11.4 Solid Waste Management Systems

The solid waste management system treats both dry and wet solid radioactive wastes. This system consists of three subsystems: the solid waste processing and storage system (which treats dry solid wastes) and the radioactive concentrates processing system (which treats wet solid wastes). These subsystems provide the equipment and devices necessary for the collection, handling, treatment, and storage of the various forms of solid radioactive waste produced during operation of the plant, including anticipated operational occurrences (AOO). The solid waste management system reduces the total volume of waste material by compaction, shredding, and evaporation processes and provides temporary storage of waste materials prior to shipment offsite to licensed radioactive waste disposal facilities.

11.4.1 Design Basis

The function of the solid waste management system is to collect, treat and store various solid radioactive wastes produced in the plant. The solid waste management system is designed to meet RG 1.143 and NUREG-0800, BTP 11-3 (Reference 1). This system is designed to handle and process solid waste generated in the radiological controlled areas during power operation, maintenance, and refueling and to store this collected waste in selected storage rooms or areas in the Radioactive Waste Processing Building until shipment offsite. The Radioactive Waste Processing Building is designed to provide adequate shielding of stored waste to meet the dose rate criteria of 40 CFR Part 190 and 10 CFR 20.1302. Radioactive waste is packed and shipped in Department of Transportation (DOT)-approved containers in accordance with the requirements of 10 CFR Part 71, 49 CFR Part 173, and applicable state regulations. The collection, solidification, packaging, and storage of radioactive waste is performed to maintain potential radiation exposure to plant personnel during system operation or during maintenance to levels consistent with as low as reasonable achievable (ALARA) requirements, in accordance with NRC RG 8.8 and 10 CFR Part 20. Additional information on the administrative and operational controls and surveillance requirements associated with the processing of radioactive solid waste is provided in the Process Control Program (See Section 11.4.3).

Consistent with the requirements of 10 CFR 20.1406, the U.S. EPR, including the solid waste management system, is designed to minimize, to the extent practicable, contamination of the facility and the environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste. Minimization of contamination and radioactive waste generation is described in Section 12.3.6.

11.4.1.1 Design Objectives

In addition to fulfilling its primary design functions, the solid waste management system meets the following design objectives:

- Collect radioactive concentrates from the liquid waste management system, ion exchange resins from the coolant purification system, and the spent resins from the liquid waste management system.

- Store coolant purification system spent resins until the activity level is reduced to a certain level. The resins are subsequently mixed with solid waste concentrates to reduce the overall activity level and then pumped into 55-gallon drums.

- Store solid wastes both before and after processing.

- Separate wet solid wastes and dry active wastes to avoid wetting dry active waste.

- Shred larger solid wastes before placing them into drums for compaction.

- Segregate storage of lower activity waste from storage of higher activity waste. Drums of solid waste are stored until the radioactivity is low enough for the waste to be transported offsite.

11.4.1.2 Design Criteria

The solid waste management system is subject to the following GDC in 10 CFR Part 50, Appendix A:

- GDC 60, which requires that nuclear power unit design include means to suitably control the release of radioactive materials in liquid effluents from the solid waste management system and to handle solid wastes produced during normal reactor operation, including AOOs. GDC 60 also requires that the design provide sufficient holdup capacity for retention of gaseous effluents containing radioactive materials.

- GDC 61, which requires in part that radioactive waste systems be designed to provide adequate safety under normal and postulated accident conditions. Radioactive waste systems must be designed with a capability to permit appropriate periodic inspection and testing of components important to safety; with suitable shielding for radiation protection; and with appropriate containment, confinement, and filtering systems.

- GDC 63, which requires that appropriate means be provided in radioactive waste systems and associated handling areas to detect conditions that may result in excessive radiation levels and to initiate appropriate safety actions.

11.4.1.2.1 Capacity

The facilities in the Radioactive Waste Processing Building have the capacity to store several years’ volume of solid waste (excluding dry active waste) resulting from plant operation. The solid wastes can be stored in one of two onsite storage areas in the Radioactive Waste Processing Building (see Figure 12.3-52). One area is a tubular shaft store for the higher activity drums and the other is a drum store for low activity drums. The storage area has a capacity of approximately 200 drums in the tubular shaft storage and approximately 350 drums in the drum store. Storage and offsite shipping of solid radioactive waste maintains exposure ALARA to personnel onsite or offsite under normal conditions or extreme environmental conditions, such as tornados, floods, or seismic events. The solid waste management system is designed with sufficient waste accumulation capacity and redundancy to allow temporary storage of the maximum generated waste during normal plant operation and AOOs.

The estimated annual volume of solid waste generated in the plant and shipped offsite is provided in Table 11.4-1—Estimated Solid Waste Annual Activity and Volume.

11.4.1.2.2 Quality Group Classification

Design criteria pertinent to systems classified as RG 1.143 safety classification RW-IIa (High Hazard) and tabulated in RG 1.143, Table 2 (Natural Phenomena and Internal/External Man-Induced Hazard), Table 3 (Design Load Combinations), and Table 4 (SSC Design Capacity Criteria) are used in design analyses of the solid waste management system. The quality classification of solid waste management system components is Quality Group D, as defined and described in Section 3.2.

11.4.1.2.3 Seismic Design Classification

The solid waste management system is classified as radwaste seismic (RS). Structures, systems, and components composing the solid waste management system that are classified as RG 1.143 safety classification RW-IIa (High Hazard) are designed to withstand a seismic loading equivalent to one-half the amplitude of the safe shutdown earthquake (SSE).

11.4.1.2.4 Controlled Releases

The radioactivity of the influents to the solid waste management system is based on estimated expected annual activity of primary influents as listed in Table 11.4-1. The activity values for concentrates, filters, spent resins, and sludge represent six months of decay to conservatively account for processing time and inprocess storage and handling time. The source terms and concentrations are consistent with Section 11.1.

The collection, solidification, packaging, and storage of radioactive waste are to be performed to maintain potential radiation exposure to plant personnel during system operation or during maintenance to as low as is reasonably achievable (ALARA) levels, in accordance with the intent of RG 8.8 in order to maintain personnel exposures well below 10 CFR Part 20 requirements. Design features include remote or semi-remote operations and shielding of equipment and storage areas to keep exposures within ALARA limits.

The radioactive concentrates processing system is designed to receive, prepare, and process radioactive concentrates and sludges. The evaporator concentrates and sludge generated in the liquid waste processing and storage system, as well as spent resins generated in the coolant purification system and the liquid waste processing system are treated in the radioactive concentrates processing system. After treatment, the waste are dried in the drums and stored in the drum store or the tubular shaft store. The system also has the capacity to pump resins to the demineralizer system for processing and disposal in a high integrity container (HIC). Those portions of the radioactive concentrates processing system that contain slurries are supplied with demineralized water connections for system flushing in accordance with NUREG-0800, BTP 11-3 (Reference 1).

Process monitors installed on the drum drying system detect in-process radiation levels to keep the operator informed of the process radiation levels, in accordance with GDC 61. In addition, area radiation monitors throughout the Radioactive Waste Processing Building detect excessive radiation levels and alert the operators to this condition, in accordance with GDC 63. Area radiation monitoring is addressed in detail in Section 12.3.4. The dried, filled solid waste drums are stored for a sufficient time to allow the short lived radionuclides to decay before shipping offsite in accordance with NUREG-0800, BTP 11-3 (Reference 1) and 10 CFR 61.55 and 61.56.

