Solid Waste Landfills and Radioactive Material Survey Report

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Radiation Task Force
Materials Management Subcommittee

Association of State and Territorial Solid Waste Management Officials (ASTSWMO)

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1. Introduction

The Association of State and Territorial Solid Waste Management Officials' (ASTSWMO) Radiation Task Force works within the ASTSWMO Materials Management Subcommittee to identify national level radiation issues; coordinate State and Territorial (State) input; encourage improved partnership between State and federal agencies; and produce issue papers and other products as necessary to promote State interests on national radiation issues.

In February 2025, it was determined that the current landscape of radioactive materials as it relates to solid waste landfills in the U.S. is an important and complex topic for States. Many radioactive materials are regulated by the U.S. Nuclear Regulatory Commission (NRC); some, but not all, of the States have an agreement with the NRC to take on some of the responsibilities of the NRC. Of the remaining radioactive materials, some are regulated in certain States, with different regulations in each, while some are not regulated.

All of the above mentioned radioactive materials may trigger alarms at landfills and the radiation control authority of each State is frequently tasked with determining whether the material is being properly dispositioned. Additionally, once identified, should the radioactive material identified at the landfill be rejected and returned, it must follow U.S. Department of Transportation (DOT) regulations while being transported. To facilitate conveyance according to DOT regulations, DOT Special Permit 11406 (DOT-SP 11406) was created (this is similar to the DOT-SP 10656 for scrap metal loads rejected for presence of radioactive materials), which exempts the carrier from many DOT regulations concerning radioactive material.

This is also relevant to States because they must approve the special permit.

With all the above in mind, in April 2025, the Task Force reached out to State radiation control programs with a questionnaire about requirements to inspect radioactive material surveys at landfills, requirements about radioactive materials not regulated by the NRC, and about experience with DOT SP-11406.

This report is a summary of key takeaways from the questionnaire, and recommendations from the Radiation Task Force for landfills.

2. State Requirements

Six of the 29 States that responded to the questionnaire have a State requirement for surveying loads incoming to a landfill for radiation/radioactive materials. Of those States with requirements, a portal or handheld monitor is used. Among States with no State requirements, a portal or handheld monitor was still commonly used.

For reporting, 12 of the 29 States that responded have reporting requirements additional to federal requirements. Reporting requirements vary by each State; some may be facility specific in a license while other States require through a Memorandum of Understanding (MOU).

The following States provided specific regulations about radioactive materials in landfills:

- New York - 6 NYCRR Part 363-7.1 (o)
- North Carolina - 10A NCAC 15 .1203; and 15A NCAC 13B .0103(b)
- Wisconsin - NR 506.12
- Illinois - 32 Ill. Adm. Code Part 622
- Arkansas - RH-407
- North Dakota - 33.1-10-23; and 33.1-20-11
- South Dakota - 34A-6-114; and 34-21-1.1
- Colorado - 6 CCR 1007-1 Part 20
- Oregon - OAR 345-050
- Idaho - IDAPA 58.01.10.020.04

3. Practices Beyond Legislative Requirements

Multiple States have requirements limiting disposal of radioactive materials that are not regulated by the NRC; it is unclear how these regulations can be consistently enforced without a requirement to monitor incoming waste for radiation. While occasionally markings or placards may provide clues about radioactive sources that are being improperly disposed of, most radioactive materials that would trigger a portal alarm are not explicitly marked as radioactive materials.

Some solutions to this difficulty in States that do not have a blanket, Statewide requirement to survey loads incoming to a landfill are as follows:

- Regulation of specific, large landfills via a license or other agreement.
- Voluntary election by facilities (to protect their own liability and to record compliance)
- Corporate requirements of landfill operators

4. DOT Permits

DOT-SPs 10656 and 11406 provide specific authorizations for the transportation of materials that inadvertently contain low levels of radioactive material. The fundamental difference between them lies in the type of material each permit covers. The more common, SP-10656, is exclusively

used for the shipment of scrap metal and related recyclable metals that have been found to have some level of radioactivity. SP-11406 is designated for the transportation of liquid or solid waste that has been unintentionally contaminated with radioactive substances. Both special permits assist in the safe removal and disposition of materials with low-level radioactive contamination without requiring the full scope of hazardous materials regulations that would otherwise apply. SP-10656 authorizes the one-way transportation of scrap metal and related metal recycle materials. It is most commonly used when radium gauges or metal alloys contain thorium or other NORM material.

SP-11406 authorizes the one-way transportation of liquid or solid waste that has unexpected or unidentified radioactive material or contamination.

The questionnaire that was sent out to States focused on solid waste landfills, so they were asked if they are familiar with SP-11406 and, if so, how frequently they used it. Many States also voluntarily reported on their use of SP-10656; key takeaways on this are also included in the summary below.

