11.2 LIQUID WASTE MANAGEMENT SYSTEMS

The Liquid Waste Management System (LWMS) collects, processes, stores, and monitors for reuse or disposal the radioactive liquid wastes generated as a result of Susquehanna SES operation. The LWMS consists of liquid radwaste, (high and low purity wastewater principally from equipment and floor drains), chemical waste, and laundry drain subsystems. Equipment location drawings are shown on Dwgs. M-270, Sh. 1, M-271, Sh. 1, M-272, Sh. 1, M-273, Sh. 1, M-274, Sh. 1, M-220, Sh. 1, and M-230, Sh. 1. A flow diagram for the LWMS subsystems is given on Figure 11.2-8 and Process and Instrumentation Diagrams (P&IDs) are presented on Dwgs. M-162, Sh. 1, M-162, Sh. 2, M-162, Sh. 3, and Dwg. M-164, Sh. 1.

11.2.1 DESIGN BASES

The objectives and criteria which form the bases for the design of the LWMS are as follows:

a. The LWMS is capable of recycling the majority of potentially radioactive wastes to condensate water quality requirements. Sufficient treatment equipment is provided to process the liquid waste from both nuclear units without impairing the operation or availability of the plant during normal operations and anticipated operational occurrences to satisfy the radiation protection requirements and design objectives of 10CFR20 and 10CFR50.

b. The LWMS has no nuclear safety-related function as a design basis.

c. Connections are provided for processing flexibility to permit the installation of vendor supplied mobile liquid processing systems. The mobile liquid processing systems are subjected to the same performance objectives as the permanently installed systems and are approved for use in accordance with applicable SSES programs and procedures.

d. Excess water or liquid wastes that cannot be processed to meet the quality requirements for recycling are sampled and discharged.

e. The LWMS is designed so that no potentially radioactive liquids can be directly discharged to the environment unless they have been monitored and diluted with the cooling tower blowdown. This results in offsite radionuclide releases, activity concentrations, and radiation exposures to individuals and the general population within the limits of 10CFR20 and 10CFR50.

f. The LWMS is designed to keep the exposure to the general population and plant personnel during normal operation and maintenance as low as reasonably achievable (ALARA).

g. The expected radionuclide activity concentrations in the LWMS process equipment are based on reactor water radioactivity concentrations corresponding to fuel defects that result in 50,000 μCi/sec noble gas release rate for one reactor unit after a 30 minute delay. The design basis radionuclide activity concentrations in the LWMS process equipment are based on reactor water radioactivity concentrations corresponding to fuel defects that result in 100,000 μCi/sec noble gas release rate for one reactor unit after a 30 minute delay.

h. The seismic and quality group classifications of the LWMS components and piping and the radwaste building are listed in Section 3.2.

i. Redundant and backup equipment, alternate process routes, interconnections, and spare volumes are designed into the system to provide for operational and unanticipated surge waste volumes due to refueling, abnormal leakage rates, decontamination activities, equipment down time, maintenance, and repair.

j. The expected daily inputs and activities to each of the three subsystems are shown in Tables 11.2-1 and 11.2-2. An evaluation of the causes for the maximum expected inputs for each subsystem shows that operational modes exclude, and the unlikely occurrence of the same failure in both units minimizes, the potential for coincidental maximum input from both units into the same subsystem.

k. Table 11.2-3 shows the design parameters for the LWMS equipment. The usage factors for pumps and processing equipment provided in Table 11.2-3 show sufficient reserve capacities for the maximum expected inputs.

l. Expected flow rates for streams shown on Figure 11.2-8, are as given in Tables 11.2-4 and 11.2-10.

m. Concurrent refuelings or cold startups are not design bases for the Station.

n. The expected and design basis radionuclide activity inventories of major LWMS components are shown in Table 11.2-5 and 11.2-6 and are based upon the following assumptions:

   1) Reactor water radionuclide activity concentrations are listed in Tables 11.1-2, 11.1-3, 11.1-4 and 11.1-5 for design conditions, and Table 11.2-9 for expected conditions.