11.4.1.2.5 Mobile Systems

The Radioactive Waste Processing Building is sized to provide space and support services for optional site-specific mobile or vendor-supplied processing equipment. Flexible hose or pipe used with site-specific mobile or vendor-supplied solid waste processing systems is subject to the hydrostatic test requirements in accordance with NUREG-0800, BTP 11-3 (Reference 1) and RG 1.143. However, such an optional mobile or vendor-supplied system is a site-specific design feature that is outside the scope of the design certification.

11.4.2 System Description

11.4.2.1 Solid Waste Processing and Storage System (Dry Solid Waste)

The solid waste processing and storage system handles the waste generated in the different controlled areas of the plant independent from the plant operating conditions. Solid radioactive wastes consist of paper, plastic, cloth, wood, metal parts, worn-out items, concrete, glass, electrical parts, spent charcoal from the gaseous waste management system, and other potentially contaminated discarded materials generated throughout the controlled area. These wastes are collected, segregated, and treated according to their properties. The wastes are placed in different containers to simplify handling, storage, and transport of the waste in the plant. Typical waste containers used are plastic bags, drums, or bins, which are transferred and placed in interim storage areas of the Radioactive Waste Processing Building. Solid waste treatment facilities include the sorting box for sorting waste. This sorting box contains a shredder and a compactor for in-drum compaction of compressible waste.

Wastes are initially classified as combustible, compressible or noncombustible and noncompressible. Compressible waste is compacted to reduce its volume. The wastes are further segregated based on properties, sizes, materials, and activity of the waste material. Waste containing moisture is collected and stored separately to avoid wetting dry active waste and to allow short-term treatment to prevent decomposition and hydrogen formation.

The combustible and compressible wastes are transferred from the storage rooms to the treatment area (e.g., compaction and compression), placed into storage drums, and compacted for temporary storage. The noncombustible and noncompressible wastes (thick metal parts, for example) are transported to the hot workshop, fragmented, and transferred into a drum.

Drums containing low-level radioactive waste are stored in the drum store area of the Radioactive Waste Processing Building until they are ready to be transported to offsite disposal. Drums stored in the drum store area have an activity level low enough that they meet ALARA dose criteria. Tubular shaft storage is provided for higher-level radioactive waste such as filter cartridges and treated resin waste.

The solid waste management processing and storage system is shown in Figure 11.4-1—Solid Waste Management Flow Diagram. Table 11.4-14—Solid Waste Management System Component Data lists the major equipment and corresponding nominal design parameters. Tables are provided showing the expected and maximum annual activities by nuclide for the noncompressible, compressible, and combustible dry active waste (DAW) in Tables 11.4-2 through 11.4-4. A summary total of the annual activity from dry active wastes is given in Table 11.4-5—Total Dry Active Waste Annual Activity.

11.4.2.2 Radioactive Concentrates Processing System (Wet Solid Wastes)

The radioactive concentrates processing system receives concentrates and sludges from other waste treatment systems and dries these influents to produce a monolithic salt block inside a storage drum. Evaporator concentrates from the concentrate tanks and contaminated sludge from the storage tanks of the liquid waste storage system are transferred to the concentrate buffer tank. These wastes are mixed, sampled, and analyzed for proper pretreatment before leaving the concentrate buffer tank.

Spent resins are stored in the resin waste tanks of the coolant purification system for an extended length of time to allow short-lived activity to decay away. These resins are then transferred into the resin proportioning tank or into a HIC. Depending upon activity levels in the resin in the proportioning tank, a portion of the resin is transferred into the concentrate buffer tank with other liquid waste where it is mixed before leaving the concentrate buffer tank. Spent resin from the demineralizer system, which is part of the liquid waste processing system, may be sent directly to the HICs or transferred to the concentrate buffer tank. In addition to spent resins, this demineralizer system produces a small amount of solid waste from the back flush of the ultrafiltration system which is treated as a wet solid waste and either placed in a HIC and dewatered or into a drum and dried.

From the concentrate buffer tank, the liquid waste can be transferred into a waste drum in one of three drum drying stations where the water content is evaporated. In the drum drying station, a vacuum seal is established on the drum and heaters are energized to evaporate the water from the drum. The vacuum in the drum allows the water to boil off at a lower required heating temperature. The water vapor is condensed, collected, and the volume measured before it is drained to the condensate collection tank. The air and radioactive noncondensable gases are routed to the radioactive waste processing building ventilation system for processing. The radioactive waste processing building ventilation system is described in Section 9.4.8. After most of the liquid has been evaporated out of the drum, the drum is refilled with more waste from the concentrate buffer tank and the drying process starts again. This filling and evaporation process is repeated until the drum is filled with a solid precipitated dry active waste product. The solid drum drying process reduces the moisture content of the solid block to less than 10 percent by weight.

When drying is complete, a final core sample of the dried contents is taken (one per batch) and the drums are sealed and capped at the drum-capping device. The core sample is analyzed via gamma spectroscopy to identify the radionuclides content and activity levels. The drum is then picked up by the drum store crane and transferred to the drum measuring device where the dose rate is obtained, main nuclides are identified, and the weight of the drum is measured. An array of five process radiation monitors displays the radiation levels at various drum elevations and azimuthal angles. Gamma spectroscopy capability is available to identify key radionuclides, such as cobalt-60 and cesium-137 in the liquid waste. Additional radiation monitors measure and record the background radiation level and dose rate from the drum. Finally, the drum is transported to temporary storage in the drum store or the tubular shaft store until the drum meets the requirements of 10 CFR Part 61 for disposal of solid radioactive waste.

If a leak or overflow occurs in the room containing solid waste, then the room contains the leak or overflow. The floor drain from the room can be opened to drain the leakage into a sump. From the sump, the liquid is pumped into a storage tank in the liquid waste storage system.

Filter cartridges may also be encapsulated in cement to allow immobilization of the cartridges in the drums or they can be loaded in HICs for disposal. The functional flow of radioactive concentrates processing system is shown in Figure 11.4-1.

Tables 11.4-6 through 11.4-11 include the expected and maximum annual activities by nuclide for the wet solid waste types. A summary total of the annual activity from wet solid wastes is given in Table 11.4-12—Total Wet Solid Waste Annual Activity.

Mixed wastes are collected in compatible containers prior to being placed in a metal container and shipped offsite. Table 11.4-13 provides a summary of the expected and maximum annual activities by nuclide of mixed wastes.

11.4.2.3 Component Description

11.4.2.3.1 Solid Radioactive Waste Processing and Storage Components (Dry Active Wastes)

Sorting Box (Shredder and In-Drum Compactor)

The sorting box is used to sort the various dry actives wastes produced in the controlled areas of the plant. The sorting box contains hand holes with rubber gloves for sorting the wastes. During the sorting process, the wastes may be placed in the shredder where they are fragmented to a size that will allow them to fit into a drum. The wastes can also be placed in a drum, where they are compacted. The filled drums are removed from the sorting box and capped. The sorting box is connected to the radioactive waste processing building ventilation system through a filling hood. Any airborne contaminants created during the sorting, shredding, or compaction processes are captured by the filling hood and subsequently treated in the radioactive waste building ventilation system.

