11.2.1 RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM

The radioactive liquid waste disposal equipment and piping systems are all housed within structures that are designed in accordance with seismic Category I and are designed to retain their integrity in the highly unlikely event of an aircraft incident **with the exception of that equipment located in the Chemical Cleaning Building (CCB). The CCB has a seismic bath tub but is not aircraft hardened. Some limited piping is located underground or in non-seismic structures.** The major equipment components of the liquid waste disposal system are tanks, pumps, precoat filters, demineralizers, evaporators, coolers, and floor and equipment drains with associated sumps. All such major components which would normally (per design basis) present a radiation hazard to plant personnel are contained within cubicles that are separated from normally occupied areas and adjacent equipment by thick concrete walls. Access to the cubicles is restricted by concrete walls forming labyrinth entry ways. The building ventilation system provides an air velocity barrier (from occupied area to the cubicle) across the entry way door to prevent airborne radioactive particulates or gases from contaminating the atmosphere of occupied areas. Area radiation monitors are strategically located to warn of excessive radiation levels within the area surveyed. Section 11.4 describes the radiation monitoring system in detail.

11.2.1.1 System Functions

The Liquid Waste Disposal System provides operating service functions to the reactor coolant system and spent fuel pools in addition to the collection, containment, and processing of miscellaneous wastes for reuse or disposal. The functions provided are listed below for each case.

a. Operating Service Functions to Reactor Coolant System and Spent Fuel Pools

   1) Chemical shim and volume control for the Reactor Coolant System.

   2) Pressurizer relief suppression, containment, and collection.

   3) Drain and fill the Reactor Coolant System.

   4) Clean up spent fuel pool water.

   5) Process reactor coolant and refueling water for reuse or disposal.

   6) Process spent fuel pool water for reuse or disposal.

b. Miscellaneous Functions

1) Process miscellaneous wastes from the following:

    a. Radioactive laboratory drains
    b. Building and equipment drains and sumps, including applicable ones in TMI-2
    c. Regeneration of deborating resins
    d. Discharge of spent resins from demineralizers
    e. Discharge of used precoat from precoat filters

2) Process potentially radioactive shower drain waste for disposal.

3) Safely dispose of waste liquids from both functions 1) and 2) above to the river.

4) Provide a means for collection, containment and sampling of potentially contaminated oil for final dispositioning.

The Liquid Waste Disposal System provides for the recovery of concentrated boric acid and purified water from the reactor coolant, the refueling water, and the spent fuel pool water processed in it.

11.2.1.2 System Description

The liquid waste disposal system process flow diagrams are shown on Drawings 302690, 302691, 302692, 302693, 302695 Sh 1, 302695 Sh 2, and 302697. Liquid Waste Disposal System component data are given in Table 11.2-1. Liquid waste processing equipment is essentially divided into two separate trains.

One train provides operating service functions to the Reactor Coolant System and the spent fuel pools (as listed in Subsection 11.2.1.1). This equipment is hereafter referred to as the reactor coolant train. The second train provides storage, treatment, and/or concentration for reuse or disposal for all miscellaneous radioactive wastes. It is hereafter referred to as the miscellaneous waste train. The equipment associated with the reactor coolant train is shown principally on **Drawings 302690 and 302691**. The reactor coolant evaporator and reclaimed boric acid storage tanks are shown on **Drawing 302692**. The reactor coolant and waste evaporators are cross-connected so either evaporator can serve either function if required.

The equipment of the liquid waste disposal system normally associated with the reactor coolant train and that associated with the miscellaneous waste train are identified in Table 11.2-2.

Controls that permit the operator to select tanks and pumps or demineralizers and a process piping route, as required for the function to be performed, are provided for the equipment and process lines involved in chemical shim and volume control and the filling or draining of the reactor coolant system.

Once selected, the process equipment and process lines are reserved exclusively to the function set up. The selection process is accomplished manually with separation of the individual trains as provided by procedural control.

Controls similar to those above are provided for cleanup and/or evaporation of reactor coolant and cleanup of spent fuel pool or refueling water. These controls permit the operator to set up a process route for the function required until the process path is terminated by the operator. Thus, the integrity of feed solutions to the reactor coolant system, bleed solutions from the reactor coolant system, spent fuel pool or refueling water are preserved in all stages of processing.

The only portion of the equipment normally utilized for cleanup of reactor coolant or spent fuel pool water that is utilized for processing miscellaneous waste solutions is precoat filter B. This is not a normal process route for cleanup of miscellaneous wastes. Automatic interlocks are not used in the manual mode (normal operating mode) and procedural controls are provided to prevent the inadvertent routing of miscellaneous wastes through any other item of reactor coolant processing equipment downstream of precoat filter B. The normal miscellaneous waste process routes can be selected by the operator for the function required until the operator terminates the process. Other process routes are provided for functions of infrequent occurrence or emergency situations. The process route selection is accomplished manually with separation of the individual trains by procedural control.

