9.3 SOLID RADWASTE SYSTEM

9.3.1 Power Generation Objective

The objective of the Solid Radwaste System is to collect, process, store, package, and prepare for shipment solid radioactive waste materials produced through operation of the three reactor units.

9.3.2 Power Generation Design Basis

1. The Solid Radwaste System shall be capable of handling the following types of wet solid wastes: Reactor Water Cleanup System Sludge, Condensate System Sludge, Fuel Pool Demin, Waste and Floor Drain Filter Sludge, Waste Demin Resins, and Thermex Sludge.

2. The system shall be capable of handling contaminated dry wastes, such as rags, paper, spent filter elements, used laboratory apparatus, used parts and equipment, and tools.

3. The system shall be capable of handling irradiated reactor components, such as spent control rods, and incore instruments.

9.3.3 Safety Design Basis

1. Packaged solid wastes shall comply with appropriate regulations of the U.S. Nuclear Regulatory Commission (10 CFR 71), 10 CFR 61 and U.S. Department of Transportation (49 CFR 170-189) disposal site criteria and the states through which the wastes pass enroute to the disposal area and disposal site criteria.

2. The Solid Radwaste System shall be designed so that operations can be conducted without exceeding maximum permissible radiation dosage to operating personnel.

9.3.4 Description (See Figures 9.2-3a, 9.2-3d, 9.2-3e, and 9.2-3f)

9.3.4.1 Wet Solid Wastes

Wet solid wastes consist of spent powdered ion exchange resins, filter aid sludge, and bead-type ion exchange resins. These are stored, packaged, and prepared for shipment in the Radwaste Building.

Storage

Spent powdered ion exchange resin and filter aid sludge are accumulated and stored in phase separator tanks. Batches of slurried materials are pumped into the tanks, where the solids settle out. The supernatant liquid is decanted off to make room for more slurry. Successive batches are accumulated until the desired settled slurry volume has been reached. After an appropriate decay period, the sludge is reslurried and pumped to the packaging area.

The cleanup phase-separator tanks are closed-top, vertical cylinders with conical bottoms. Each has an overflow outlet leading to the Radwaste Building equipment drain sump. Decant outlets are located at three levels above the maximum settled sludge level. A bottom outlet leads to the suction of a sludge transfer pump. To ensure complete reslurrying, sludge pump discharge flow is directed through a set of eductors located in the settled sludge region. A flow through the eductors is maintained throughout the slurry transfer period.

The condensate phase-separator tanks are vertical cylinders with conical bottoms. Each has an overflow outlet leading to the Radwaste Building equipment drain sump. Decant outlets are located at three levels above the maximum settled sludge level. A bottom outlet leads to the suction of a sludge transfer pump. To ensure complete reslurring, sludge pump discharge flow and air operated spargers are used to stir up the settled sludge. Air flow through the sparger is maintained throughout the slurry transfer period.

High-activity-level sludge from the reactor water cleanup filter-demineralizers is stored in three cleanup phase-separator tanks. Each has a total capacity of about 785 cubic feet, which consist of water and settled sludge. The tanks are of stainless steel. Normal operating requirements can be met with two tanks with a 60-day decay period. The third tank provides operating flexibility and additional decay time.

Six condensate phase-separator tanks are provided for storage of sludge from the condensate, the fuel pool filter-demineralizers, and the waste and floor drain filters. Sludge from the various sources may be mixed in the six tanks or segregated. Each tank has a total capacity of about 1850 cubic feet which consist of water and settled sludge. The tanks are fabricated out of stainless steel.

Bead-type ion exchange resins from the waste demineralizer are stored in the spent resin tank. The tank is a closed-top, vertical cylinder with a conical bottom. It has a capacity of 245 cubic feet and is capable of holding the resin and water resulting from one backwash of the waste demineralizer. The tank is made of stainless steel. The spent resin remains in the tank until operations personnel determine it needs to be transferred. From the tank the spent resin is transferred to the phase separators where it is mixed with other sludges. After mixing it is sent to the packaging area.

Thermex sludge is stored in a shielded container located in the Radwaste Building.

Packaging

The packaging system is designed to permit the use of several different types of containers. These include disposable tanks (liners) in reusable shields constructed of carbon steel or high density polyethylene plastic. Each type of container has a slurry inlet connection and a vent connection. A connection is provided also for the attachment of a level indicator during filling of the container. A diagram of the packaging system is shown in Figure 9.2-3f.

Prior to a packaging run, a container is positioned at one of two dewatering systems, either in a shipping cask or in a shielded enclosure. For a condensate phase-separator, hoses are connected and the sludge pump and air-operated spargers are used to stir up the settled sludge in the phase-separator and bring it into suspension. For a cleanup phase-separator, eductors are used to mix the slurry instead of air spargers. The slurry then is pumped to the loading station and back to the phase-separator tank. A portion of the slurry is drawn off into the waste package until the package is nearly filled. Water is withdrawn through the built-in filter elements via the portable dewatering system(s) and drained into the waste package drain tank via one of the drain header valves shown in Figure 9.2-3f. This process is repeated until the package is nearly full of dewatered slurry. The portable dewatering system hoses are disconnected, package penetrations are plugged, and the package is prepared for onsite storage or offsite shipment.