2) Radwaste inputs, isotopic activities, and component parameters are based on data from operating plants (NUREG 0016), data collected by GE, and design and operating data for Susquehanna SES as shown in Tables 11.2-1, 11.2-2, 11.2-3, 11.2-4 and 11.2-10.

3) Decontamination factors used for determining activity retention by cleanup equipment are as follows:

Filtration:	Expected/Design Basis
Activation/Corrosion Products	10 / 100
Demineralization:	
Cesium and Rubidium	10 / 100
Anions and Other Fission Products	100 / 100

4) While a process stream is collecting in a collection or sample tank, the isotopes already in the tank are undergoing radioactive decay (see Table 11.2-11 for expected holdup times).

o. Major LWMS components are located in separate shielded compartments based on anticipated radiation levels. Accessibility for maintenance and repair while operating redundant components of the system was considered.

p. Instrumentation and controls are designed and located to minimize exposure to the operating personnel.

q. Floor drains and sloped floors are provided in equipment rooms to control the spread of contamination from leakage. Except for indoor tanks containing processed liquids (i.e. sample tanks), equipment rooms containing liquid radwaste are provided with curbs or elevated door thresholds, with drains routed to the appropriate LWMS subsystem, to minimize the potential spread of contamination from leaks or spills. The Equipment and Floor Drainage System, which includes provisions for collecting potentially radioactive liquid, chemical and detergent wastes, is discussed in Section 9.3.3.

r. Table 11.2-16 lists tanks outside reactor containment which contain potentially radioactive liquids and the provisions for high level monitoring and alarm and for collecting and processing overflow.

Atmospheric liquid radwaste tanks are provided with an overflow connection of at least the size of the largest inlet connection. (common overflow from laundry drain tanks (OT-311A&B) to chemical radwaste funnel is exempt from this requirement. Refer to Section 11.2.2.4.) The overflow is connected below the tank vent, at least one inch above the high level alarm trip point. Overflow liquid is routed to a redundant tank or to the nearest atmospheric drainage point.

Tanks located outside the reactor containment and containing radioactive materials in liquids are designed to prevent uncontrolled releases of radioactive materials due to spillage in buildings or from outdoor dikes and storage tanks. The following design features are included for tanks that may contain radioactive materials:

1) Except as noted on Table 11.2-16, tanks have provisions to monitor liquid levels, alarm potential overflow conditions, and have their overflows, drains and sample lines routed to the LWMS. Retention by an intermediate sump or drain tank, designed for handling radioactive materials and having provisions for routing to the LWMS, is employed as shown in Table 11.2-16.

2) Indoor tanks have floor drains routed to the LWMS. Retention by an intermediate sump or drain tank designed for handling radioactive materials and having provisions for routing to the LWMS is employed as shown in Table 11.2-16.

3) Outdoor tanks have a dike or retention pond capable of containing the tank contents in the event of a rupture, preventing runoff in the event of a tank overflow and providing for sampling collected liquids and routing them to the LWMS.

s. Design features provided to reduce maintenance, equipment down time, liquid leakage, radioactive gaseous releases to the building atmosphere, and to facilitate cleaning, or otherwise improve radwaste operations include the following, where practicable:

1) Automatically and manually controlled valves and instrumentation are located outside equipment rooms that contain large volumes of radioactive materials, unless required by the process.

2) Sequencer controlled valve positioning and pump operations upon manual initiation of main process steps.

3) Automatic or manual flushing of subsystems after process termination.

4) Manual override provisions for all sequencer operated and interlocked components.

5) Manholes and access ladders on storage tanks.

6) Remote manual drain valves on storage tanks.

7) Low point piping and equipment drains in isolable portions of systems.

8) Condensate flushing connections on all major piping routes.

9) Vents of LWMS tanks, filters, and demineralizer are routed to the building ventilation system filters. A slight negative pressure against atmosphere is maintained in these components when vented.