Liquid Waste Disposal System piping is so arranged that all liquids collected in equipment of either the reactor coolant or miscellaneous waste trains must be routed through the reactor coolant or miscellaneous waste evaporators and the condensate demineralizers and be collected in the waste evaporator condensate storage tanks or CC-T-2 before they can be discharged into the effluent from the mechanical draft cooling tower **basin**, or reused. Portable demineralizers may be used instead of the permanent evaporator and/or condensate demineralizers. A minimum effluent flow rate of 5000 gpm is always maintained from the mechanical draft cooling tower **basin** for dilution of radioactive liquid wastes during their release.

During the design of Unit 2, certain radwaste interconnections were designed to provide means of transfer for liquid radwaste between the units. With the accident at TMI-2, this transfer could have resulted in excessive contamination of Unit 1 from Unit 2 liquid radwaste. Therefore, methods were established to isolate the interconnections.

The following liquid waste disposal interfaces between Units 1 and 2 are isolated:

a. The connection from the Unit-2 Reactor Coolant Bleed Holdup Tanks to the Unit-1 Reactor Coolant Waste Evaporator.

b. The ability to transfer condensate from the Unit-1 Miscellaneous Waste Evaporator to Unit-2 Evaporator Condensate Test Tanks.

c. An interconnection to permit the movement of evaporator concentrates between units. Reclaimed boric acid as well as bottoms from the miscellaneous waste evaporator could have used this path.

d. The ability to move spent ion exchange resin between units.

NRC approval was received to allow reconnection of the interfaces. The following interface has been reestablished:

a. The contents of the Unit-2 Neutralizer Tanks, Contaminated Drain Tanks, Reactor Coolant Bleed Holdup Tanks, Auxiliary Building Sump Tank, and Miscellaneous Waste Holdup Tank can be transferred to Unit-1 for storage and processing in the Unit-1 Liquid Waste Disposal System. Similarly, Unit-1 miscellaneous waste water can be transferred to the Unit-2 Miscellaneous Waste Holdup Tank. However, the Unit-2 Neutralizer Tanks, Contaminated Drain Tanks, and the Reactor Coolant Bleed Tanks are administratively isolated. The Unit-2 Auxiliary Building Sump Tank and the Miscellaneous Waste Holdup Tank are also part of the Unit-2 Post Defueling Monitored Storage (PDMS) Program.

The three (3) sumps (asterisked in Table 11.2-2) normally collect groundwater that may seep into the areas they drain. Since they are located in areas that might conceivably receive radioactively contaminated water in the event of a pipe leak or rupture, the effluent from the sumps is intermittently discharged into the miscellaneous waste storage tank or into the Auxiliary Building sump.

It is anticipated that the activity level of the contents of the laundry waste tank (collects water from the decon showers and lavatory drains) will normally be less than 10^{-7} ûCi/cm^3. (Starting in 1986, the hot laundry was not used so water from this source was not sent to the laundry waste tank. This change would not alter the activity of the water appreciably from the original license basis of 10^{-7} ûCi/cm^3.) The contents will be pumped to the miscellaneous waste evaporator or the neutralizer feed tank for processing in the liquid waste system.

Condensate collected in the waste evaporator condensate storage tanks may be transferred to the reactor coolant bleed tanks for feed to the primary system, rather than being discharged to the river. It is also possible to transfer the waste evaporator condensate tank contents to the reclaimed water tank (of the Chemical Addition System) for miscellaneous uses throughout the radioactive waste systems.

All concentrates collected in the concentrated waste storage tanks are packaged in the solid waste disposal system for shipment offsite. As an alternative, concentrated liquid waste may be shipped offsite to a licensed processor for volume reduction prior to disposal. Concentrate collected in the reclaimed boric acid tanks may be reused in the reactor coolant system or spent fuel pools or packaged for shipment offsite.

Any wastes stored in the evaporator condensate storage tanks, the concentrated radioactive waste storage tanks, or the reclaimed boric acid tanks may be reprocessed through the waste evaporator or Reactor Coolant Evaporator for further decontamination or concentration.

Potentially contaminated oil from plant components such as pumps, motors, etc. can be placed in a collection tank where it will be contained and sampled. If contaminated, the tank can be gravity drained to the Solid Waste Disposal System for processing or it can be drained for disposal as appropriate. This separate system is located on the 331' 0" elevation in an area of the Auxiliary Building known as the Chemical Addition Room.