Thermex sludge is packaged and shipped offsite for further processing if required. Processed sludge may be shipped to a licensed disposal facility or returned to BFN for onsite storage in an approved storage area.

9.3.4.2 Dry Solid Wastes

Dry solid wastes include contaminated rags, paper, clothing, spent filter elements, laboratory apparatus, small parts and equipment, and tools. Items of dry solid waste are collected in suitable containers located throughout the plant.

Spent elements from air and gas filtration systems, liquid filter elements from the filter demineralizers and laundry system, and elements from the offgas system, which may have a high-radiation level, are packaged in accordance with applicable burial site requirements prior to being transported for processing, burial, or approved onsite storage. Low-level solid wastes, such as sand, dewatered sludges, dewatered resins, overpacked damp or wet wastes and solidified or stabilized wastes, may be stored onsite in approved storage areas. In such instances a maximum curie inventory of 325 curies will not be exceeded. After a period of storage, the containers are removed from the storage area and prepared for disposal.

Shielded containers are provided for offsite shipment of high-activity waste if required.

Waste may be shipped offsite to a processor for volume reduction.

An equipment decontamination unit is in operation allowing equipment and tools previously disposed of as radioactive material to be placed back into inventory or disposed of as clean trash.

Some LLW, stored in drums or boxes, are placed in trailers until they can be sent to commercial processing or disposal facilities or transferred to approved onsite storage facilities.

9.3.4.2.1 Onsite Storage Facility (OSF)

In order to provide storage for low-level radioactive waste (LLRW), an onsite storage facility has been constructed. This facility is located on the Browns Ferry Nuclear Plant reservation outside the existing security fence. The grade elevation is approximately 574 feet above sea level, which is above the probable maximum flood elevation.

The LLRW facility is comprised of module number 2. The module is designed to contain radioactive waste generated at Browns Ferry and is segmented into compartments. Radioactive wastes will be stored in High Integrity Containers (HICs) within those compartments. The module is an above ground, safety-related structures constructed of reinforced concrete. Access to the module is provided only from above and is primarily used for placing LLRW in or removing LLRW from the modules. The module is designed to resist loads resulting from extreme environmental events, such as high winds, tornadoes, and seismic events. The structural characteristics of the OSF meet or exceed the criteria applicable to the Browns Ferry site.

The storage module’s foundation is composed of concrete base slab and walls, placed on either in situ soil or compacted fill. The module’s compartment is provided with internal liquid drainage and collection capability routed to an external point for sampling and collection. The external collection point is surrounded by a covered concrete sump connected to the module.

The sump for the module compartment will be used as a passive sump to collect any liquid. The liquid will be sampled as necessary to detect the presence of water and/or radioactive releases in the module. The OSF structure is designed to contain (within the module) all fire suppression water from a design basis fire in a way that will not preclude processing of the water (if determined to be radioactive) using the existing BFN liquid radioactive waste treatment system.

The module is enclosed within an access controlled security fence.

9.3.4.3 Irradiated Reactor Components

Spent control rods and incore instrument strings and other miscellaneous irradiated components are stored in the spent fuel pools. They are loaded into shielded containers under water. These containers may then be stored onsite in approved areas or shipped offsite.

9.3.5 Power Generation Evaluation

The system is capable of handling the necessary types, quantities and radioactivity levels of solid waste materials. Therefore, the Solid Radwaste System fulfills the power generation design bases.

9.3.6 Safety Evaluation

A study of containers for shipping spent resins and filter aid was made under a contract awarded by TVA. The purpose of this study was to develop and test designs for licensable containers.

All containers used to package low-level spent resins or filter media for offsite shipment have been approved for use by NRC and/or authorized by the Department of Transportation. Spent control rods, irradiated components, and spent resins or filter media, may also be shipped in shielded containers owned by vendors.

Filling of containers with spent resins and filter aid is carried out without significant radiation exposure to personnel. Containers being filled are usually inside shields. Container connections are designed so that hose connections can be disconnected and plugs inserted easily and quickly. Filling lines may be rinsed with condensate before personnel enter the packaging area. Personnel involved with the entire operation of filling, disconnecting, plugging, and loading of solid radwaste will adhere to the various plant radiological procedures to maintain radiation exposures as low as reasonably achievable.

It is therefore concluded that the safety design bases are met.

9.3.7 Inspection and Testing

Prior to operation with radioactive materials, the wet solids handling system was tested with nonradioactive spent powdered resin, filter aid, and bead resin to determine performance characteristics of the system.