10) Welded piping connections, where practical. Line sizes over two inches are butt welded to avoid crud traps.

11) Pumps provided with mechanical seals with flush connections.

12) Pump baseplates with drip lips.

t. Processed wastes are collected in sample tanks prior to their reuse as condensate or are monitored and discharged into the cooling tower blowdown pipe for dilution before entering the Susquehanna River.

u. Control and monitoring of radioactive releases in accordance with General Design Criteria 60 and 64 of Appendix A to 10CFR50 is discussed in Subsection 11.2.3 and Section 11.5.

11.2.2 SYSTEM DESCRIPTIONS

11.2.2.1 General

The Liquid Waste Management System serves both reactor units and consists of three processing subsystems, each for collecting, processing, storing, monitoring, and dispositioning of specific types of liquid wastes according to their conductivity, chemical composition, and radioactivity. These subsystems are:

a) Liquid Radwaste Processing

b) Liquid Radwaste Chemical Processing

c) Liquid Radwaste Laundry Drain Processing

Waste influent to each of the subsystems is collected in batch tanks to allow for quality and volume monitoring before processing.

Recirculation of the collection and sample tank contents while isolated or being pumped out minimizes settling of suspended solids and provides representative grab samples. The recirculation lines with stroke limited valves guarantee a minimum pump flow for cooling in case a pump discharge valve is closed.

Recirculation and pump-out of all process tanks is remote manually initiated and ceases upon a low level signal. This protects the pumps from cavitation. Manual fill selection of multiple tanks is provided. In the automatic mode, the tanks are filled sequentially to their high level. High level alarms and level indication over the live volume range are provided in the radwaste control room.

Simultaneous filling of one tank and mixing, sampling, or processing of another is possible through separate suction and recirculation lines and pumps for each tank.

A local pressure gauge is provided in each pump discharge line. A more detailed description of the instrumentation and controls of the LWMS is contained in Section 7.7.

Suction lines of multiple pump and tank arrangements are cross-connected to provide backup capability. Manual valves and individual controls for all automatic valves and pumps also allow transfer of waste between tanks, complete pump-out of tanks for maintenance or repair, system flushing with condensate, and bypassing of process equipment.

The following subsections describe additional features of each of the three subsystems.

11.2.2.2 Liquid Radwaste Processing Subsystem

The liquid radwaste processing subsystem is used to process radioactive waste water from equipment leakage, floor drains and other sources throughout the Station. (see Table 11.2-1). A schematic flow diagram and P&IDs for the liquid radwaste processing subsystem are presented in Figure 11.2-8 and Dwgs. M-162, Sh. 1, M-162, Sh. 2 and M-162, Sh. 3.

During normal plant operation, waste water is routed directly or through local sumps to collection tanks located in the radwaste building. Three sets of twin tanks, which are not individually isolable, collect the low conductivity waste in batches. When in the Automatic Fill Mode, a radwaste building control room alarm annunciates when two out of three tank sets are unavailable and a main control room alarm annunciates when all three collection tank sets are unavailable. When all three radwaste collection tank sets are unavailable, the wastewater is routed into the liquid radwaste surge tanks. These additional two twin sets of tanks provide surge capacity for unanticipated high waste volumes. These tanks are associated with one common pump. High conductivity waste inadvertently collected in the liquid radwaste tanks can be pumped directly to the chemical waste tank.

The liquid radwaste subsystem process stream normally consists of separate filtration and demineralization. The resultant condensate quality water is collected in sample tanks and subsequently transferred for reuse in the plant or to the condensate storage tank. Excess water, or off quality water, is discharged through the monitored discharge pipe into the cooling tower blowdown pipe.

Branch lines from the liquid radwaste processing subsystem are provided for hookup to a mobile radwaste processing system. Connections from and to the liquid radwaste collection and sample tanks are provided.

