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Radioactive Waste Storage Facility and Tank System Design Criteria Standards

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Lawrence Livermore National Laboratory

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Preface

The Radioactive Waste Storage Facility and Tank System Design Criteria Standards is one of several local Lawrence Livermore National Laboratory (LLNL) environmental, safety, and health standards that was prepared during the Work Smart Standards Closure Process to address areas not adequately covered by Department of Energy (DOE) orders or national consensus standards. The original version was approved on March 16, 1999. Questions or comments about this standard should be addressed to the Operations and Regulatory Affairs Division in the Environmental Protection Department.

Lawrence Livermore National Laboratory

Radioactive Waste Storage Facility and Tank System Design Criteria Standards

1.0 Scope

This standard specifies performance-based requirements to ensure that adequate containment controls are provided for new and existing radioactive waste container storage areas or tank systems. Compliance with the criteria of this standard will result in the prevention or mitigatation of releases of radioactive waste to subsurface soils, ground water, surface soils/water, wetlands, or other environmental resources that could threaten human health or the environment. These requirements apply to all areas of any hazards classification where radioactive waste (i.e., high-level, transuranic, or low-level) is stored after it has been removed from the initial waste accumulation site, located at or near the site of waste generation.

The requirements in this standard are in addition to the requirements specified by other standards that apply to container storage areas or tanks systems. The following is a list of issues that may be present at radioactive waste container storage areas or tanks systems that would have requirements specified in other standards:

- Facility siting, including:
  - Natural topographic and geologic conditions (e.g., floodplains and wetlands)
  - Existing cultural, historic, and archeological resources
  - Endemic plant and animal species
  - Health, safety, and environmental protection requirements (e.g., exposure to the public)
  - Land use
- Industrial safety
- Industrial hygiene
- Occupational safety (e.g., lighting, communication systems, and noise abatement)

- Physical protection (e.g., security, barriers, and warning signs)
- Off-gas and ventilation control
- Fire protection (detection and control)
- Emergency response equipment
- Radiation and criticality safety
- Safety analysis
- Other controls determined by safety analysis

This standard does *not* apply to the initial accumulation of radioactive waste at or near the site of waste generation, such as waste collection in a laboratory.

2.0 Objectives

A container storage area or tank system design must:

- Minimize the possibility of any unplanned release of radioactive wastes to the environment.
- Protect subsurface soils, ground water, surface soils/water, wetlands, or other environmental resources from accidental releases of radioactive waste, resulting from human action or natural hazards.

3.0 Performance Standards for Container Storage Areas

3.1 Design of New Container Storage Areas

3.1.1 Foundation

Each storage area shall have a continuous base that is impervious to the waste to be stored.

3.1.2 Secondary Containment

All containerized liquid radioactive waste (including waste containing free liquids) shall be stored within secondary containment areas or devices. The storage of solid waste does not require secondary containment, although

secondary containment may be required to retain contaminated fire-fighting water from the activation of an existing fire-suppression system.

Each secondary containment area or device shall be designed to facilitate collecting and removing spills and accumulated liquids, and to provide adequate capacity to prevent releases to the environment. Surfaces that may come in contact with spilled waste shall be made impervious by coating or other methods. All cracks, gaps, and construction joints within the containment area shall be sealed. The selected sealant shall also be chemically resistant and impermeable to the wastes expected to be stored. Highly abrasion-resistant coatings shall be applied to bermed areas where heavy equipment, such as forklifts, will be used. Drains in secondary containment areas or devices will be equipped with a closing mechanism that can be locked shut.

The following factors shall be taken into account when determining the secondary containment capacity requirements:

- Displacements of pallets, equipment, and containers, etc.
- Capacity for containing either 10 percent of the aggregate volume of all liquid waste containers or the volume of the largest container of liquid waste, whichever is greater.
- Capacity for containing rainfall accumulation during a 24-hour, 25-year storm and run-on as necessary.
- Capacity for containing fire-fighting water as determined by a fire hazards analysis or safety analysis report.

3.1.3 Spill Detection

Secondary containment areas shall be (1) equipped with detection devices that activate an alarm when accumulated liquids are present, or (2) inspected at least weekly to check for spilled or accumulated liquids.