11.2.1.3 Methods Of Operation

While within the equipment of the liquid waste disposal system, the integrity of all solutions involved in chemical shim adjustment, volume control of reactor coolant inventory, and filling or draining of the reactor coolant system are protected by procedural controls.

Control of tritium concentration in the primary coolant is achieved by disposal, as required, of condensate produced from the evaporation of reactor coolant. The amount of condensate that must be disposed of will depend on the actual building rate of tritium in the reactor coolant.

All normally radioactive liquids collected within the liquid waste system have to pass through an evaporator, as condensate, and a mixed bed demineralizer prior to being collected for reuse or disposal to the river. A portable demineralizer may be used instead of the permanent evaporator and/or evaporator demineralizer. Such disposals to the river are on a batch basis with activity analyses (including an isotopic breakdown) of the samples from the batch being obtained prior to disposal. Based on the batch analysis and the diluent flow rate from the mechanical draft cooling tower **basin**, a maximum flow rate for the disposal of the batch is determined. The flow rate of each such batch disposal of radioactive liquids is controlled to ensure that the activity in the **basin** effluent being discharged to the river is within ODCM limits. Set points on the flow and activity monitors (providing direct surveillance over the discharge of a batch) are set accordingly before initiating the discharge.

After liquid waste enters the effluent from the mechanical draft cooling tower **basin**, the mixture travels approximately 275 ft before discharging into the west channel of the Susquehanna River, approximately 600 ft downstream of the river water intake structure.

Batches of liquid waste are not disposed of in the effluent from the mechanical draft cooling tower **basin** if the effluent's flow rate is less than 5000 gpm. Dilution credit is taken for cooling tower effluent flow rates up to 38,000 gpm. On an average annual basis for liquid waste disposal, the summation is made on the basis that the flow rate of cooling tower **basin** effluent has been the minimum 5000 gpm throughout the year. This method of operation, under design basis conditions of reactor coolant activity and quantity, assures that the activity in the cooling tower **basin** effluent is within ten times the concentration levels specified in 10CFR20.1001-20.2401, Appendix B, Table 2.

All concentrates produced from the evaporators are either reclaimed for reuse or packaged for shipment offsite. Stored liquid collected in the concentrated waste storage tank is sampled, analyzed, and, if required, chemically adjusted for Ph before disposal. All slurries (spent resin and filter precoat), produced as a result of radioactive system operation, are packaged for shipment offsite. Potentially contaminated oil is sampled for radiological content. It is disposed of by gravity drain to the Solid Waste Disposal System or by other appropriate solid waste management methods.

The processing equipment will be decided sometime in the future.

11.2.1.4 System Design Evaluation

Since most of the liquid waste disposal system equipment is contained within shielded cubicles (drained below grade) located inside Class I structures designed to withstand the hypothetical aircraft incident, it is not considered credible that any single accident could violate the multiple barriers required to release significant quantities of radioactive liquids to the environment. Two tanks and their pumps are located in the Chemical Cleaning Building (CCB) along with the space for a rented demineralizer system. The CCB has a seismic bath tub but is not aircraft hardened. The CCB has been previously evaluated (NUREG 0591) and used to hold liquid from the TMI-2 accident and to process that liquid through demineralizers located in its lower level. The radiological content of the accident water bounds that of any water expected to be generated by TMI-1.

Discharges of liquid waste are initiated in accordance with strict administrative procedures. If an operator inadvertently initiates a release of excessive amounts of liquid waste, either of two radiation monitors would terminate the release.

An analysis relative to the release of liquid wastes to the river was made and is summarized in Table 11.2-4. The analysis simulates operation of the plant wherein primary coolant is continuously let down for chemical shim adjustment and immediately goes through one cycle of cleaning followed by concentration in the evaporator for boric acid recovery. The condensate from the evaporation is processed through the evaporator condensate demineralizers, as necessary, to the evaporator condensate storage tanks. Subsequently, the condensate is sampled, analyzed, chemically adjusted for Ph if required, and disposed of to the river via the mechanical draft cooling tower **basin** effluent or reused. A summary of assumptions for the analysis is presented in Table 11.2-3.

Based on the above indicated systems and equipment, the design basis waste liquid quantities generated annually are 49,000 μCi of mixed fission products (excluding tritium) and 5.095×10^8 μCi of tritium. Using the 5000 gpm design basis number for the annual average effluent flow rate, the Unit 1 annual discharge volume for which dilution credit may be taken is 1.02×10^{13} ml. This results in an annual average concentration of mixed fission products (excluding tritium) and tritium in the plant effluent of 4.8×10^{-9} μCi/ml and 4.99×10^{-5} μCi/ml, respectively. This annual average concentration of mixed fission products (including tritium) is within concentration levels of 10CFR20.