Radwaste Filters

Two vertical centrifugal filters are provided for filtering low conductivity liquids. The two filters may be operated in either parallel or in series. Normally both filters are used in series. One filter may be used for filtering of liquid waste with the second used as a backup or out of service.

Normally, the filters are operated with a powdered resin precoat. Normal filtering flow is in the range of 40 to 160 gpm (nominally 100 gpm) which is 1/7 to 1/2 gpm per sq. ft. Based on operating experience, an adjustable amount of filter aid may be injected into the waste inlet stream to extend the filter run length over the full allowable differential pressure range up to 90 psi.

The precoat and filter aid pumps and tanks are supplied with the filters and are located in a normally accessible area. When used to either supplement or back up the ion exchange function of the radwaste demineralizer, the filter plates are precoated with powdered ion exchange resin.

The filtering process is terminated upon a high differential pressure alarm across the filter or when the maximum allowable cake thickness between the filter plates occurs. The latter, although not normally the cause, can be observed through an illuminated sight glass in the filter vessel shell and a filter run timer set accordingly. Experience has shown that a filter will alarm on differential pressure prior to reaching maximum cake thickness. Flow controllers keep the flow rate independent of the increasing pressure drop over a filter run length.

Upon termination of a filter run, the filter vessel is drained to the waste sludge phase separator and then centrifugally discharged to the waste mixing tanks. The filter cake is spun off the filter plates by motorized rotation of the vertical stacking shaft, and a scraper at the vessel bottom discharges it through a vertical chute into the waste sludge phase separator of the solid waste management system described in Section 11.4. After backflushing into the waste sludge phase separator, the filter is filled and ready for a fresh precoat. Normally a filter is back in service in approximately two hours.

Radwaste Demineralizer

The filtered liquid waste is processed at a nominal flow rate of 100 gpm through one nonregenerated deep bed demineralizer before entering the liquid radwaste sample tanks. The differential pressure between the vessel inlet and outlet is indicated and alarmed over an adjustable range up to 25 psi. The differential pressure and a level indication is provided on a local instrument rack and in the radwaste control room.

The effluent conductivity instrumentation is designed to indicate, record, and alarm at a high and high-high value of conductivity as specified in the Chemistry Control Program. The demineralizer inlet valve is designed to close automatically upon high-high conductivity in the effluent, high differential pressure or loss of control air or power. Experience has shown the effluent conductivity instrumentation is inaccurate and unreliable therefore the instrumentation is not operated and the alarm and isolation functions are not available. The alternate more conservative method of controlling the quality of the demineralizer effluent to the LRW sample tanks involves sampling and analysis of the tanks on a batch basis prior to return to the CST. Sample tank water within more detailed and conservative specifications than conductivity will be returned to the CST; out of specification water will be discharged to the river or reprocessed. Exhausted or fouled ion exchange resins are sluiced to the spent resin tank for subsequent dewatering and disposal.

Fresh resin beads are manually loaded through the resin addition funnel located above the demineralizer vessel and mixed inside using low pressure compressed air. The air is vented through the radwaste mist eliminator to the tank exhaust system filter described in Subsection 9.4.3. Total outage time for removal and replacement of the resin bed is approximately six hours.

11.2.2.3 Liquid Radwaste Chemical Processing Subsystem

The chemical processing subsystem generally treats high conductivity wastes from potentially radioactive sources throughout the plant as listed in Table 11.2-1. A schematic flow diagram and the P&IDs for this subsystem are provided in Figure 11.2-8 and Dwgs. M-163, Sh. 1, M-163, Sh. 2 and M-163, Sh. 3.

The high conductivity wastes are routed directly or via local sumps to the chemical processing subsystem collection tanks. Except for the chemical waste neutralizer tanks, which are located in the turbine building, all components of this subsystem are located in the radwaste building.

Two chemical waste neutralizer tanks are associated with each reactor unit. Due to their large volume relative to the chemical waste tank and with the cessation of chemical regeneration of the condensate demineralizers, these tanks are used to store waste originally collected in the chemical waste tank, as described below, prior to processing.

