

**UNCLASSIFIED**  
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**DC & Reviewing Official: Mark Hogue, Principal Health Physicist, 10/12/2006**  
**(signature on file)**

**PROPOSED PROCEDURE**  
**SURVEYING EXCLUSIVE USE RADIOACTIVE MATERIAL SHIPMENTS**

**1.0 PURPOSE**

To provide instructions for the monitoring of radioactive material packages for off-site shipment in accordance with Department of Transportation (DOT) regulations.

To provide instructions for the monitoring of exclusive use radioactive material transport vehicles for off-site shipments in accordance with DOT regulations.

**2.0 SCOPE**

This procedure provides the proper method for monitoring radiation and contamination levels of radioactive material packages and their off-site exclusive use transport vehicles in accordance with DOT regulations, 49 CFR 173.441 and 173.443.

This procedure does not address the off-site shipment of DOT Class 7 radioactive material that does not meet the thresholds for shipping in exclusive use vehicles. If the package of Class 7 radioactive material offered for transport does not exceed 200 mrem/hr at any point on the external surface of the package and the transport index does not exceed 10, then an exclusive use vehicle is not required by DOT. There are no DOT requirements for monitoring the exterior surfaces and occupied spaces of these vehicles.

This procedure does not address the off-site shipment of radiological material (per DOE definition) that is less than the DOT definition of Class 7 radioactive material.

This procedure does not address the monitoring of radioactive material packages and their transport vehicles for on-site movement of material. Those movements are controlled by site-specific procedures.

**3.0 GENERAL INFORMATION**

Do not place any portion of your body under a suspended load while monitoring.

Work safely when using ladders, stepladders, scaffolding, etc. to survey elevated surfaces

#### 4.0 RESPONSIBILITIES

#### 5.0 PROCEDURE

#### 5.1 Monitoring Packages of Radioactive Material

##### 5.1.1. Contamination Survey

Wipe an area of 300 cm<sup>2</sup> of the packaging surface with an absorbent material, using moderate pressure, and measuring the activity on the wiping material. The wipe should be initially monitored in the field with a portable contamination survey instrument to determine if decontamination of the package surface is required. If contamination is found, notify the shipper that decontamination is required. If decontamination of the package is not required, the wipe should be counted in a wipe counter to determine the level of contamination, in dpm/cm<sup>2</sup>, for comparison to the DOT contamination limits.

Sufficient measurements must be taken in the most appropriate locations to yield a representative assessment of the non-fixed contamination levels.

The amount of radioactivity measured on any single wiping material, divided by the surface area wiped and divided by the efficiency of the wipe procedure (the fraction of removable contamination transferred from the surface to the absorbent material), may not exceed the limits set forth in Table 1 at any time during transport. For this purpose, the actual wipe efficiency may be used, or the wipe efficiency may be assumed to be 0.10; or alternately, the level of non-fixed radioactive contamination may be determined by using other methods of equal or greater efficiency.

**Table 1 - Non-Fixed External Radioactive Contamination Limits for Packages (10 percent wipe efficiency)**

Contaminant	Maximum permissible limits		
	Bq/cm <sup>2</sup>	dpm/cm <sup>2</sup>	dpm/100cm <sup>2</sup>
1. Beta and gamma emitters and low toxicity alpha emitters <sup>a</sup>	4	220	22,000
2. All other alpha emitting radionuclides	0.4	22	2,200

<sup>a</sup> *Low toxicity alpha emitters* means natural uranium; depleted uranium; natural thorium; uranium-235 or uranium-238; thorium-232; thorium-228 and thorium-230 when

contained in ores or physical and chemical concentrates; and alpha emitters with a half-life of less than 10 days.

Per 49 CFR 173.443(b), in the case of packages transported by rail or public highway only, the removable (non-fixed) radioactive contamination on any package at any time during transport may not exceed ten times the limits in (Table 1). The levels at the beginning of transport may not exceed the limits in (Table 1).

### **5.1.2. Surface Radiation Survey**

Survey all accessible surfaces of the package, i.e., top, bottom and sides, for the maximum radiation dose rate.

Perform radiation surveys using a Bicron Micro Rem LE instrument or equivalent. If the instrument has the option of open or closed window readings, take only an open window reading. If appropriate, also establish the maximum neutron exposure rate. Record the background-corrected reading from the instrument(s). Add the neutron exposure rate to the beta-gamma exposure rate, if appropriate. Report the actual measured values; do not use “None Detected” or “Less Than” in documenting results.

**NOTE:** Some sites employ a conversion factor to convert the surface exposure rate to an “extremity rate” for hands-on worker tasks. This conversion should not be applied to the determination of the package surface exposure rate. Additionally, the beta correction factor applied by some sites to open window readings should not be applied.

### **5.1.3. 1 Meter Radiation Survey**

The 1-meter reading will be used to determine the Transport Index (TI) for the package. The TI is the dimensionless expression of the mrem/hr reading taken at 1 meter, e.g., 4.5 mrem/hr at 1 meter equates to a TI of 4.5.

Survey all accessible surfaces of the package, i.e., top, bottom and sides, for the maximum radiation dose rate at 1 meter. **NOTE:** Some sites use a measuring device to ensure the readings are taken consistently at a distance of 1 meter from the package surface.

Perform radiation surveys using a Bicron Micro Rem LE instrument or equivalent. If the instrument has the option of open or closed window readings, take only an open window reading. If appropriate, establish the maximum neutron exposure rate. Record the background-corrected reading from the instrument. Add the neutron exposure rate to the beta-gamma exposure rate, if appropriate. Report actual values; do not use “None Detected” or “Less Than” in documenting results.