The detailed analysis of compliance with 10CFR50 Appendix I, in accordance with Reg. Guides 1.109, 1.110, 1.111, and 1.112, is presented in References 18 and 19.

The Waste Oil Storage System has the capacity for storage of up to 700 gallons of oil in WDL-T-17 and 25,000 gallons of oil in WDL-T-27. WDL-T-17 satisfies ASME codes, it is mounted to meet Seismic Class II criteria, and is located within a Seismic Class I curbing which represents a bathtub. The associated piping serving as the principal boundary of containment of the oil is within the curbing. WDL-T-27 was designed and fabricated to NFPA and 1968 ASME code, Sec VIII. It was built Seismic I and is located in a Seismic I structure. Collected oil is typically not contaminated, however, oil has been found with gross activity levels on the order of 1.0×10^{-5} μC/ml. Worst case pathway analyses show that offsite concentrations resulting from release of the tanks is well below regulatory limits. The designs therefore provide sufficient provisions for safe operation. Oil with activity levels orders of magnitude greater than analyzed can be contained without a safety concern.

11.2.2 RADIOACTIVE GAS WASTE DISPOSAL SYSTEM

The equipment and piping of the waste gas system are all housed within structures that are designed in accordance with seismic Category I and are designed to retain their integrity in the highly unlikely event of the hypothetical aircraft incident. The major equipment components of the system are gas decay tanks and gas compressors. The gas spaces of those tanks of the liquid waste system that are listed in Table 11.2-1 as being vented to the vent header system also serve as part of the waste gas system. All major components of the waste gas system which would normally (per design basis) present a radiation hazard to plant personnel are contained within cubicles that are separated from normally occupied areas and adjacent equipment by thick concrete walls. Access to the cubicles is restricted by concrete walls forming labyrinth entry ways, each of which is provided with a door. The building ventilation system provides an air velocity barrier between occupied areas and the interiors of the cubicles to prevent possible contamination of the atmosphere of the occupied areas. The area radiation monitors serving the auxiliary building provide surveillance over equipment of the liquid waste disposal and waste gas disposal systems. Section 11.4 describes the radiation monitoring system in detail.

11.2.2.1 System Function

The waste gas system provides for the safe collection and storage of gases evolved from reactor coolant in all tanks or items of equipment where this might occur.

The following items are indicated in Table 11.2-1 as being vented to the atmosphere of the cubicles in which they are located: spent resin storage tank, used filter precoat tank, concentrated waste storage tanks, neutralizer tank, neutralizer feed tank, neutralized waste storage tank, evaporator condensate storage tank, miscellaneous waste evaporator feed tank, laundry waste tank, and the precoat filters. Although some of these items may contain highly radioactive material, essentially none of it is in the form of radioactive gases. In all cases, the radioactive material contained in these items of equipment is either in the form of crystalline, dissolved ionic, or resin-fixed ionic solids.

Also, the water in these items is either clean water (not primary coolant that has been provided from the plant supply for regenerating resin, flushing resin or filter precoat from their process beds, and so forth) or previously degassed primary coolant (concentrated waste storage tanks, and miscellaneous waste evaporator feed tank only) that contains only dissolved ionic solids. Therefore, the probability of radioactive gases evolving from the normal contents of these items of equipment is extremely low. However, in the unlikely event that significant amounts of radioactive gas did escape from any of these tanks, they would pass into the exhaust ventilation system for the Auxiliary and Fuel Handling Buildings, through the roughing, HEPA, and charcoal filters, and be sensed by the unit vent radiation monitor.

Volumetrically, hydrogen is the principal gas evolved in those tanks which normally might receive reactor coolant and is vented to the low pressure vent header system or to the waste gas compressors. The radioactive fission products, activated dissolved gases, and so forth, contribute an extremely small fraction of the total volume of gas liberated. The waste gas system has been designed to provide a blanket of inert nitrogen gas in which to collect the gases evolved from the reactor coolant. The mixture of gases collected (nitrogen, hydrogen, and radioactive gaseous isotopes) is compressed and stored for decay of the radioactive components prior to recycle (as blanket gas) or disposal to the atmosphere.

The low pressure portions of the vent header system are protected from overpressure by relief valves off the piping of the vent header proper, and by water filled loop seals or relief valves on the liquid waste storage tanks whose gas spaces form a portion of the system. Protection of tanks and piping against excessive vacuum in the event of a combination of highly unlikely equipment malfunctions has been provided. The waste gas decay tanks are protected from overpressure by individual relief valves, as are the waste gas compressors.

11.2.2.2 System Description

Drawing 302694 and Figure 11.2-7 are process flow diagrams of the Waste Gas Disposal System and the waste gas system compressors, respectively. Component data for the waste gas system are given in Table 11.2-5.