Two chemical waste neutralizer tank pumps recirculate the chemical waste in each tank while local grab samples are taken. In order to bring the pH value of the chemical waste in the neutralizer tanks within the required range for processing, small amounts of sulfuric acid and sodium hydroxide are injected into the system.

Various chemical solutions originating from laboratory, equipment, and sample rack drains and decontamination stations throughout the plant are collected in the chemical waste tank located in the radwaste building. Auxiliary boiler blowdown waste is also collected in the chemical waste tank due to the possibility of radioactive contamination. The chemical waste tank contents are recirculated by one of the two redundant chemical waste tank pumps while remote grab samples may be taken on the radwaste building sample rack.

The pH value of the chemical waste tank contents can be adjusted in the same manner as that of the chemical waste neutralizer tanks. Pumps for chemical wastes are provided with automatic gland seal flushing with condensate.

Liquid waste from the chemical waste tank and from the chemical waste neutralizing tanks is processed through a mobile radwaste processing system. Branch lines from the chemical processing subsystem are provided to the monitoring room near the truck loading area in the radwaste building for hookup of mobile radwaste processing systems. The chemical waste processing subsystem has been modified to allow the mobile radwaste processing equipment to discharge directly to the distillate sample tank where the processed fluid can be sampled and subsequently discharged to the environment.

The controls and instrumentation of the liquid radwaste chemical processing subsystem are as described in Subsection 11.2.2.1 except that the chemical waste neutralizer, chemical waste, and evaporator distillate sample tanks are equipped with level recording instrumentation in place of indicating instruments to provide performance records.

Mobile Radwaste Processing

The waste water collected in the chemical waste tank and the chemical waste neutralizer tanks is processed through a mobile processing system containing both filtration and selective ion removal/demineralization capabilities. A typical schematic for this system is provided on Figure 11.2-14. The system is located in the solid radwaste storage area on the 676'0" elevation of the radwaste building.

With either the chemical waste pump or a chemical waste neutralizer tank pump recirculating its respective tank contents, the waste is diverted to the mobile radwaste processing system at a flowrate of approximately 30 gpm. Effluent from the system is collected in the evaporator distillate sample tank. Bag filters may be used prior to and following the main system vessels. The main system vessels are capable of using either ion exchange media or activated carbon filtration media in order to obtain the appropriate treatment to satisfy effluent water quality requirements for discharge to the environment. The activated carbon provides mechanical filtration capability to remove the suspended solids activity while the ion exchange media removes soluble activities prior to discharge.

Process Vessels - The process vessels are fabricated of stainless steel with a design pressure of 150 psig at 200°F. The vessels are ASME code stamped and have a useful capacity of 30 ft^3. The vessels are provided with a top-mounted inlet, a top-mounted sluice line, outlet, fill, and vent connections. The inlet and outlet connections may be reduced to match the size of the process hoses. A pressure relief valve is provided on each vessel inlet line to prevent overpressure conditions when a vessel is isolated.

Bag Filter Vessel - The bag filter vessel is a standard, top-opening, stainless steel housing. The top has an O-ring seal and quick release eyebolts for rapid filter changeout. Drain and vent valves are provided.

Sluice Manifold - Charcoal/Resin sluice connections are designed to provide double isolation. Sluicing operations may be performed through a common sluice manifold or by individual sluice connections.

Process Hoses - Inlet, outlet, and sluice hoses are designed to safely operate at up to 250 psig at 250°F. They are reinforced with two or more steel braid. End connections are Camlock style quick disconnects with bolted clamps.

Instrumentation - The valve manifolds are provided with sampling vent connections, and pressure gauges. Pressure gauges are provided at the inlet, bagfilter, process vessel inlet and outlet headers, and outlet bag filter.