- 18 out of 29 State respondents reported familiarity with SP-11406. Of these, the frequency of issuance varied from never used, to infrequently, to multiple times per week.
- Multiple States reported that the cause for the alarm is often medical waste, which can be disposed of without further restriction under NRC rule 10 CFR 35.75.
- One State reported frequently receiving the SP-11406 from other States, as a transit State or the dispositions State, but rarely issues them.
- 5 of the 12 States that reported not being familiar with the form expressed familiarity with SP-10656.
- Several States reported frequent use of SP-10656.

5. Best Practices - Response

It is difficult to enforce regulations related to the prohibition of radioactive materials in landfills without active monitoring systems interdicting the incoming waste. Therefore, this section will focus on the best practices for facilities equipped with portal alarms.

When a vehicle carrying municipal solid waste triggers a radiation portal monitor, a swift, safe, and systematic response is paramount. The primary objectives are to protect facility personnel, the public, and the environment. Follow all applicable operating procedures, monitoring and notification plans, and disposal actions or permits to ensure compliance with State and federal regulations. This is a best practice guide and not meant to replace any facility specific procedures.

5.1 Immediate Response Protocol

Upon the activation of a radiation portal monitor alarm, the following actions are suggested to isolate the vehicle and prevent its contents from entering the general waste stream or tipping floor.

5.1.1 Control the Vehicle

Operators or other designated personnel must halt the vehicle before it proceeds to the tipping face or any other disposal area. The driver should be instructed to pull over to a designated, isolated survey area, and remain in the cab pending alarm confirmation.

5.1.2 Confirm the Alarm

If the landfill operator has a handheld gamma radiation meter, they can proceed to this step independently. If not, they will require assistance from a radiation consultant to perform that task, which can delay the timeframe of determination of the location, isotope(s), and form of the radioactive material.

A calibrated handheld (gamma) radiation survey meter can confirm that the portal monitor alarm is valid and radiation levels are above the local background reading. Some portal monitor systems can identify the location of a source within waste; additionally, most if not all systems have banks of detectors on each side of an incoming lane at a landfill, so it can often be indicated on one side, making isolation easier.

It is possible that the source will be “volumetric”, meaning that it is distributed throughout the load and is not a specific object.

5.1.3 Communicate Internally

Follow any facility notification plans and communication with the driver on the next steps. Attempt to obtain the following data for reporting:

- Facility name, permit number, and location
- Date and time of the alarm
- Name of the hauling company and, if known, the waste generator
- Vehicle description (truck number, license plate)
- Maximum radiation survey readings (at contact and 1 meter), including the background radiation level
- Isotope(s) identified by the Radionuclide Identification Device (RIID), if available
- A brief description of the actions taken to isolate the vehicle

5.2 Characterization and Identification of the Source

After the initial response, isolation of the vehicle, and alarm confirmation, the facility must investigate to characterize the radioactive source. This is critical for determining the level of risk and the appropriate disposition path for the waste.

5.2.1 Detailed Vehicle Survey

Dose rate measurements should be recorded at the surface and 1 meter (3.2 feet) from container. This is essential for assessing worker safety and determining if DOT shipping regulations apply. Note locations where radioactivity is elevated. Follow your State’s rules, but a common action

level indicating alternative disposal is needed is a dose rate exceeding 50 microroentgens per hour (µR/hr) above background when measured at 1 meter from the surface of the vehicle.

5.2.2 Isotope Identification

If the facility is equipped with a RIID, it must be used to identify the specific isotope(s) emitting the radiation. Alternatively, landfills can acquire samples from the waste and wait for sample results; this path will inevitably be more time consuming. Isotope identification is the single most important step in determining the origin, potential hazard of the material, and disposal path.

- **Common Medical Isotopes:** Finding Technetium-99m (99mTc), Lutetium-177 (Lu-177), Iodine-131 (131I), or Thallium-201 (201Tl) strongly suggests the source is medical waste, often from patient excreta disposed of in municipal trash. These isotopes have short half-lives (hours to days) and typically represent a low overall risk.

- **Naturally Occurring Radioactive Material (NORM)/Technologically Enhanced Naturally Occurring Radioactive Material (TENORM):** Identification of uranium (U), thorium (Th), or their decay products may indicate the presence of NORM or TENORM. Sources can include granite slabs, ceramic materials, certain types of industrial sludges, or drilling muds.

- **Industrial Sources:** The identification of isotopes such as Cesium-137 (137Cs), Iridium-192 (Ir-192), or Cobalt-60 (60Co) is a more serious concern, as it may indicate a lost or improperly disposed of industrial source from a device like a radiography camera, or density gauge. These sources pose a higher potential risk.

5.2.3 Notification of State Regulatory Bodies

Some States have prohibitions for certain radioactive materials, while some allow for specific ones. Therefore, it is dependent on what is acceptable within the regulatory framework within any specific State.