The waste gas vent header system is essentially split into two sections, one section within the Reactor Building and one section within the Auxiliary Building. Condensing water vapor or liquids, entering the section of the vent header system within containment, drain to the reactor coolant drain tank, while those entering the vent header system within the Auxiliary Building drain to the miscellaneous waste storage tank. The vent header from the reactor coolant drain tank discharges to the miscellaneous waste storage tank. The gas spaces of the miscellaneous waste storage tank and the three reactor coolant bleed tanks are joined as an intermediate gas storage area and discharge the gases they collect to the suction of the waste gas compressors via an intermediate waste gas delay tank. Make up tank gas sample return and waste gas release are routed directly downstream of the waste gas delay tank and upstream of the waste gas compressors to avoid hydrogen pockets in the low pressure radwaste liquid and gas tanks. Prior to makeup tank venting, the decay tank will be filled with diluting nitrogen to insure that the H_2 content complies with ODCM limitations.

The compressed gas portion of the waste gas system starts at the waste gas compressors and includes the three waste gas decay tanks. These tanks provide for a minimum of 30 days of storage for gases during normal operation prior to release to the atmosphere. Release is possible prior to the minimum decay time of 30 days if calculations done in accordance with Reference 27 indicate that the radioactive gas concentration is within 10CFR20 and 10CFR50, Appendix I limits. When the currently filled decay tank is pressurized to 80 psig, an automatic sequencing system preferentially selects a new waste gas decay tank for filling based on the pressure within the tank (i.e., it being less than 80 psig) and that waste gas is not being discharged from it at that time. Administrative approval is required to manually initiate either recycle or release to the atmosphere of waste gases stored in any waste gas decay tank.

11.2.2.3 Methods Of Operation

Except for initiating the makeup tank sample and waste gas venting and the recycle or disposal of compressed waste gases stored in the waste gas decay tanks, the operation of the waste gas system is entirely automatic. One waste gas compressor comes on automatically, removing gases from the vent header system as required to maintain the pressure in the system at a maximum of about 16.4 psia.

The second waste gas compressor is on standby and automatically starts, as required, to backup the running compressor. Before receiving waste gas, the decay tanks will be filled with diluting nitrogen to insure that the H_2 content complies with ODCM limitations.

Compressed waste gases are sampled shortly after the completion of filling of a waste gas decay tank. The analysis of this sample is the basis for determining whether the gas in the tank should be reused (as makeup blanket gas to the vent header system) or disposed of to the environment. If stored gas is to be recycled, recycling may be initiated at any convenient time following analysis of the initial sample.

Any release of radioactive gases from the waste gas system will be made as follows:

a. After analysis of samples taken from batches prior to their release, and establishing flow and radiation level alarm point per Reference 27.

b. Only through paths that require positive manual operation in order to effect the release.

c. Through a path in which the gas is monitored twice, once as it leaves the decay tanks, and again after it mixes with other gases in the Auxiliary Building ventilation system. Either monitor will terminate the gas discharge automatically in the event its set point is exceeded.

11.2.2.4 System Design Evaluation

Waste Gas Disposal System equipment and piping (external to the Reactor Building) are designed for pressures considerably in excess of those capable of being applied. The maximum gas pressure capability in the low pressure vent header system is positively limited to approximately 8.0 psig by relief valves and the overflow loop seals on the tanks vented to it. A highly unlikely combination of equipment malfunctions and operator inattention is required to blow the water in these loop seals. The absolute minimum volume provided by the gas spaces of tanks associated with the low pressure vent header system is approximately 4000 ft^3. The maximum gas flow rate anticipated in the system (80 scfm) would have to occur for a minimum of about 27 minutes, with no removal of gases by either waste gas compressor, before the loop seals would blow. All gas flows in the waste gas system of this order of magnitude are initiated by operator action, by either pumping water into the system from a source not connected to the vent header system, or by venting the pressurized gas space of a tank to the system. Therefore, the operator has adequate time to terminate the gas displacement or discharge in the event that both waste gas compressors fail.

The design pressure of the high pressure waste gas system piping and equipment is 150 psig while the design discharge capability of the waste gas compressors is only 80 psig. Further, each waste gas decay tank is protected by its own relief valve, which is set to relieve the tank at 85 psig. The relief valve on the discharge of the compressors is also set to relieve at 85 psig. Consequently, it is not considered credible that a rupture or major failure resulting from overpressure could occur in the piping or other components of the high pressure portion of the waste gas system.

Accidental discharges resulting from the relieving of a waste gas decay tank or compressor relief valve are not considered credible as the operator will have approximately 8 minutes (between receiving the alarm that the automatic sequencer has not been able to transfer waste gas discharge to a fresh tank, and the popping of the relief valve on the overfilled tank) in which to take the action required to get an empty, or partially empty tank on the line, and/or to terminate the gas displacement or discharge into the vent header system.