Drum Transport Carts

Drum transport carts are used to transport both empty and filled drums with untreated and treated solid radioactive waste. The filled drums typically are moved from the collection areas to waste storage areas within the Radioactive Waste Processing Building. Grippers are installed on the carts to provide lateral control of the drums and a hydraulic lifting device can raise the drums off the floor during movement. Operators drive the carts manually. Drums that are to be stored in the drum store or the tubular shaft store must be transported to the transfer position of the drum store crane.

Shielding Casks

Shielding casks are used to transport higher activity solid waste drums from their fill stations to their temporary storage in the tubular shaft store until these drums are again moved to the vehicle entrance area of the Radioactive Waste Processing Building for shipment offsite. The shielding casks are designed to keep dose rate exposures within ALARA limits. The casks are designed with lugs for lifting the drum with the cranes.

Vehicle Entrance Area Crane

The vehicle entrance area of the Radioactive Waste Processing Building has an installed high capacity crane used for loading and unloading drums and other containers from trucks or trailers. The crane is also used to load and unload various plant components used in conjunction with the Radioactive Waste Processing Building. Different grab systems are provided to manipulate the various containers, shielding casks, and drums. This crane is used to lift the HICs to trucks that transport them to final disposal. Power for the crane is provided from a non-safety-related electrical bus. The crane is remotely controlled and manually operated.

Drum Store Crane

The drum store crane installed in the drum store is used to transport the drums containing solid or dried waste from the drum transfer position to the dose rate measuring device to determine radiation levels in the drum. After dose rate measuring is complete, the crane then moves the drums to a temporary storage location in the drum store or tubular shaft store, depending upon radiation levels in the drum.

Drum Store

The drum store is a room located in the Radioactive Waste Processing Building and is used for temporary storage of low level radioactive waste treated by the solid waste processing system. The drums can be stacked a maximum of five drums high to optimize the available storage space. The drums are stored for a sufficient time to allow the short-lived radionuclides to decay before shipping offsite in accordance with BTP ETSB 11-3 and ALARA requirements.

Tubular Shaft Store

The higher activity waste is stored in tubular shafts that are formed from concrete and are part of the Radioactive Waste Processing Building. The waste includes solid waste, such as spent filter cartridges, as well as treated spent resins that may be combined with sludge and evaporator concentrates from the radioactive waste concentrates processing system. The drum store crane is used to place drums into and remove drums from the tubular shaft store. The drums are stored for a sufficient time to allow the short-lived radionuclides to decay before shipping offsite in accordance with BTP ETSB 11-3 and ALARA requirements.

11.4.2.3.2 Radioactive Concentrates Processing System Components (Wet Solid Wastes)

The piping and equipment for these components are constructed of stainless steel to avoid corrosion caused by wastewater, demineralized water, chemicals, and decontamination wastes.

Concentrates Recirculation Pump

The concentrate recirculation pump circulates the liquid waste contained in the concentrate buffer tank to allow the following:

- Homogeneous mixture.
- Transfer of the contents of the buffer tank to the three drum drying stations.
- Transfer of excess liquid from the buffer tank back to the concentrate tanks of the liquid waste storage system.
- Transfer of the contents of the buffer tank to the transfer station for transfer to a mobile tank.

Vacuum Unit

The vacuum unit consists of a pump, separator, and cooler. The separator maintains a water seal for the pump to prevent vapor and gases from escaping from the pump. The pump maintains a negative pressure in the drum to evaporate the liquid from the concentrates in the drum drying stations' drums at a temperature greater than about 140°F. The cooler, using component cooling water as the coolant, condenses the water vapor from the drums. The condensate is collected and eventually returned to the liquid waste storage tanks.

High Pressure Cleaning Device

The high pressure water jet uses a spray lance to remove encrusted waste from each of the filling hoods in the three drum drying stations. Cleaning water for the device is demineralized water from the demineralized water distribution system.

Condensate Collection Pump

The condensate collection pump transfers liquid collected in the condensate collection tank to the liquid waste storage tanks.

Resin Proportioning Tank

The resin proportioning tank is mounted vertically with a conical bottom. Spent resins from the resin waste tanks of the coolant purification system are transferred to the resin proportioning tank. Excess water is drained from the resin proportioning tank through screen baskets to retain the resins in the tank. After sufficient resin has been transferred into this tank, and excess water removed, the resin is then proportioned using a minimum amount of flushing water to the concentrate buffer tank.

Concentrate Buffer Tank

The concentrate buffer tank is mounted vertically with a motor-operated agitator on the top of the tank to mix the tank contents. In case of an agitator malfunction, a ring header injects air to mix the tank contents. The concentrate buffer tank is used as a buffer and mixing tank for the pretreatment of the liquid waste, which is routed to the drum drying stations for evaporation of the aqueous portion of the waste. Spent resin from the proportioning tank is metered into and mixed with the concentrates in the buffer tank. A decanting device and screen basket in the tank allow for the removal of excess water and prevents draining resin from the tank into the plant drains.

Condensate Collection Tank

The condensate collection tank is mounted vertically and used to collect the condensate generated in the condenser drying unit. The tank can store approximately one day's volume of drum drying operation before the maximum tank level is reached and the collected condensate is discharged to the liquid waste storage tanks.

Scrubber Tank

The scrubber tank is mounted vertically with an internal basket filled with metal pall rings that disperse air and gases coming from the condenser drying unit. The demineralized water in the scrubber tank removes the entrained impurities and other water soluble gases before the remaining air and noncondensable gas pass to the vacuum unit. The remaining air and noncondensable gases are routed to the radioactive waste building ventilation system.

Resin Traps

Resin traps prevent transport of spent resins from the resin proportioning tank and concentrate buffer tank into the back flush piping, thus preventing additional contamination by resins.

Condenser Drying Unit

A separate condenser drying unit is used for each drum drying station. Each condenser drying unit is a standard tube and shell heat exchanger with component cooling water as the cooling medium. The condenser drying units condense the vapor generated in the drum drying stations due to evaporation. The condensed vapor is then collected in the condensate counter.

Condensate Counter

One condensate counter is provided for each drum drying station. The counter collects an exact volume of condensed water from the condenser drying unit. When the counter is full, a drain valve automatically opens to drain the water by gravity from the condensate counter to the condensate buffer sluice. These fill and drain cycles are counted over a time interval and the information is used for control inputs to the drum drying station.

Condensate Buffer Sluice

The condensate buffer sluice collects the condensate from the condensate counters of each of the condenser drying units. When the buffer sluice is full, the condensate buffer sluice inlet valve closes, and a second valve opens to vent the sluice to atmospheric pressure. A drain valve opens to gravity drain the water to the condensate collection tank. After a set period of time the drain valve and the vent valve are closed and the inlet valve reopens to restart the cycle.

Transfer Station

The transfer station transfers contaminated or possibly contaminated steam generator blowdown demineralizing resins to trucks in the vehicle entrance area. These trucks bring the resins to a vendor for reprocessing or decontamination and disposal. Removable flexible hose and couplings are used as necessary. The flexible hose is subject to hydrostatic test requirements delineated in RG 1.143.