Charcoal/Resin Transfer/Dewatering Pump - A double diaphragm pump designed to pump a bead resin/liquid slurry from resin drums to refill the process vessels. This pump is also used to drain down the system manifold to allow hose changes without spills and may be used to dewater the filter and radwaste liners as necessary.

Radwaste Evaporators

Radwaste evaporators are physically connected and capable of being used for radwaste processing. However, with the elimination of chemical regeneration of condensate demineralizer resins, using this equipment for processing waste inputs to the chemical processing subsystem is considered to be impractical. The current plant operating practice is to utilize filtration and demineralization via the mobile processing system described above. The radwaste evaporators have been administratively removed from service. The following is a description of the as-installed evaporator equipment.

Two radwaste evaporators are piped in parallel for simultaneous operation and as backup to each other. Depending on the concentration in the shell, each radwaste evaporator can process 15 to 30 gpm of radioactive waste. Concentration is limited by precipitation of solids out of the solution and increased carry-over of iodine and other volatile activity into the distillate to approximately 25 w/o. The contents of one neutralizer tank or the chemical waste tank can be processed through one or both evaporators at the same time.

Each evaporator can separately process the contents of one tank provided the suction streams are not mixed in cross-over lines.

The radwaste evaporators are of the forced circulation design with bowed titanium tubes for chill-shock descaling. A manhole permits access to the shell for clean-out.

Heating steam is provided from the two auxiliary boilers in the turbine building, allowing both evaporators to operate during normal plant operation and reactor shutdowns.

An electric heater is provided in the evaporator shell to keep the concentrate in solution during steam interruptions and startups. The evaporators are designed for automatic unattended process operation until the desired bottom concentration, as determined by on-line indication or local grab sampling is obtained. Pump-out of the cooled concentrate as a batch, startup, and blowdown require attendance of an operator at the radwaste control room panel.

Influent to the evaporators is controlled by the level in the shell to keep the tubes submerged.

Through-put (distillate produced and feed rate) is manually set and automatically controlled by the flow of cooling water to the distillate condenser. The evaporators operate at 0-3 psig and are of fail safe design, recirculating the process streams internally when isolated.

The heating steam of the evaporators is collected and cooled in condensate return tanks for reuse in the auxiliary boilers.

A pump for recycling and returning of this condensate to the auxiliary boiler deaerator is provided with each tank. The discharge stream is monitored and, upon high conductivity that indicates an evaporator tube leak, it is diverted to the liquid radwaste collection tanks.

Service water (cooling tower water quality) is used to cool the evaporator distillate and the auxiliary steam condensate.

Instrumentation and controls of the evaporator assemblies are located in the radwaste control room and include: evaporator shell (concentrate) level indication with high and low alarms, concentrate temperature indication with low alarm, concentrate recirculation flow low alarm, shell pressure indication with high and low alarm, distillate conductivity indication with high alarm, distillate temperature indication with high and low alarms, evaporator condenser level indication with high and low alarms, condensate return tank level indication with high and low alarms, evaporator condenser cooling water inlet and outlet temperature indication, inlet flow and pH to each evaporator with a high and low pH alarm.

The evaporator shell is shielded by a concrete block wall to reduce operator exposure during maintenance and repair of the evaporator condenser, the concentrate or distillate pumps and instrumentation located in a local rack on the evaporator assembly skid.

11.2.2.4 Liquid Radwaste Laundry Drain Processing Subsystem

The laundry drain processing subsystem is located in the radwaste building. This equipment is no longer used for onsite processing of contaminated laundry wastewater. Plant laundry is shipped offsite for processing. The subsystem is used to treat the wastewater from regulated shop and cask cleaning drains as well as detergent-containing wastewater from various equipment washdown stations and personnel decontamination facilities throughout the plant. The bulk of the input to this subsystem originates from decontamination activities (floor decontamination waste). A schematic flow diagram and the P&IDs for this subsystem are provided in Figure 11.2-8 and Dwg. M-164, Sh. 1.