The potential for adverse concentrations of hydrogen and oxygen in the Waste Gas (WG) System is very low. A nitrogen overpressure is maintained on the WG headers; therefore, the only source of hydrogen or oxygen in the system during operation is from the Reactor Coolant System (RCS). The Makeup tank is vented directly to a Waste Gas Decay Tank (WGDT) with nitrogen dilution to minimize the potential for a combustible mixture in the vent header. The WGDT can withstand the pressure peak of a detonation.

Continuous online gas analyzers at Unit 1 monitor for hydrogen and oxygen in the waste gas system. The analyzers are described in Section 9.2.2.

Since all the piping and equipment are housed in hypothetical aircraft incident proof Class I structures, within cubicles enclosed by concrete shield walls, it is not considered credible that any physical damage could occur to the waste gas system that would release radioactive gases to the environment from any of the components of the waste gas system in an uncontrolled manner.

Although such an event is not considered credible, an analysis of the rupture of a waste gas decay tank is presented in Chapter 14 to demonstrate that the results of such an accident are well below the limits of the 10 CFR 100 guidelines.

All normal releases of radioactive waste gases from the Waste Gas Disposal System will be made in a controlled manner, with double monitoring of the release, to assure that annual average activity levels at or beyond the site boundary will be within the limits of 10CFR20.

An analysis was made of waste gas release from the Waste Gas Disposal System. The analysis assumes a maximum 90 day holdup period for compressed radioactive gases prior to their release to the environment, that all gas compressed during the year is released (no gas recycled) and averages the release over the year. Assumptions of this analysis are presented in Table 11.2-6 and the results of the analysis are summarized in Table 11.2-7.

This analysis indicates that Kr85 is essentially the sole contributor (99.9 percent) to the activity in the waste gas system's discharge to the unit vent, and that the annual average concentration resulting at the site boundary is 0.00263 MPC for the mixture estimated to be discharged.

A detailed analysis which demonstrates compliance with 10CFR50, Appendix I gaseous releases in accordance with Regulatory Guides 1.109, 1.110, 1.111, and 1.112 is presented in References 18, 19, and 27.

11.2.3 RADIOACTIVE SOLID WASTE DISPOSAL SYSTEM

Interim Mobile Solidification System for packaging radioactive solid and liquid wastes is located outside of the Auxiliary Building. Filled packages will normally be loaded aboard a truck adjacent to the Solidification Building.

Packaging of wastes for offsite shipment is in Department Of Transportation approved containers supplied and transported by a subcontractor licensed for such activity. Shipping packages are shielded with overpacks, as required.

Five general types of waste are produced, processed, and shipped from **the TMI site** as solid radioactive waste. These wastes are:

a. Concentrated liquid waste (evaporator bottoms)

b. Used precoat (spent powdered resin)

c. Spent resin (bead type)

d. Dry compactible trash

e. Dry noncompactible trash

Dry trash is either shipped offsite directly following compaction (to reduce the volume) or shipped to an offsite processor for decontamination and/or volume reduction prior to recycle or disposal. Appropriate packaging of dry trash is performed in accordance with applicable shipping and disposal regulations.

Concentrated liquid waste*, and contaminated used precoat and spent resin will be solidified prior to being shipped offsite for disposal where required by applicable regulations. When solidification is not required for contaminated precoat and spent resin, they will be properly dewatered prior to being shipped offsite for disposal. Contaminated used precoat and spent resin may be shipped to a licensed offsite processor for volume reduction prior to disposal. Permanently installed plant equipment does not currently exist to solidify radwaste.

A two part program has been initiated to solidify these wastes. For the short term, until the permanent system is available, Unit 1 will use a contractor supplied mobile solidification system.

* Note: If not being shipped for disposal, liquid waste may be shipped in liquid form to a licensed processor for volume reduction prior to disposal. The shipment must comply with DOT regulations for shipment and license conditions of the recipient.

11.2.3.1 System Function

The function of the Solid Waste Disposal System is to package radioactive solid and concentrated liquid wastes in such a manner as to ensure minimum exposure of unit personnel during the packaging process, produce waste packages that provide protection for the public during their transportation from the unit to an offsite processor or to the ultimate disposal site, and meet ultimate disposal requirements for waste packages sent for direct disposal.