Measuring Glass

A measuring glass is provided for the concentrate buffer tank, with inlet, overflow, and drain connections. The measuring glass provides visual indication of the amount of solids (resins and sludge) within the liquid in the tank.

Drum Drying Stations

Each drum drying station consists of a filling hood, two level measurements, fixed and pivoting electrical heating elements, and a transfer slide. Two level measurements are inserted into the drums during filling from the concentrate buffer tank to prevent overfilling of the drum. These are removed and isolated during the evaporation process. Pneumatic operated electrical shell heaters and fixed electrical bottom heaters provide the thermal energy to the drum to remove liquid from the drums. The transfer slide moves the empty drum from the pickup position to the filling station under the filling hood. A pneumatic cylinder lifts the drum to and lowers the drum from the filling hood. An inflatable seal seals the filling hood against the drum to prevent gases and water vapor from escaping into the environment. At the completion of the drying cycle, the drum is returned to the pickup station for later relocation by the drum transfer device.

Drum Transfer Device

The drum transfer device is a conveyor that transfers uncapped empty drums from the manual drum input/output position to the pick up position conveyer, where the drums are transferred to the drum handling device. After the drying process, the drum transfer device transports the filled drum from the pick up position conveyor to the sampling device for dried waste, the drum capping station for capping, and finally to the drum input/output position where the drums are picked up by the drum store crane.

High Integrity Container

A HIC may be used instead of or in conjunction with the drum drying equipment to de-water various wastes. The HIC is part of the demineralizer system and can be used for sludge and resins. HICs may also be provided for other types of solid wastes (e.g., filter cartridges and wet solid wastes). Wastes in HICs are dried through a dewatering process.

Sampling Box

The sampling box serves as the sampling point for the concentrate buffer tank. The box enclosure is equipped with gloves and a gate for inserting and removing the sample bottles. Inside the box are the sample valve and a demineralized water valve used to flush the inside of the box and the sample bottles. A ventilation connection is provided to maintain a negative pressure within the sampling box.

Drum Capping Device

The drum-capping device is used to cap or uncap each filled drum.

Drum Measuring Device

The drum store crane positions the filled drum on a turntable at the drum measuring device. Five dose rate detectors measure the dose from each drum. Dose rates are taken at the surface and one meter away from the drum as it slowly rotates on the turntable. Gamma spectroscopy determines the nuclides and their activity levels. Additionally, the weight of each drum is recorded.

Sampling Device for Dried Waste

The sampling device for dried waste takes a sample by drilling material out of the dried solid waste product in the drum. A core hole drill is used to drill the sample from the block. The sample, along with the core hole drill bit, is removed from the drum and is inserted in a shielded tube. After the drum is removed from under the hood, the shielded tube containing the core hole drill bit and sample are manually removed from the machine, capped, and transported to the laboratory. In the laboratory, the sample is removed from the core hole drill bit and analyzed for residual moisture content, activity, and main chemical composition. The core hole drill bit is cleaned to remove remaining waste material and reused to collect another sample.

Drum Handling Device

The drum handling device is used to transfer the empty drums from the pickup position conveyor to the bottom heater of one of the three drum drying stations. After the drums are filled and dried, the drum handling device then transfers the filled drum from the drum drying station back to the pickup position conveyor.

11.4.2.4 Packaging, Storage, and Shipping

Large pieces of waste may be stored in various rooms of the Radioactive Waste Processing Building and covered with plastic to act as a temporary shield prior to decontamination of the wastes in the decontamination rooms. Once decontamination operations are completed, the waste is placed in large transport containers or is taken apart, as much as possible, to allow it to fit in disposal containers. As addressed in Section 11.4.3, the elements of the Process Control Program will be described by the COL applicant. This program will include site-specific information on operational practices to indicate what fraction, if any, of waste processing will be contracted out to waste brokers or specialized facilities and whether such wastes will be returned to the plant for disposal or shipped directly by the processor for disposal.

The waste characteristics shipped for disposal meet the requirements specified in 10 CFR 61.56. For the transfer and manifesting of radioactive waste shipped offsite, the requirements of Appendix G, "Requirements for Transfers of Low-Level Radioactive Waste Intended for Disposal at Licensed Land Disposal Facilities and Manifests," to 10 CFR Part 20 will be met. Based on industry experience, the radioactive waste shipped offsite for disposal is expected to consist of 79 percent Class A, 11 percent Class B, and 10 percent Class C waste.

The containers used for solid waste shipments meet the requirements of 49 CFR Parts 171-180 (Department of Transportation Radioactivity Material Regulations) and 10 CFR Part 71 (Packaging of Radioactive Materials for Transport). The solid waste system is designed to allow for the use of 55-gallon drums for shipment of evaporator concentrates, wastes collected from the centrifuge portion of the liquid waste processing system, sludge from the bottom of the liquid waste storage system storage tanks, spent resins from the coolant purification system, spent resins from the demineralizer system, spent filter cartridges, wet solid wastes, DAW, and mixed wastes. Alternatively, DAW may be shipped in transportable cargo (e.g., SeaLand) containers, and HICs may be used for the shipment of spent resins from the coolant purification system, spent resins from the demineralizer system, wet wastes from the demineralizers, mixed wastes, spent filter cartridges, drummed evaporator concentrates, and drummed sludges.

Untreated solid waste is stored near its generating area until it is ready to be processed. If provisions for additional onsite storage become necessary (i.e., due to disposal site temporary unavailability), the guidance in NUREG-0800, Appendix 11.4-A, "Design Guidance for Temporary Storage of Low-Level Radioactive Waste" of Reference 2 is followed. Once treated, the solid waste, along with the treated concentrates, is shipped offsite in a HIC, transportable cargo container, or is stored in one of two onsite drum storage areas. One area is a tubular shaft store for the higher activity drums and the other is a temporary drum store for lower activity drums. Once the activity has reduced to a low enough level, the drums are transported to an NRC-licensed offsite disposal facility. Layout drawings of the packaging, storage, and shipping areas are provided in the radiation zone maps on Figures 12.3-52 through 12.3-58.

The vehicle entrance area of the Radioactive Waste Processing Building is provided with a 20-ton crane used for loading and removal of drums and other containers from a transport truck. A 2-ton capacity drum store crane serves to transfer the drums containing solid or dried liquid radioactive waste from the drum transfer position to the various storage places in the drum store and tubular shaft store or back. The drum store crane also transports the drums from the drum transfer station or storage areas to the dose rate measuring device.

The maximum and expected annual volumes and activity of wastes to be shipped offsite are provided for each waste type in Table 11.4-1.

11.4.2.5 Effluent Controls

Figure 11.4-1 shows a process flow diagram showing the inputs and operations associated with the solid waste system. A list of expected annual activity values for primary influents processed and shipped, expected annual activity values for primary influents, and expected annual activity values for shipped primary waste is provided in Table 11.4-1. Tables 11.4-2 through 11.4-13 detail the individual activity values for each type of waste listed in Table 11.4-1.

