs


6. Revisions

6.1 Rev 00 – 2023-10-19 – New SOP.

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7. Appendices

- 7.1 A – Shipment Worksheet**
- 7.2 B – Chemtrec Document Submission Form**
- 7.3 C – Control Checklist for Limited Quantities**
- 7.4 D – Certification for Limited Quantity of RAM Memo**
- 7.5 E – Chemtrec Form – UN2910**
- 7.6 F – ERG 161 for UN2910**
- 7.7 G – Control Checklist for Type A Packages**
- 7.8 H – Declaration of Dangerous Goods Form**
- 7.9 I – Chemtrec Form – UN2915**
- 7.10 J – ERG 163 for UN2915**
- 7.11 K – Bill of Lading**

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Appendix A – Shipment Worksheet

See excel attachment.

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Appendix B – Chemtrec Document Submission Form



CHEMTREC
2900 Fairview Park Dr.
Falls Church, VA 22042-4513
USA
Attn: SDS Department

Document Submission Form

Companies registered with CHEMTREC are required to provide CHEMTREC with product information for all hazardous materials and dangerous goods they ship, prior to any shipments taking place.

) *#=-Uuk-#*
Follow the indexing instructions on the "SDS Submission Information" page on the CHEMTREC website.

Company Information

CHEMTREC Customer Number (CCN):

Company Name:

Submission Information

Total number of documents in this submission:

Date of submission:

Select one:

First Submission (new customers only)

Update my current set of documents

Full Set*

One-off shipment date**:

**If you select full set, ALL previous documents sent to CHEMTREC will be deleted*


***Documents for one-off shipments will be deleted two weeks after the shipment date.*

Contact Information

Name:

Email:

Phone Number:

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Appendix C – Control Checklist for Limited Quantities

CONTROL CHECKLIST FOR PACKAGING AND SHIPPING OF RADIOACTIVE MATERIAL FOR A LIMITED QUANTITY SHIPMENT

Shipment Description (Inventory Number, Radionuclide, Date): _____

PRE-SHIPMENT PREPARATION (Initial when each step is complete)

- _____

1. Verify shipped activities for all radionuclides are entered in Appendix A Shipment Worksheet, decay corrected, and in correct units.
 2. Verify ship date is correct in worksheet.
 3. Verify consignee's RAM license for the following and does not exceed license limits:
 Radionuclide Form Quantity of material Shipping address Amend#: _____
 4. Verify that strong outer packaging sufficient for limited quantity shipments is used.

PACKAGING AND MARKING (Initial when each step is complete)

- _____

5. Verify sample matches worksheet paperwork.
 6. Perform leak test if applicable. Include copy in FedEx pouch for recipient.
 7. The marking "Radioactive" is present on inner package or, if there is no inner package, "Radioactive" is marked on the outer surface of the package.
 8. Ensure the Limited Quantity package is sealed securely.
 9. Place consignor/consignee label on package with EHS and recipient addresses. Include emergency phone numbers for EHS and Chemtrec.
 10. Record highest dose rate in mR/hr.
Dose Rate, contact: _____ Dose Rate, 1 meter: _____
Instrument S/N: _____ Calibration Date: _____
NOTE: If surface reading is >0.5mR or 1 meter reading is >background, this is not a limited quantity package. Contact the RSO as needed.
 11. Ensure the proper shipping name and UN number label are on at least one side of the Limited Quantity package. Check applicable UN number:
 UN 2908 and "EMPTY" label UN 2909
 UN 2910 UN 2911
 12. Verify external contamination $\leq 72,000$ dpm/300 cm² β -, γ and < 7200 dpm/300 cm² α .
Instrument S/N: _____ Calibration Date: _____
 13. Cover old labels or markings that are no longer applicable.

NOTE: Provided the limited quantity package is not a Reportable Quantity, it is exempt from the requirement of dangerous goods shipping paperwork.