3.1.4 Run-on and Run-off Protection

Run-on and run-off controls shall be incorporated into the storage area design to minimize storm water run-on and protect the environment from releases of waste. Controls shall minimize the quantity of rainwater entering the storage area, and any rainwater that has contacted waste containers shall be contained.

3.1.5 Weather Protection

Some containers (e.g., cardboard, plastic, and wood) used to store radioactive waste can deteriorate from exposure to the weather (i.e., exposure to precipitation, UV light, temperature, and wind). Container storage areas used to hold containers susceptible to degradation by the weather shall be designed to protect the containers.

3.2 Existing Container Storage Areas

3.2.1 Foundation

Each storage area shall have a continuous base that is impervious to the waste to be stored.

3.2.2 Secondary Containment

At a minimum, all containerized liquid radioactive waste (including waste containing free liquids) shall be stored within secondary containment devices. These devices include, but are not limited to, secondary containment pallets, bermed areas, and portable berms. Drains in secondary containment areas or devices shall be equipped with a closing mechanism that can be locked shut. The factors that shall be taken into account when determining capacity of the secondary containment device are specified in Part 3.1.2.

3.2.3 Spill Detection

An inspection program will be set up to detect spills or accumulated liquids at least once a week.

3.2.4 Run-on and Run-off Protection

Run-on and run-off controls shall be incorporated into the storage area to minimize storm water run-on and protect the environment from releases of waste. Controls shall minimize the quantity of rainwater entering the storage area, and any rainwater that has contacted waste containers shall be contained.

3.2.5 Weather Protection

Some containers (e.g., cardboard, plastic, and wood) used to store radioactive waste can deteriorate from exposure to the weather (i.e., exposure to precipitation, UV light, temperature, and wind). Container storage areas used to hold containers susceptible to degradation by the weather shall be designed to protect the containers.

4.0 Performance Standards for Tank Systems

4.1 Design of a New Tank System

4.1.1 Corrosion Control

The radioactive waste tank system must be designed to prevent releases due to corrosion or structural failure for the operational life of the radioactive tank system. Additionally, the radioactive waste tank system must be constructed or lined with material that is compatible with the stored waste.

4.1.2 Spill and Overfill Prevention Equipment

Spill and overfill prevention equipment must be used to prevent spilling and overfilling associated with waste transfer to the radioactive waste tank system. The equipment shall meet the following criteria:

- Spill prevention equipment that will prevent release of waste to the environment when the transfer hose is detached from the fill pipe (e.g., a spill catchment basin).
- Overfill prevention equipment that will
  - — Automatically shut off or direct the flow from the tank when the tank is nearly full so that none of the fittings located on top of the tank are exposed to the waste; or
  - — Alert the transfer operator when the tank is nearly full by restricting the flow into the tank and triggering a high-level alarm; or
  - — Allow the operator to visually monitor the waste level in the tank.

4.1.3 Release Protection

The design of a new radioactive waste tank system must include a secondary containment system to prevent any release of waste to the environment during the operational life of the system. The following factors shall be taken into account when determining the secondary containment capacity requirements:

- Displacements of pallets, equipment, tanks, etc.
- Capacity for containing either 10 percent of the aggregate volume of all tanks or 100 percent of the capacity of the largest tank within its boundary, whichever is greater.
- Capacity for containing rainfall accumulation during a 24-hour, 25-year storm and run-on as necessary.
- Capacity for containing fire-fighting water as determined by a fire hazards assessment or safety analysis report.

4.1.4 Release Detection

The design of a radioactive waste tank system shall include a release detection method, or combination of methods, that allows detection of a release from any portion of the tank system that routinely contains or transports waste. The release detection frequency shall be based on the probability of a significant environmental impact occurring if there were a leak between monitoring times. At a minimum, release detection must be performed semiannually.

4.2 Existing Tank Systems

4.2.1 Release Detection

The design of a radiaoctive waste tank system shall include a release detection method, or combination of methods, that allows detection of a release from any portion of the radioactive waste tank system that routinely contains or transports waste. The release detection frequency shall be based on the probability of a significant environmental impact occurring if there were a leak between monitoring times. At a minimum, release detection must be performed semiannually.