11.4.2.6 Operation and Personnel Exposure

To reduce occupational radiation exposure, the solid waste system is operated either automatically or remotely. The drum drying, moving, and activity measurements are performed using automatic controls. When it is determined that the activity has reached a low enough level, drums are brought from the storage rooms to the vehicle entrance area by cranes. The dose is measured (either by personnel using equipment or with remote equipment attached to the overhead crane) and if within the limits set by 10 CFR Part 61, 10 CFR Part 71, and DOT regulations, the containers are placed on a truck. In addition, shielding is provided to maintain doses ALARA and connections are provided to the radioactive waste processing building ventilation system (refer to Sections 9.4.8 and 12.3.3) to minimize airborne radioactivity.

Sections 12.1 and 12.3 describe how the ALARA provisions of RG 8.8 and RG8.10 are implemented in system designs and operation to comply with occupational dose limits of 10 CFR 20.1201 and 10 CFR 20.1202 and occupational limits of Table 1, annual limit on intake (ALI) and derived air concentration (DAC), of Appendix B to 10 CFR Part 20.

11.4.2.7 Inspection and Testing Requirements

Solid waste management system storage tanks are routinely inspected and tanks are provided with manholes (large tanks) or hand holes (small tanks) for inspection and cleaning access. The concentrate buffer tank is also periodically inspected to determine the condition of the tank wall. Routine operational testing is not required for the solid waste processing system because the system is in continuous operation and plant personnel easily can detect and then correct malfunctions.

The radioactive concentrate processing system is subject to preoperational testing as described in Section 14.2. This testing confirms the design adequacy and performance of the radioactive concentrates processing system.

11.4.2.8 Instrumentation Requirements

The dose rate and nuclide content of a filled drum are measured by the drum measuring device of the radioactive waste concentrates processing system. Level instrumentation on the processing tanks in the solid waste management system provides accurate indications of tank volumes. High tank levels alarm locally and in the main control room to alert the operators of an abnormal system condition.

11.4.3 Radioactive Effluent Releases

Solid wastes are shipped offsite for burial at an NRC-licensed (per the requirements of 10 CFR Part 61) radioactive waste burial site. The containers used for solid waste shipments meet the requirements of 49 CFR Parts 171-180 (Department of Transportation Radioactivity Material Regulations) and 10 CFR Part 71 (Packaging of Radioactive Materials for Transport). Table 11.4-1 summarizes the annual total solid radioactive waste processed. The processes used to demonstrate compliance with GDC 13, GDC 63, and GDC 64, as they relate to monitoring and controlling radioactive releases during routine operations and accident conditions are described in Section 11.5.

A COL applicant that references the U.S. EPR will fully describe, at the functional level, elements of the Process Control Program (PCP). This program description will identify the administrative and operational controls for waste processing process parameters and surveillance requirements which demonstrate that the final waste products meet the requirements of applicable federal, state, and disposal site waste form requirements for burial at a 10 CFR Part 61 licensed low level waste (LLW) disposal site and will be in accordance with the guidance provided in RG 1.21, NUREG-0800, BTP 11-3 (Reference 1), ANSI/ANS-55.1-1992 (Reference 3) and Generic Letters 80-09 (Reference 4), 81-38 (Reference 5), and 81-39 (Reference 6).

11.4.4 Solid Waste Management System Cost-Benefit Analysis

In addition to meeting the numerical ALARA design objective dose values for effluents released from a light water reactor, 10 CFR Part 50, Appendix I, also requires that plant designs include additional items based on a cost benefit analysis. Specifically, the design must include items of reasonably demonstrated cleanup technology that, when added to the solid waste processing system sequentially and in order of diminishing cost-benefit return, can, at a favorable cost-benefit ratio, reduce the dose to the population reasonably expected to be within 50 miles of the reactor.

There is no separate cost-benefit analyses performed for the SWMS since there are no releases of solid radioactive waste other than those shipped offsite for disposal. Any radioactive liquid and gases generated as a result of the operation of the SWMS are evaluated as a part of the liquid and gaseous cost-benefit analyses in Sections 11.2 and 11.3, respectively.

11.4.5 Failure Tolerance

There are no requirements to design the systems against single failure criterion or multiple component train separation. The following internal hazards, however, are considered in the system design:

- Load drop. If a filled drum is dropped, the drum may split and spill its contents on the floor. Personnel protective equipment is required (protective clothing, respirators, etc.) when cleaning up spilled contamination. Potential airborne contamination is removed and treated by the Radioactive Waste Processing Building ventilation exhaust system to prevent airborne activity from spreading into the environment.

- Fire. Storage drums are sealed with lids after filling; a sealed drum can contain a fire long enough for operators to extinguish the fire before it spreads to other drums or areas. In the event of a fire in one of the drums, fire and smoke detectors provide an alarm to alert the operators. The room ventilation supply and exhaust dampers are closed to isolate the room until the fire is extinguished. Then, potential airborne contamination and smoke is removed and treated by the Radioactive Waste Processing Building ventilation exhaust system to prevent airborne activity from spreading into the environment.

The solid radioactive waste management systems are not designed for safe shutdown in an earthquake nor is protection against an explosion pressure wave required. Protection against external hazards is also not required.

11.4.6 References

1. NUREG-0800, BTP 11-3, “Design Guidance For Solid Radioactive Waste Management Systems Installed In Light-Water-Cooled Nuclear Power Reactor Plants,” Revision 3, U.S. Nuclear Regulatory Commission, March 2007.

2. NUREG-0800, “U.S. NRC Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” U.S. Nuclear Regulatory Commission, March 2007.

3. ANSI/ANS-55.1-1992, “Solid Radioactive Waste Processing System for Light-Water-Cooled Reactor Plants,” American Nuclear Society, 1992.

4. Generic Letters 80-09, “Low Level Radioactive Waste Disposal,” U.S. Nuclear Regulatory Commission, January 1980.

5. Generic Letters 81-38, “Storage of Low Level Radioactive Wastes at Power Reactor Sites,” U.S. Nuclear Regulatory Commission, November 1981.

6. Generic Letters 81-39, “NRC Volume Reduction Policy,” U.S. Nuclear Regulatory Commission, November 1981.

7. NUREG/CR-2907, “Radioactive Materials Released from Nuclear Power Plants, Annual Report,” Vol. 14, U.S. Nuclear Regulatory Commission, December 1995.

8. ANS/ANSI-18.1-1999, “American National Standard-Radioactive Source Term for Normal Operation of Light Water Reactors,” American Nuclear Society/American National Standards Institute, September 21, 1999.

9. NUMARC/NESP-006, “The Management of Mixed Low-Level Radioactive Waste in the Nuclear Power Industry,” Nuclear Management Resources Council, Inc., Washington, D.C., January 1990.