DOCUMENTATION

- _____

14. Prepare the Certification for Limited Quantity of RAM Memo.
 15. Create airway bill with Fedex.com or Bill of Lading if applicable.
 16. Place two copies of ERG 161 in the FedEx pouch.
 17. Fill out both Chemtrec submission forms and email copies to sds@chemtrec.com.
 18. Include 2 copies of the memo, ERG, and Bill of Lading if applicable in the FedEx pouch on package

Shipment approved for release by:


Date: _____

MU EHS Shipper Signature

I accept this shipment,

Date: _____

Courier Signature

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Appendix D – Certification for Limited Quantity of RAM Memo

CERTIFICATION FOR LIMITED QUANTITIES OF RADIOACTIVE MATERIAL

This package conforms to the conditions and limitations specified in:

IATA Section 10 (Radioactive Materials) and 49 CFR 173.421 for radioactive material, excepted package--limited quantity of material, UN2910.

Shipping Information: *Internal Inventory #:*
 Return Kit Number:
 Federal Express Airway Bill #:

Consignee:


Consignor:

Emergency Response Number:
CHEMTREC #200404 – (800) 424-9300
EHS – (573) 882-7018

Certified Shipper Signature:

Date:

Please email delivery confirmation to:

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Appendix E – Chemtrec Form – UN2910

CHEMTREC Information Regarding Shipments of Low-Level Radioactive Materials


Shipper: University of Missouri, Environmental Health & Safety

Product Shipped: Radioactive Material, Excepted Package, UN2910

No. of Packages	Basic Description	Label	Transport Index	Form	Radionuclide	Activity
	Radioactive Material, Excepted package, UN 2910	UN2910	N/A			

Applicable ERG Guide Number: 161 (attached)

Other identifying or pertinent information: none

Offsite Shipments of RAM		 Environmental Health & Safety University of Missouri	
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Appendix F – ERG 161 for UN2910

POTENTIAL HAZARDS

HEALTH

- Radiation presents minimal risk to transport workers, emergency response personnel and the public during transportation accidents. Packaging durability increases as potential hazard of radioactive content increases.
- Very low levels of contained radioactive materials and low radiation levels outside packages result in low risks to people. Damaged packages may release measurable amounts of radioactive material, but the resulting risks are expected to be low.
- Some radioactive materials cannot be detected by commonly available instruments.
- Packages do not have RADIOACTIVE I, II, or III labels. Some may have EMPTY labels or may have the word "Radioactive" in the package marking.

FIRE OR EXPLOSION

- Some of these materials may burn, but most do not ignite readily.
- Many have cardboard outer packaging; content (physically large or small) can be of many different physical forms.
- Radioactivity does not change flammability or other properties of materials.

PUBLIC SAFETY

- **CALL 911. Then call emergency response telephone number on shipping paper.** If shipping paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.
- **Priorities for rescue, life-saving, first aid, fire control and other hazards are higher than the priority for measuring radiation levels.**
- Radiation Authority must be notified of accident conditions. Radiation Authority is usually responsible for decisions about radiological consequences and closure of emergencies.
- Stay upwind, uphill and/or upstream.
- Keep unauthorized personnel away.
- Detain or isolate uninjured persons or equipment suspected to be contaminated; delay decontamination and cleanup until instructions are received from Radiation Authority.

PROTECTIVE CLOTHING

- Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide adequate protection.

EVACUATION

Immediate precautionary measure

- Isolate spill or leak area for at least 25 meters (75 feet) in all directions.

Large Spill

- Consider initial downwind evacuation for at least 100 meters (330 feet).

Fire

- When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 meters (1000 feet) in all directions.

EMERGENCY RESPONSE

FIRE

- Presence of radioactive material will not influence the fire control processes and should not influence selection of techniques.
- If it can be done safely, move undamaged containers away from the area around the fire.
- Do not move damaged packages; move undamaged packages out of fire zone.

Small Fire

- Dry chemical, CO₂, water spray or regular foam.

Large Fire


- Water spray, fog (flooding amounts).

SPILL OR LEAK

- Do not touch damaged packages or spilled material.
- Cover liquid spill with sand, earth or other non-combustible absorbent material.
- Cover powder spill with plastic sheet or tarp to minimize spreading.