11.2.3.2 System Description

The Solid Waste Disposal System consists of the concentrated waste storage tanks (WDL-T6-A and B), pumps and associated piping system, the spent resin (WDL-T-4) and used precoat (WDL-T-5) tanks, and the slurry pump and associated piping system, which are part of the Liquid Waste Disposal System and are located on the 281-ft elevation of the Auxiliary Building, the mobile waste packaging and solidification equipment and controls which are described below, the Waste Handling and Packaging Facility (WHPF), the Interim Solid Waste Staging Facility (ISWSF), the Solid Waste Staging Facility (SWSF), and the Respirator Cleaning and Laundry Maintenance (RLM) Facility. Two piping systems, one from the slurry pump serving the spent resin and used precoat storage tanks and the other from the concentrated waste pumps, provide for recirculating radioactive slurries or concentrated radioactive evaporator bottoms from the storage tanks through the waste packaging area and back to the particular source tank. Although considered an abnormal occurrence, provisions exist to drain the Waste Oil Collection tank to the mobile solidification system for disposal if oil is sufficiently contaminated.

The mobile solidification system uses cement to solidify all three types of waste in a preshielded container. The shielding is designed to be sufficient to protect operating personnel for the worst case of solidifying spent resin. A disposal liner with an internal mixer is used as the solidification container. The ratios of cement, additives, if required, and waste that will produce a dry product are determined through test solidification in a laboratory in accordance with the Process Control Plan (PCP).

The quantity of waste to be solidified is pumped into the liner. (Bead resin may be dewatered to reduce the waste volume). The mixer is started and cement is added. Mixing is continued until the mixer motor current increases indicating the mixture is beginning to set. Following visual and tactile verification of solidification, the liner and cask are closed and shipped.

The approximate solidification process rates are as follows:

Evaporator Bottoms	45 ft^3/day
Used Precoat	25 ft^3/day
Spent Resin	25 ft^3/day

The approximate radwaste production rates are as follows:

Evaporator Bottoms	20 ft^3/week
Used Precoat	<1 ft^3/week
Spent Resin	<5 ft^3/week

The available storage capacity for unsolidified radwaste is as follows:

Evaporator Bottoms	1456 ft^3
Used Precoat	300 ft^3
Spent Resin	500 ft^3

The WHPF was designed for processing and packaging DAW and contaminated tools and equipment. The following functions may be performed in the WHPF:

a. Sectioning and disassembly of large pieces of equipment to a size that will fit into packages such as a 55 gallon drum or a 4 ft x 4 ft x 6 ft strong tight container, also known as a low specific activity (LSA) box. This size reduction is accomplished by use of plasma arc and oxy-acetylene torches as well as hand-held tools.

b. Decontamination of tools and equipment by an abrasive blaster, as required.

c. Compaction of DAW.

d. Packaging uncompactible trash and equipment into LSA boxes, drums, or approved containers.

e. Temporary staging of radioactive material prior to, during, and after processing.

f. Transferring radioactive waste after processing, sorting, and/or packaging to an onsite staging facility.

Operations in the RLM Facility include the temporary staging of radioactive materials prior to, during, and after processing and compaction and packaging of DAW.

11.2.3.3 System Storage Capacity

Prior to the accident at TMI-2, the solid radwaste system installed at TMI-1 was shared by both TMI-1 and TMI-2. The TMI-2 design utilized the TMI-1 solid radwaste system to provide for the solidification of TMI-2 waste by transferring all TMI-2 wastes to TMI-1 and by solidifying them at TMI-1. As a result of the isolation/separation requirement of the October 2, 1985 NRC letter to GPUN (See GPUN document reference 5211-85-3239) authorizing TMI-1 restart (and lifting the 1979 Commission imposed shutdown order) and containing this Condition of Operation (as contained in Commission Order CLI-85-9, dated May 29, 1985), the TMI-1 solid radwaste system has been completely separated from TMI-2. However, by letter dated August 30, 1989 (Letter No. C311-89-2073) GPUN advised the NRC of certain planned activities that would involve use of TMI-1 facilities to process material contaminated at TMI-2. These activities included use of the TMI-1 laboratory to analyze TMI-2 samples, use of tools and instruments having residual contamination from TMI-2 at TMI-1, use of common shipping containers and the TMI-1 trash compactor for radioactive waste from both units and consolidation of decontamination facilities. By letter dated January 10, 1990, the NRC staff agreed that the scope of the Condition of Operation provided in the October 2, 1985 NRC letter did not preclude the types of activities discussed in GPUN letter of August 30, 1989.

The Solid Waste Disposal System also provides capability for spent resin and used precoat to be shipped either solidified with cement or dewatered in licensed shipping casks. If the waste is dewatered, the water is returned to the floor drain system and subsequently to the auxiliary building sump.