Table 11.4-1—Estimated Solid Waste Annual Activity and Volume
Sheet 1 of 2

Waste Type	Quantity (ft^3)	Activity (Ci)		Shipping Volume (ft^3)		Average Curies per Package		Maximum Number of Containers
		Expected	Maximum	Expected	Maximum	Expected	Maximum	
Wet Solid Waste								
Evaporator Concentrates	710	1.50E+02	9.12E+03	-	140	7.81E+00	4.75E+02	19.2[1]
Coolant purification and spent fuel pool spent resins	90	1.07E+03	5.23E+04	90	90	1.07E+03	5.23E+04	1.0[2]
Demineralizer spent resins	140	2.96E+01	1.80E+03	140	140	1.85E+01	1.13E+03	1.6[2]
Demineralizer wet waste	8	1.69E+00	1.03E+02	8	8	1.69E+01	1.03E+03	0.1[2]
Centrifuge sludge	8	1.69E+00	1.03E+02	-	8	1.54E+00	9.36E+01	1.1[1]
Spent cartridge filters	120 ($3.40\ m^3$)	6.86E+02		120	120	5.28E+02		1.3[2]
Storage tank sludge	70	1.48E+01	9.00E+02	-	35	3.70E+01	2.25E+03	0.4[2]
Total Solid Waste (stored in drums)	1146	1.95E+03	6.50E+04	358	541			
Mixed Waste	2	4.00E-02	2.43E+00	2	2	0.13	8.10	0.3[1]

Table 11.4-1—Estimated Solid Waste Annual Activity and Volume
Sheet 2 of 2

Waste Type	Quantity (ft^3)	Activity (Ci)		Shipping Volume (ft^3)		Average Curies per Package		Maximum Number of Containers
		Expected	Maximum	Expected	Maximum	Expected	Maximum	
Dry Active Waste								
Noncompressible DAW	70	2.97E-01	1.81E+01	70	70	2.97E+00	1.81E+02	0.1[3]
Compressible DAW	1415	6.01E+00	3.66E+02	707	707	4.29E+00	2.61E+02	1.4[3]
Combustible DAW	5300	3.19E+01	1.94E+03	5300	5300	6.02E+00	3.66E+02	5.3[3]
Total Dry Active Waste	6785	3.82E+01	2.32E+03	varies	varies	varies	varies	varies
Total								
Overall Totals	7933	1.99E+03	6.73E+04	varies	varies	varies	varies	varies

Notes:

1. 55 gal drum.
2. 8-120 HIC.
3. SEALAND.

Table 11.4-2—Noncompressible DAW Annual Activity

Nuclide	Expected Activity (Ci)[1]	Maximum Activity (Ci)
H-3	3.99E-03	2.43E-01
Be-7	2.09E-04	1.27E-02
C-14	2.24E-03	1.36E-01
Cr-51	7.22E-03	4.39E-01
Mn-54	2.87E-03	1.75E-01
Fe-55	1.05E-01	6.40E+00
Fe-59	4.13E-04	2.51E-02
Co-58	3.96E-02	2.41E+00
Co-60	4.14E-02	2.52E+00
Ni-59	5.46E-04	3.32E-02
Ni-63	2.80E-02	1.70E+00
Zn-65	8.93E-04	5.43E-02
Sr-89	6.23E-04	3.79E-02
Sr-90	4.11E-03	2.50E-01
Zr-95	3.49E-03	2.12E-01
Nb-95	6.57E-03	4.00E-01
Ru-106	5.87E-04	3.57E-02
Ag-108m	9.76E-04	5.93E-02
Ag-110m	1.57E-03	9.52E-02
Sn-113	7.37E-05	4.48E-03
Sb-124	5.32E-04	3.24E-02
Sb-125	1.75E-03	1.06E-01
I-129	4.24E-05	2.58E-03
I-131	4.29E-04	2.61E-02
Cs-134	9.59E-03	5.83E-01
Cs-137	3.15E-02	1.91E+00
Ba-140	6.11E-04	3.72E-02
La-140	6.09E-04	3.70E-02
Ce-144	9.19E-04	5.59E-02
Pu-241	9.49E-04	5.77E-02
Total	**2.97E-01**	**1.81E+01**

Note:

1. The expected activity is based on industry data from NUREG-2907 (Reference 7). The maximum activity is based on 0.25% failed fuel fraction.

Table 11.4-3—Compressible DAW Annual Activity

Nuclide	Expected Activity (Ci)[1]	Maximum Activity (Ci)
H-3	8.07E-02	4.90E+00
Be-7	4.22E-03	2.56E-01
C-14	4.53E-02	2.76E+00
Cr-51	1.46E-01	8.87E+00
Mn-54	5.80E-02	3.53E+00
Fe-55	2.13E+00	1.29E+02
Fe-59	8.34E-03	5.07E-01
Co-58	8.01E-01	4.87E+01
Co-60	8.37E-01	5.09E+01
Ni-63	5.65E-01	3.44E+01
Ni-59	1.10E-02	6.72E-01
Zn-65	1.80E-02	1.10E+00
Sr-89	1.26E-02	7.65E-01
Sr-90	8.30E-02	5.05E+00
Zr-95	7.06E-02	4.29E+00
Nb-95	1.33E-01	8.08E+00
Ru-106	1.19E-02	7.21E-01
Ag-108m	1.97E-02	1.20E+00
Ag-110m	3.17E-02	1.93E+00
Sn-113	1.49E-03	9.05E-02
Sb-124	1.08E-02	6.54E-01
Sb-125	3.54E-02	2.15E+00
I-129	8.58E-04	5.21E-02
I-131	8.67E-03	5.27E-01
Cs-134	1.94E-01	1.18E+01
Cs-137	6.36E-01	3.87E+01
Ba-140	1.24E-02	7.51E-01
La-140	1.23E-02	7.48E-01
Ce-144	1.86E-02	1.13E+00
Pu-241	1.92E-02	1.17E+00
Total	**6.01E+00**	**3.66E+02**

Note:

1. The expected activity is based on industry data from NUREG-2907 (Reference 7). The maximum activity is based on 0.25% failed fuel fraction.

Table 11.4-4—Combustible DAW Annual Activity

Nuclide	Expected Activity (Ci)[1]	Maximum Activity (Ci)
C-14	2.22E-01	1.35E+01
Cr-51	3.35E-01	2.04E+01
Mn-54	8.55E-01	5.20E+01
Fe-55	1.58E+01	9.61E+02
Co-58	4.41E+00	2.68E+02
Co-60	4.67E+00	2.84E+02
Ni-63	3.86E+00	2.35E+02
Zr-95	1.80E-01	1.09E+01
Nb-95	4.86E-01	2.95E+01
Ru-106	1.57E-01	9.55E+00
Ag-110m	2.56E-01	1.56E+01
Ba-140	1.79E-01	1.09E+01
La-140	1.79E-01	1.09E+01
Pu-241	3.19E-01	1.94E+01
Total	**3.19E+01**	**1.94E+03**

Note:

1. The expected activity is based on industry data from NUREG-2907 (Reference 7). The maximum activity is based on 0.25% failed fuel fraction.