FIRST AID

- Call 911 or emergency medical service.
- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.
- Medical problems take priority over radiological concerns.
- Use first aid treatment according to the nature of the injury.
- Do not delay care and transport of a seriously injured person.
- Give artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Injured persons contaminated by contact with released material are not a serious hazard to health care personnel, equipment or facilities.

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Appendix G – Control Checklist for Type A Packages

CONTROL CHECKLIST FOR PACKAGING AND SHIPPING OF TYPE A RADIOACTIVE MATERIAL

Shipment Description (Inventory Number, Radionuclide, Date): _____

PRE-SHIPMENT PREPARATION (Initial when each step is complete)

- _____ 1. Verify shipped activities for all radionuclides are entered in Appendix A Shipment Worksheet, decay corrected, and in correct units.
- _____ 2. Verify ship date is correct in worksheet.
- _____ 3. Verify consignee's RAM license for the following and does not exceed license limits:
 - Radionuclide Form Quantity of material Shipping address Amend#: _____

PACKAGING MARKING AND LABELING (Initial when each step is complete)

- _____ 4. Verify sample matches the worksheet.
- _____ 5. Perform leak test if applicable. Include a copy in FedEx pouch for recipient.
- _____ 6. Ensure package certification is on file and 'USA DOT 7A TYPE A' is present on the package.
- _____ 7. Ensure 'RADIOACTIVE MATERIAL, TYPE A PACKAGE, UN2915' is on opposite sides of package.
- _____ 8. Seal the package according to the manufacturer's specifications, using a security seal.
- _____ 9. Place consignor/consignee label on package with EHS and recipient addresses. Include emergency phone numbers for EHS and Chemtrec.
- _____ 10. Record the highest dose rate and transport index in mR/hr and apply Primary Hazard labels on opposite sides of the package.

Category (Circle)	Surface limit (mR/hr)	Max surface dose rate (mR/hr)	TI	TI Limit
W-I	≤ 0.5		N/A	0
Y-II	≤ 50			≤ 1
Y-III	> 50			≤ 10

Instrument S/N: _____


Calibration Date: _____

DOCUMENTATION (Initial when each step is complete)

- _____ 11. Verify external contamination ≤ 72,000 dpm/300 cm² β-, γ and < 7200 dpm/300 cm² α.
 Instrument S/N: _____ Calibration Date: _____
- _____ 12. Cover old labels or markings that are no longer applicable.
- _____ 13. Verify all subsidiary risk and handling label(s) are placed adjacent to the primary hazard labels. 'RQ' included before or after the proper shipping name, if applicable.
 - RQ CAO Sub Risk N/A
- _____ 14. Complete the Declaration of Dangerous Goods Form and place two signed copies in the FedEx pouch.
- _____ 15. Place two copies of ERG 163 in the FedEx pouch.
- _____ 16. Fill out both Chemtrec submission forms and email copies to sds@chemtrec.com.
- _____ 17. Create FedEx Airway Bill at FedEx.com or using a hard copy.


Shipment approved for release by:	
_____	Date: _____
MU EHS Shipper Signature	

I accept this shipment,	
_____	Date: _____
Courier Signature	

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Appendix H – Declaration of Dangers Goods Form

See attached PDF for form.

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Appendix I – Chemtrec Form – UN2915

CHEMTREC Information Regarding Shipments of Low Level Radioactive Materials


Shipper: University of Missouri, Environmental Health & Safety

Product Shipped: Radioactive Material, Type A Package, 7, UN2915

No. of Packages	Basic Description	Label	Transport Index	Form	Radionuclide	Activity (MBq and mCi)
	Radioactive Material, Type A package, UN2915					

Applicable 2020 ERG Guide Number: 163 (attached)

Other identifying or pertinent information:

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Appendix J – ERG 163 for UN2915

GUIDE RADIOACTIVE MATERIALS 163 (LOW TO HIGH LEVEL RADIATION)