4.2.2 Tank System Upgrade

All existing radioactive waste tank systems must be evaluated to determine the probability and consequences of a release to the environment. The following factors shall be considered in the evaluation:

- Age, materials of construction, and physical condition of the tank system.
- History of leaks.
- Characterization of the waste and relative hazards.
- Potential impacts to the environment.
- Waste throughput.
- Tank system size.
- Expected operating life of the tank system.

A radioactive waste tank system must be upgraded if the evaluation indicates the radioactive waste tank system will have a leak during its expected operating life and if that leak could allow radioactive constituents to enter the environment in concentrations exceeding the limits specified in the Chapter III of DOE Order 5400.5. Upgrades shall include corrosion control, spill and overfill prevention equipment, and release protection as described in Section 3.1.

5.0 Storage Locations for Large Quantities of Radionuclides

Areas or facilities that accumulate an inventory of radioactive waste exceeding a reportable quantity for radionuclides specified in 40 CFR 302.4, Appendix B, "Radionuclides," shall be evaluated for natural phenomena hazards (e.g., seismic, flooding, and wind) following the requirements in Section 4.4 of DOE Order 420.1, "Facility Safety." Areas or facilities used for storage of large quantities of radionuclides must be constructed to ensure that adequate levels of safety are included in the design to mitigate the natural phenomena hazards identified.

6.0 Long-term Storage Locations

Areas or facilities used for long-term storage of radioactive waste (>1 year) shall be evaluated for natural phenomena hazards (e.g., seismic, flooding, and wind) following the requirements in Section 4.4 of DOE Order 420.1, "Facility Safety." Areas or facilities used for long-term storage shall be constructed to ensure that adequate levels of safety are included in the design to mitigate the natural phenomena hazards identified.

7.0 Definitions

Accumulation means the collection of waste at or near the site of waste generation until the waste is moved to another location to be stored, treated, or disposed of.

Compatible means the ability of two or more substances to maintain their respective physical and chemical properties upon contact with one another for the design life of the tank system under conditions likely to be encountered in the tank.

Container means any device that is open or closed and portable that can be used to store, handle, treat, transport, recycle, or dispose of material.

Overfill release is a release that occurs when a tank is filled beyond its capacity, resulting in a discharge of waste to the environment.

Portable berm is a type of secondary containment that can be easily assembled and disassembled. It is comprised of a base and rigid or inflatable side walls that are continuously lined; any seams in the liner are sealed so that it remains leakproof. The liner is made of a durable material that is resistant to the type of chemical to be contained and to degradation from the weather. A portable berm must meet secondary containment capacity requirements.

Radioactive Waste Container Storage Area is a location (e.g., building, shed, or concrete pad) where containers of liquid or solid waste containing radionuclides in concentrations exceeding the radioactive waste criteria are held after being removed from the point where the waste was initially accumulated.

Radioactive Waste Tank System is a storage tank, connected piping, ancillary equipment, and containment system that contains liquid or solid waste containing radionuclides in concentrations exceeding the radioactive waste criteria as defined in this document.

Radioactive waste is a solid, liquid, or gaseous waste stream that contains radioactive material above the radioactive-added criteria established in "Criteria and Procedure for the Certification of Nonradioactive Hazardous Waste" (UCRL-AR-109662) and that does not meet the criteria for high-level or transuranic waste.

Release means any spill, leak, emission, discharge, escape, leach, or disposal from a tank system into ground water, surface water, or subsurface soils.

Release detection means determining whether a release of a waste has occurred from the tank system into the environment or into the interstitial space between the tank system and its secondary barrier or secondary containment around it.

Secondary containment is a device or system that provides a barrier to releases that may occur from containers or tanks located within the device or system to ground water, surface water, or surface/subsurface soils.

Storage means the holding of waste after it has been accumulated until it treated or disposed.

Tank is a stationary device designed to contain an accumulation of liquid, sludge, or solids and constructed of nonearthen materials (e.g., concrete, steel, or plastic) that provide structural support.

Tank system means a storage tank, connected piping, ancillary equipment, and containment system, if any.