Table 11.4-5—Total Dry Active Waste Annual Activity

Nuclide	Expected Activity (Ci)[1]	Maximum Activity (Ci)
H-3	8.47E-02	5.14E+00
Be-7	4.43E-03	2.69E-01
C-14	2.70E-01	1.64E+01
Cr-51	4.88E-01	2.97E+01
Mn-54	9.16E-01	5.57E+01
Fe-55	1.80E+01	1.10E+03
Fe-59	8.75E-03	5.32E-01
Co-58	5.25E+00	3.19E+02
Co-60	5.55E+00	3.37E+02
Ni-59	1.15E-02	7.05E-01
Ni-63	4.45E+00	2.71E+02
Zn-65	1.89E-02	1.15E+00
Sr-89	1.32E-02	8.03E-01
Sr-90	8.71E-02	5.30E+00
Zr-95	2.54E-01	1.54E+01
Nb-95	6.26E-01	3.80E+01
Ru-106	1.69E-01	1.03E+01
Ag-108m	2.07E-02	1.26E+00
Ag-110m	2.89E-01	1.76E+01
Sn-113	1.56E-03	9.50E-02
Sb-124	1.13E-02	6.86E-01
Sb-125	3.72E-02	2.26E+00
I-129	9.00E-04	5.47E-02
I-131	9.10E-03	5.53E-01
Cs-134	2.04E-01	1.24E+01
Cs-137	6.68E-01	4.06E+01
Ba-140	1.92E-01	1.17E+01
La-140	1.92E-01	1.17E+01
Ce-144	1.95E-02	1.19E+00
Pu-241	3.39E-01	2.06E+01
Total	**3.82E+01**	**2.32E+03**

Note:

1. The expected activity is based on industry data from NUREG-2907 (Reference 7). The maximum activity is based on 0.25% failed fuel fraction.

Table 11.4-6—Evaporator Concentrates Annual Activity

Nuclide	Expected Activity (Ci)[1]	Maximum Activity (Ci)
Cr-51	2.15E-01	2.15E-01
Mn-54	1.58E+01	1.58E+01
Fe-55	1.69E+01	1.69E+01
Fe-59	1.61E-01	1.61E-01
Co-58	8.43E+00	8.43E+00
Co-60	8.20E+00	8.20E+00
Zn-65	4.40E+00	4.40E+00
Sr-89	---	7.90E-01
Sr-90	1.96E-01	8.38E-01
Y-90	1.96E-01	8.39E-01
Y-91	---	1.63E-01
Zr-95	5.78E-01	2.15E-01
Nb-95	1.16E+00	4.40E-01
Ru-103	2.51E+00	4.05E-02
Ru-106	1.95E+00	4.58E-01
Rh-103m	2.26E+00	3.65E-02
Rh-106	---	4.58E-01
Ag-110m	1.15E+01	2.76E-03
Te-127m	---	2.75E+00
Te-129	---	2.59E-01
Te-129m	---	3.98E-01
Cs-134	2.76E+01	3.63E+03
Cs-137	4.78E+01	2.79E+03
Ba-137m	---	2.64E+03
Ce-144	7.53E-02	1.04E+00
Pr-144	---	1.04E+00
Total	**1.50E+02**	**9.12E+03**

Note:

1. The expected activity is based on ANSI 18.1-1999 (Reference 8) standard and industry data. The maximum activity is based on 0.25 percent failed fuel fraction. Activity levels include a 6-month decay period to account for processing and inprocess storage and handling time.

Table 11.4-7—Annual Activity for Spent Resins from Radwaste Demineralizer

Nuclide	Expected Activity (Ci)[1]	Maximum Activity (Ci)
Cr-51	4.24E-02	4.24E-02
Mn-54	3.12E+00	3.12E+00
Fe-55	3.33E+00	3.33E+00
Fe-59	3.17E-02	3.17E-02
Co-58	1.66E+00	1.66E+00
Co-60	1.62E+00	1.62E+00
Zn-65	8.68E-01	8.68E-01
Sr-89	---	1.56E-01
Sr-90	3.86E-02	1.65E-01
Y-90	3.86E-02	1.65E-01
Y-91	---	3.21E-02
Zr-95	1.14E-01	4.24E-02
Nb-95	2.29E-01	8.68E-02
Ru-103	4.95E-01	7.99E-03
Ru-106	3.85E-01	9.03E-02
Rh-103m	4.46E-01	7.20E-03
Rh-106	---	9.03E-02
Ag-110m	2.27E+00	5.44E-04
Te-127m	---	5.42E-01
Te-129	---	5.11E-02
Te-129m	---	7.85E-02
Cs-134	5.44E+00	7.16E+02
Cs-137	9.43E+00	5.50E+02
Ba-137m	---	5.21E+02
Ce-144	1.48E-02	2.05E-01
Pr-144	---	2.05E-01
Total	**2.96E+01**	**1.80E+03**

Note:

1. The expected activity is based on ANSI 18.1-1999 (Reference 8) standard and industry data. The maximum activity is based on 0.25 percent failed fuel fraction. Activity levels include a 6-month decay period to account for processing and inprocess storage and handling time.

Table 11.4-8—Annual Activity for Wet Waste from Demineralizers or Centrifuge Sludge

Nuclide	Expected Activity (Ci)[1]	Maximum Activity (Ci)
Cr-51	2.42E-03	2.42E-03
Mn-54	1.78E-01	1.78E-01
Fe-55	1.90E-01	1.90E-01
Fe-59	1.81E-03	1.81E-03
Co-58	9.50E-02	9.50E-02
Co-60	9.24E-02	9.24E-02
Zn-65	4.96E-02	4.96E-02
Sr-89	---	8.90E-03
Sr-90	2.21E-03	9.44E-03
Y-90	2.21E-03	9.45E-03
Y-91	---	1.84E-03
Zr-95	6.51E-03	2.42E-03
Nb-95	1.31E-02	4.96E-03
Ru-103	2.83E-02	4.56E-04
Ru-106	2.20E-02	5.16E-03
Rh-103m	2.55E-02	4.11E-04
Rh-106	---	5.16E-03
Ag-110m	1.30E-01	3.11E-05
Te-127m	---	3.10E-02
Te-129	---	2.92E-03
Te-129m	---	4.48E-03
Cs-134	3.11E-01	4.09E+01
Cs-137	5.39E-01	3.14E+01
Ba-137m	---	2.97E+01
Ce-144	8.48E-04	1.17E-02
Pr-144	---	1.17E-02
Total	**1.69E+00**	**1.03E+02**

Note:

1. The expected activity is based on ANSI 18.1-1999 (Reference 8) standard and industry data. The maximum activity is based on 0.25 percent failed fuel fraction. Activity levels include a 6-month decay period to account for processing and inprocess storage and handling time.

Table 11.4-9—Annual Activity for Storage Tank Sludge

Nuclide	Expected Activity (Ci)[1]	Maximum Activity (Ci)
Cr-51	2.12E-02	2.12E-02
Mn-54	1.56E+00	1.56E+00
Fe-55	1.67E+00	1.67E+00
Fe-59	1.59E-02	1.59E-02
Co-58	8.31E-01	8.31E-01
Co-60	8.08E-01	8.08E-01
Zn-65	4.34E-01	4.34E-01
Sr-89	---	7.79E-02
Sr-90	1.93E-02	8.26E-02
Y-90	1.93E-02	8.27E-02
Y-91	---	1.61E-02
Zr-95	5.70E-02	2.12E-02
Nb-95	1.14E-01	4.34E-02
Ru-103	2.47E-01	3.99E-03
Ru-106	1.92E-01	4.52E-02
Rh-103m	2.23E-01	3.60E-03
Rh-106	---	4.52E-02
Ag-110m	1.13E+00	2.72E-04
Te-127m	---	2.71E-01
Te-129	---	2.55E-02
Te-129m	---	3.92E-02
Cs-134	2.72E+00	3.58E+02
Cs-137	4.71E+00	2.75E+02
Ba-137m	---	2.60E+02
Ce-144	7.42E-03	1.03E-01
Pr-144	---	1.03E-01
Total	**1.48E+01**	**9.00E+02**

Note:

1. The expected activity is based on ANSI 18.1-1999 (Reference 8) standard and industry data. The maximum activity is based on 0.25 percent failed fuel fraction. Activity levels include a 6-month decay period to account for processing and inprocess storage and handling time.