Notify applicable regulatory authorities and provide information from section 5.1.3. That information is crucial to determining the proper disposal options and procedures to use.

5.3 Waste Disposition and Management

5.3.1 Disposition Options

- **Dispose as accepted waste in your State or Territory:** Many States allow disposal of some radioactive materials not regulated by the NRC. If this is the case, they might still necessitate a notification or lab analysis of some sort to confirm the field readings before disposal.
- **Return to Generator:** This is the most common and preferred outcome. The generator is required to accept the return of their rejected waste. However, this process is subject to strict transportation regulations. If the original hauler is not licensed to transport radioactive material, a DOT SP may be required to authorize the one-time transport of the

material back to the generator or to another appropriate facility. The SP is the framework for shipping materials that cannot meet all standard regulatory requirements but can be transported safely under specified conditions.

- **Transfer to a Licensed Facility:** If the generator cannot be identified (an "orphan" source) or is unable to accept the return of the waste, the material must be transported to a facility licensed to receive and manage radioactive waste. This typically requires the landfill to contract with a specialized radioactive waste broker who will arrange for packaging, transportation, and disposal.
- **On-site Management (Rare and by Exception Only):** For waste containing only very short-lived medical isotopes (e.g., 99mTc), regulators may, on a case-by-case basis, authorize the material to be held in a secure, isolated area for decay-in-storage. After a sufficient decay period (typically 10 half-lives), the material will be resurveyed. If it is no longer above background, it may be approved for disposal in the landfill.

6. Best Practices - Equipment

Technology for radiation portal monitor systems currently consists of sophisticated systems that can even identify the location of a source within a container of waste. This makes it easier for qualified radiation consultants to access and segregate the radioactive material. Additionally, driving vehicles through portal monitors is the best way to ensure that radioactive waste does not enter the landfill.

Should a landfill have such a system in place, then the threshold for an alarm is paramount. The Conference of Radiation Control Program Directors (CRCPD) recommendation is to set the threshold for the alarm between two and five times the local background value. If the threshold is set on the lower end, sometimes false alarms are triggered from various media such as NORM to elevated radon progeny. Most facilities set the threshold toward the upper end, usually around four times background.

Handheld instrumentation is a valuable asset used in conjunction with radiation portal monitor systems. Once a radiation alarm has been triggered, the next step is verifying the location of radioactive materials within the load of waste or scrap. This is best performed with a handheld instrument sensitive to gamma radiation.

While there are many instruments which can detect gamma radiation in conjunction with others such as a pancake G-M detector, these instruments are not sensitive enough for gamma radiation levels which trigger radiation portals, hence not applicable.

The instrument of choice should be a gamma-radiation-only with a detection capability of Roentgens (R) or rem (rem) per hour (some instruments may report numbers in Sieverts, µSv). All of these units may have a prefix of “µ” (equal to 10-6 of the unit) or “m” (equal to 10-3 of the unit). Often, instruments[1] provide the option to show readings in different units.

[1] Mention of specific instruments does not constitute an ASTSWMO endorsement.

Such instruments for example would be a Ludlum Model 19 survey meter. However, this instrument has a limitation on the ability to detect gamma radiation in excess of 5 mR/hr. Should a load of waste trigger a radiation portal alarm, and the exposure rate on the surface of the conveyance be more than this value, obtaining an accurate exposure rate with this instrument is only possible at a distance, leading to the potential for significant exposure to the facility staff depending on the actual exposure rate.

A more useful instrument would be the Mirion RDS-32 which is capable of detecting gamma radiation from the microrem/hr range up to 10 rem/hr. This range is adequate for nearly all scenarios at transfer stations and landfills and is also useful for responding to radiation alarms at scrap metal facilities as well.

The other type of instrument is one which not only detects gamma radiation, but can discern gamma emitting isotopes via the energy by the gamma rays individual isotopes emit. This information is useful for the radiation control authority to adjudicate the radiation source and disposal options. These instruments are more sophisticated to use, are available at a higher price point, and are offered by many manufacturers. Examples include the RIIDs from Kromek and Thermo Fisher's SPRD.

7. Resources

- ASTSWMO: https://astswmo.org/
- ASTSWMO Radiation Task Force: https://astswmo.org/radiation-task-force/
- CRCPD: https://crcpd.org/
- U.S. DOT SP-10656:
    - https://crcpd.org/wp-content/uploads/2023/11/DOT-SP-10656-Revision-2023-002.pdf
    - https://www.phmsa.dot.gov/hazmat/documents/offer/SP10656.pdf/2023014425/SP10656
- U.S. DOT SP-11406:
    - https://crcpd.org/wp-content/uploads/2023/11/DOT-SP-11406-Revision-2023-1.pdf
    - https://www.phmsa.dot.gov/hazmat/documents/offer/SP11406.pdf/2023014426/SP11406