## 5.2 Monitoring Flatbed Exclusive Use Vehicle

If the maximum surface radiation rate of the package does not exceed 200 mrem/hr, but the TI is greater than 10, an exclusive use (flatbed style) vehicle is allowed to be used for transport. The surface radiation rate of the transport vehicle may not be greater than 200 mrem/hr, and the 2 meter radiation rates may not be greater than 10 mrem/hr.

### 5.2.1 Surface Radiation Levels

Using a Bicron Micro Rem LE or equivalent instrument in an open window configuration survey the outer surfaces of the vehicle. Conduct a neutron survey, if applicable. The survey must include the upper surface of the load or enclosure if used, lower external surface of the vehicle, and all points on the vertical planes projected from the outer edges of the vehicle.

A ladder, stepladder, portable platform, etc. may be required to fully conduct the survey. A second individual may be required to help position the instrument accurately when conducting the survey of the vertical planes projected from the outer edges of the vehicle.

The purpose of the survey is to ensure that the maximum radiation reading at any surface of the vehicle does not exceed 200 mrem/hr.

### 5.2.1 2 Meter Radiation Levels

The DOT limit is 10 mrem/hr at any point 2 meter (6.6 feet) from the outer lateral surfaces of the vehicle. This survey excludes the top and underside of the vehicle.

Using a Bicron Micro Rem LE or equivalent instrument in an open window configuration survey at all points 2 meters (6.6 feet) from the vertical planes projected by the outer surfaces of the vehicle (excluding the top and underside of the vehicle). Conduct a neutron survey, if applicable.

A ladder, stepladder, portable platform, etc. may be required to fully conduct the survey. A measuring device and a second individual may be required to help position the instrument accurately when conducting the survey.

### 5.2.2 Occupied Space

Using a Bicron Micro Rem LE or equivalent instrument (and neutron instrument, if applicable) survey the normally occupied spaces of the vehicle. The exposure rate cannot exceed 2 mrem/hr, except that this provision does not apply to carriers if they operate under the provisions of a State or federally regulated radiation protection program and if personnel under their control who are in such an

occupied space wear radiation dosimetry devices. If required, the radiation dosimetry devices should be provided by the carrier company.

### **5.3 Monitoring Closed Exclusive Use Vehicle**

If the maximum surface radiation rate of the package exceeds 200 mrem/hr, but is not greater than 1,000 mrem/hr, and/or the TI is greater than 10, an exclusive use closed vehicle is allowed to be used for transport. The package shall be secured within the vehicle so that its position remains fixed during transportation, and there are no loading or unloading operations between the beginning and end of the transportation. The surface radiation rate of the transport vehicle may not be greater than 200 mrem/hr, and the 2 meter radiation rates may not be greater than 10 mrem/hr.

#### **5.3.1 Transport Surface Radiation Levels**

Using a Bicron Micro Rem LE or equivalent instrument in an open window configuration survey the outer surfaces of the vehicle. Conduct a neutron survey, if applicable. The survey must include any point on the outer surfaces of the vehicle, including the top and underside of the vehicle. The surface dose rate may not be greater than 200 mrem/hr.

A ladder, stepladder, portable platform, etc. may be required to fully conduct the survey.

#### **5.3.2 2 Meter Radiation Levels**

Using a Bicron Micro Rem LE or equivalent instrument in an open window configuration survey at all points 2 meters (6.6 feet) from the outer surfaces of the vehicle (excluding the top and underside of the vehicle). Conduct a neutron survey, if applicable. The dose rate at 2 meter may not be greater than 10 mrem/hr.

A ladder, stepladder, portable platform, etc. may be required to fully conduct the survey. A measuring device and a second individual may be required to help position the instrument accurately when conducting the survey.

#### **5.3.3 Occupied Space**

Using a Bicron Micro Rem LE or equivalent instrument (neutron instrument, if applicable) survey the normally occupied spaces of the vehicle. The exposure rate cannot exceed 2 mrem/hr, except that this provision does not apply to carriers if they operate under the provisions of a State or federally regulated radiation protection program and if personnel under their control who are in such an occupied space wear radiation dosimetry devices. If required, the radiation dosimetry devices should be provided by the carrier company.

#### **5.4 Release Monitoring of Exclusive Use Vehicle**

Each exclusive use transport vehicle must be surveyed with appropriate radiation detection instruments (e.g., Bicron LE in open window mode) after each use. A vehicle may not be returned to service until the radiation dose rate at each accessible surface is 0.5 mrem/hr or less. A vehicle may not be returned to service until any removable radioactive surface contamination is less than the values in the Table 1.

#### **5.5 Radiological Criteria for Closed Exclusive Use Vehicle (Sole Use)**

Some closed exclusive vehicles are used solely for the transportation of Class 7 (radioactive) material packages with contamination levels that exceed Table 1 limits. The package may not exceed 10 times those limits.

(1) A survey of the interior surfaces of the empty vehicle must show that the radiation dose rate at any point does not exceed 10 mrem/hr at the surface or 2 mrem/hr at 1 meter from the surface.

(2) Each vehicle is stenciled with the words "For Radioactive Materials Use Only" in letters at least 3 inches high in a conspicuous place on both sides of the exterior of the vehicle; and

(3) Each vehicle is kept closed except for loading or unloading.

#### **6.0 RECORDS**

Maintain all records in accordance with site procedures.

#### **7.0 REFERENCES**

49 CFR 173.403, Definitions, 1/26/2004  
49 CFR 173.441, Radiation level limitations, 1/26/2004  
49 CFR 173.443, Contamination control, 1/26/2004