Table 11.4-10—Cartridge Filter Annual Activity

Nuclide	Activity[1] (Ci)
Cr-51	9.78E-01
Mn-54	1.97E+02
Fe-55	2.52E+02
Fe-59	8.70E-01
Co-58	5.67E+01
Co-60	1.28E+02
Zn-65	5.10E+01
Total	**6.86E+02**

Note:

1. Activity levels include a 6-month decay period to account for processing and inprocess storage and handling time.

Table 11.4-11—Coolant Purification System Spent Resin Annual Activity

Nuclide	Expected Activity (Ci)[1]	Maximum Activity (Ci)
Cr-51	---	7.04E-01
Mn-54	1.41E+02	1.41E+02
Fe-55	1.81E+02	1.81E+02
Fe-59	---	6.26E-01
Co-58	4.08E+01	4.08E+01
Co-60	9.22E+01	9.22E+01
Zn-65	3.66E+01	3.66E+01
Sr-89	---	3.20E+00
Sr-90	2.29E+00	9.81E+00
Y-90	2.29E+00	9.81E+00
Y-91	---	7.16E-01
Zr-95	2.65E+00	9.88E-01
Nb-95	5.45E+00	2.06E+00
Ru-103	9.19E+00	1.48E-01
Ru-106	1.81E+01	4.25E+00
Rh-103m	8.28E+00	1.34E-01
Rh-106	---	4.25E+00
Ag-110m	9.61E+01	2.32E-02
Te-127m	---	1.66E+01
Te-129m	---	1.38E+00
Cs-134	1.47E+02	1.94E+04
Cs-137	2.85E+02	1.66E+04
Ba-137m	---	1.57E+04
Ce-141	---	7.22E-02
Ce-144	6.56E-01	9.09E+00
Pr-143	---	1.43E-04
Pr-144	---	9.09E+00
Total	**1.07E+03**	**5.23E+04**

Note:

1. The expected activity is based on ANSI 18.1-1999 (Reference 8) standard and industry data. The maximum activity is based on 0.25 percent failed fuel fraction. Activity levels include a 6-month decay period to account for processing and inprocess storage and handling time.

Table 11.4-12—Total Wet Solid Waste Annual Activity

Nuclide	Expected Activity (Ci)[1]	Maximum Activity (Ci)
Cr-51	1.26E+00	1.97E+00
Mn-54	3.59E+02	3.59E+02
Fe-55	4.55E+02	4.55E+02
Fe-59	1.08E+00	1.71E+00
Co-58	1.09E+02	1.09E+02
Co-60	2.31E+02	2.31E+02
Zn-65	9.34E+01	9.34E+01
Sr-89	0.00E+00	4.24E+00
Sr-90	2.55E+00	1.09E+01
Y-90	2.55E+00	1.09E+01
Y-91	0.00E+00	9.31E-01
Zr-95	3.41E+00	1.27E+00
Nb-95	6.98E+00	2.64E+00
Ru-103	1.25E+01	2.01E-01
Ru-106	2.07E+01	4.85E+00
Rh-103m	1.13E+01	1.82E-01
Rh-106	0.00E+00	4.85E+00
Ag-110m	1.11E+02	2.68E-02
Te-127m	0.00E+00	2.02E+01
Te-129m	0.00E+00	1.90E+00
Cs-134	1.83E+02	2.42E+04
Cs-137	3.48E+02	2.03E+04
Ba-137m	0.00E+00	1.92E+04
Ce-141	0.00E+00	7.22E-02
Ce-144	7.55E-01	1.05E+01
Pr-144	0.00E+00	1.05E+01
Total	**1.95E+03**	**6.50E+04**

Note:

1. The expected activity is based on ANSI 18.1-1999 (Reference 8) standard and industry data. The maximum activity is based on 0.25 percent failed fuel fraction.

Table 11.4-13—Mixed Waste Annual Activity

Nuclide	Expected Activity (Ci)[1]	Maximum Activity (Ci)[1]
H-3	5.37E-04	3.26E-02
Be-7	2.81E-05	1.71E-03
C-14	3.01E-04	1.83E-02
Cr-51	9.71E-04	5.90E-02
Mn-54	3.86E-04	2.35E-02
Fe-55	1.41E-02	8.60E-01
Fe-59	5.55E-05	3.37E-03
Co-58	5.33E-03	3.24E-01
Co-60	5.57E-03	3.39E-01
Ni-59	7.35E-05	4.47E-03
Ni-63	3.76E-03	2.29E-01
Zn-65	1.20E-04	7.30E-03
Sr-89	8.37E-05	5.09E-03
Sr-90	5.52E-04	3.36E-02
Zr-95	4.69E-04	2.85E-02
Nb-95	8.84E-04	5.37E-02
Ru-106	7.89E-05	4.80E-03
Ag-108m	1.31E-04	7.98E-03
Ag-110m	2.11E-04	1.28E-02
Sn-113	9.90E-06	6.02E-04
Sb-124	7.15E-05	4.35E-03
Sb-125	2.35E-04	1.43E-02
I-129	5.70E-06	3.47E-04
I-131	5.77E-05	3.51E-03
Cs-134	1.29E-03	7.84E-02
Cs-137	4.23E-03	2.57E-01
Ba-140	8.22E-05	5.00E-03
La-140	8.18E-05	4.98E-03
Ce-144	1.24E-04	7.51E-03
Pu-241	1.28E-04	7.76E-03
Total	**4.00E-02**	**2.43E+00**

Note:

1. The activities are based on nuclear power industry data from NUMARC/NESP-006 (Reference 9), NUREG/CR-2907 (Reference 8), and data in Table 11.4-6.

Table 11.4-14—Solid Waste Management System Component Data

Components/Parameters	Nominal Value
Resin Proportioning Tank	
Number	1
Total Volume	150 gallons
Material	Stainless Steel
Concentrate Buffer Tank	
Number	1
Total Volume	3000 gallons
Material	Stainless Steel
Condensate Collection Tank	
Number	1
Total Volume	150 gallons
Material	Stainless Steel
Concentrate Recirculation Pump	
Number	1
Type	Centrifugal
Design Flow Rate	50 gpm
Material	Stainless Steel
Condensate Collection Pump	
Number	1
Type	Centrifugal
Design Flow Rate	15 gpm
Material	Stainless Steel
Drum Drying Stations	
Number	3
Material	Stainless Steel
Condenser Drying Units	
Number	1
Type	Tube Bundle Heat Exchanger
Design Flow Rate (shell/tube)	< 1/5 gpm
Temperature Inlet (shell/tube)	140°F/100°F
Temperature Outlet (shell/tube)	< 110°F/120°F
Material	Stainless Steel

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