Storage capacity is provided within the liquid waste system estimated to be sufficient to provide the periods indicated below between packaging of the various wastes:

Type of Waste	Period between packagings of waste
Concentrated liquids	about 26 weeks (average)
Spent resins	about 1 year
Used precoat filter material	about 2 years
Potentially Contaminated oil	about 2 years

Based on prior analyses of samples obtained from the wastes to be packaged and the PCP, the operator determines the approximate maximum quantities of the wastes that may be put into a container. The system also has the ability to solidify contaminated oil, if necessary. The maximum capacity of the contaminated waste oil tank (WDL-T-17) is 750 gallons, which approximates the total system capacity.

11.2.3.4 System Design Evaluation

LSA waste (solidified evaporator bottoms, dry trash and other LSA waste) can be stored in existing space in the TMI-1 Auxiliary Building. Other storage space is available outside the Auxiliary Building, and has the capacity of:

a. 100, 55 gallon drums unshielded (compacted trash)

b. 20, 100 ft^3 LSA boxes unshielded

This amount of storage would provide storage for up to six months. Solidified evaporator bottoms and packaged used precoat and spent resin could be stored in the SWSF. Fifty-five gallon drums and boxes of uncompacted waste will be stored in the ISWSF. That Facility has the capacity for a minimum of six months of solid waste storage of material other than evaporator bottoms, used precoat, and spent resin.

11.2.4 OPERATING POLICY ON RADIOACTIVE DISCHARGES TO THE ENVIRONMENT

The policy for the control of radioactive discharges to the environment from the unit is (1) to discharge the minimum quantity of radioactive materials (either liquids or gases) to the environment which is consistent with the capability of the equipment provided in the unit, and (2) to meet all the conditions of the operating license and all applicable federal, state, and local regulations.

With respect to disposal of liquid wastes, no specific holdup times are utilized to take advantage of radioactive decay since the degree of reduction in the activity discharged from the unit achieved by radioactive decay is insignificant when compared to that which can be achieved by the equipment installed in the unit for decontaminating the liquid wastes. This equipment consists of cation and mixed-bed demineralizers, precoat filters, and waste evaporators, and is so interconnected that liquid wastes in any stage of processing may be reprocessed as required to reduce activity levels and quantities in the effluent from the unit. Although no credit is taken for radioactive decay of liquid wastes, it is anticipated that there will be a minimum period of about two days between the time a batch of primary coolant is letdown and the time that demineralized distillate (produced from that batch) is discharged into the effluent from the mechanical draft cooling tower **basin**.

For the design basis quantities and activity levels of liquid wastes to be discharged to the environment (see Table 11.2-3, Item e.2), credit was taken for only one pass of reactor coolant through the cation demineralizer prior to evaporation and subsequent demineralization of the evaporator distillate which is to be discharged to the environment. Since the unit is designed to recover and reconcentrate boric acid from the reactor coolant letdown for the purpose of using the concentrated boric acid produced as makeup to the Reactor Coolant System, it is necessary to achieve an average decontamination factor of about 200 for the reactor coolant (letdown over a core lifetime) prior to evaporation to ensure that the activity level in the reclaimed boric acid does not contribute to buildup of activity in the Reactor Coolant System or offer any significant radiation hazard to operating personnel. The actual decontamination factor required varies from a minimum of about 60 for letdown produced during dilution of the refueling water boric acid concentration, to 700 for letdown produced at the point in core lifetime when resin deboration replaces bleed and feed as the means of adjusting chemical shim concentration. Therefore, the actual decontamination factor achieved in the cation demineralizers during normal operation is, conservatively, about four times greater than that assumed here.

With respect to the discharge of tritium to the environment, there is no commercial equipment available to remove tritium from the liquid wastes prior to dilution in the cooling tower effluent.

In implementing the above stated policy with respect to disposal of gaseous wastes from the radwaste system, a combination of holdup for radioactive decay and filtration through roughing, HEPA and charcoal filters is utilized prior to release. For the radioactive waste gases stored in the waste gas system, a design maximum storage capacity is provided to permit storage of radioactive gases for periods of up to a maximum of 90 days during normal operation prior to release to the environment. However, it is anticipated that a minimum holdup time, prior to release, of about two weeks might be anticipated during periods when equipment has failed, malfunctioned, or is unavoidably out of service. For waste gas releases during normal operation, the minimum holdup period prior to release of gas from the waste gas system is set at 30 days decay time. Releases prior to 30 days are allowed after calculations are performed (Reference 27) to verify that the radioactive gas concentrations and their associated dose or dose commitment to an individual, in an unrestricted area, are within 10CFR20 and 10CFR50, Appendix I limits. When purging of the Reactor Building atmosphere is required to obtain access, these releases will be made through roughing and HEPA filters for removal of particulates and charcoal filters for the removal of iodine. The Kidney Filter system is utilized to decrease particulate and iodine radioactivity prior to purging.