POTENTIAL HAZARDS

HEALTH

- Radiation presents minimal risk to transport workers, emergency response personnel and the public during transportation accidents. Packaging durability increases as potential hazard of radioactive content increases.
- Undamaged packages are safe. Contents of damaged packages may cause higher external radiation exposure, or both external and internal radiation exposure if contents are released.
- Type A packages (cartons, boxes, drums, articles, etc.) identified as "Type A" by marking on packages or by shipping papers contain non-life-endangering amounts. Partial releases might be expected if "Type A" packages are damaged in moderately severe accidents.
- Type B packages, and the rarely occurring Type C packages (large and small, usually metal), contain the most hazardous amounts. They can be identified by package markings or by shipping papers. Life-threatening conditions may exist only if contents are released or package shielding fails. Because of design, evaluation and testing of packages, these conditions would be expected only for accidents of utmost severity.
- The rarely occurring "Special Arrangement" shipments may be of Type A, Type B or Type C packages. Package type will be marked on packages, and shipment details will be on shipping papers.
- Radioactive White-I labels indicate radiation levels outside single, isolated, undamaged packages are very low (less than 0.005 mSv/h (0.5 mrem/h)).
- Radioactive Yellow-II and Yellow-III labeled packages have higher radiation levels. The transport index (TI) on the label identifies the maximum radiation level in mrem/h one meter from a single, isolated, undamaged package.
- Some radioactive materials cannot be detected by commonly available instruments.
- Water from cargo fire control may cause pollution.

FIRE OR EXPLOSION

- Some of these materials may burn, but most do not ignite readily.
- Radioactivity does not change flammability or other properties of materials.
- Type B packages are designed and evaluated to withstand total engulfment in flames at temperatures of 800°C (1475°F) for a period of 30 minutes.

PUBLIC SAFETY

- **CALL 911. Then call emergency response telephone number on shipping paper.** If shipping paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.
- **Priorities for rescue, life-saving, first aid, fire control and other hazards are higher than the priority for measuring radiation levels.**
- Radiation Authority must be notified of accident conditions. Radiation Authority is usually responsible for decisions about radiological consequences and closure of emergencies.
- Stay upwind, uphill and/or upstream. • Keep unauthorized personnel away.
- Detain or isolate uninjured persons or equipment suspected to be contaminated; delay decontamination and cleanup until instructions are received from Radiation Authority.

PROTECTIVE CLOTHING

- Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide adequate protection against internal radiation exposure, but not external radiation exposure

EVACUATION

Immediate precautionary measure

- Isolate spill or leak area for at least 25 meters (75 feet) in all directions.

Large Spill

- Consider initial downwind evacuation for at least 100 meters (330 feet).

Fire

- When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 meters (1000 feet) in all directions.

EMERGENCY RESPONSE

FIRE

- Presence of radioactive material will not influence the fire control processes and should not influence selection of techniques.
- If it can be done safely, move undamaged containers away from the area around the fire.
- Do not move damaged packages; move undamaged packages out of fire zone.

Small Fire

- Dry chemical, CO₂, water spray or regular foam.

Large Fire


- Water spray, fog (flooding amounts).
- Dike runoff from fire control for later disposal.

SPILL OR LEAK

- Do not touch damaged packages or spilled material.
- Damp surfaces on undamaged or slightly damaged packages are seldom an indication of packaging failure. Most packaging for liquid content have inner containers and/or inner absorbent materials.
- Cover liquid spill with sand, earth or other non-combustible absorbent material.

FIRST AID

- Call 911 or emergency medical service.
- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.
- Medical problems take priority over radiological concerns.
- Use first aid treatment according to the nature of the injury.
- Do not delay care and transport of a seriously injured person.
- Give artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Injured persons contaminated by contact with released material are not a serious hazard to health care personnel, equipment or facilities.

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Appendix K – Bill of Lading

University of Missouri Radioisotope Receipt & Transfer

Straight Bill of Lading

24 hour Emergency Contact
Telephone Number

MU EHS: (573) 882-7018

To:	From:

Number of Units & Container Type	HM	Basic Description	Total quantity (volume, gallons, etc.)	Weight
	X	UN , Radioactive Material, Contains MBq (mCi) of		
		ERG		

Placards Tendered (Circle One): YES NO

Shipper Certification:

This is to certify that the above named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

Shipper : University of Missouri per

Signature:

Date:

Carrier Signature: _____ **Date:** _____