Influent to one of the two laundry drain tanks is selected from the radwaste control room. The two tanks are interconnected by a 4" overflow line below the overflow connection piped to the chemical radwaste sump. Each tank is associated with a pump for recirculation through an internal mixing eductor or processing of the contents through the laundry drain filters. The pumps are protected by coarse strainers in the suction lines. Both pumps and filters can be operated simultaneously. Cross-connections are provided to serve either or both filters by one pump. An internal mixing eductor in the laundry drain sample tank ensures a representative grab sample on the radwaste sample rack.

Effluent from the sample tank is discharged by one or both laundry drain sample tank pumps through the monitored discharge pipe into the cooling tower blowdown pipe. Filtrate with high conductivity can be transferred to the chemical waste tank. A return line allows recycling of sampled water back to the laundry drain tanks.

The controls and instrumentation of the liquid radwaste laundry processing subsystem are as described in Subsection 11.2.2.1, except that the laundry drain and laundry drain sample tanks are equipped with level recording instrumentation instead of indicating instruments to provide performance records of the laundry drain filters. High differential pressure through the strainers in the laundry drain tank pump suction lines is alarmed in the radwaste control room.

Laundry Drain Filters

Two banks of triplex filters are piped in parallel for simultaneous operation. Each filter bank consists of 3 individual filters arranged in parallel. The filter housings are capable of utilizing cartridge or bag filter elements, of various micron ratings, to provide flexibility to meet changing suspended solids concentration and/or particle size distribution. The purpose of these filters is to remove particulate contamination at a normal flow rate of 25 gpm per filter. The maximum flow rate per filter is 50 gpm. The filter elements are replaced when the pressure differential alarms in the radwaste control room trip at a maximum set point of 25 psid. Replacement of the filter elements is done manually because of the low expected radioactivity. Swing bolted housing closures and lift rings facilitate replacement of the cartridges. Depending on the activity level, the spent filter elements are disposed of in either the compacted solid waste or the dewatered radwaste described in Section 11.4.

11.2.3 RADIOACTIVE RELEASES

During liquid processing by the LWMS, radioactive contaminants are removed so that the bulk of the liquid can be either recycled in the plant or discharged to the environment. The radioactivity removed from the liquids is concentrated in filters and ion exchange media. These wastes are sent to the Solid Waste Management System for dewatering, packaging, and eventual shipment to a licensed burial ground. If the liquid is to be recycled back to the plant, it must meet the quality requirements for condensate makeup established by the Chemistry Control Program. If the liquid is to be discharged, the activity concentration must be consistent with the discharge criteria of 10CFR20.

Normally, most of the liquid passing through the liquid radwaste processing subsystem is recycled in the plant. However, the treatment in this subsystem is such that this liquid can be discharged from the plant, after monitoring, if required by plant water balance considerations. Normally most of the liquid passing through the chemical and laundry drain processing subsystems is discharged from the plant. Liquid processed through these subsystems may also be recycled back to the liquid radwaste subsystem for reprocessing and reuse in the plant.

The resulting doses from radioactive effluents will be within the guideline values of Appendix I to 10CFR50. In addition to the radioactivity limitations on releases, water quality standards for discharge may necessitate recycling of the water, rather than discharging.

Although the plant discharges vary as stated above, this analysis assumes the following:

a) Discharge of 2 percent of the liquid radwaste processing stream

b) Discharge of 100 percent of the chemical processing stream

c) Discharge of 100 percent of the laundry drain processing stream.

The assumptions and parameters used to calculate the yearly activity releases and their bases are given in Table 11.2-8. The yearly activity releases for each waste stream and the totals are given in Table 11.2-13.

Design and administrative controls are incorporated into the LWMS to prevent inadvertent releases to the environment. Controls include administrative procedures, operator training, redundant discharge valves, a discharge radiation monitor that alarms and initiates automatic discharge valve closure (see Section 11.5). Prior to any discharging, activity concentrations are measured in samples taken from the various sample tanks. The discharge header receives effluents from the discharge points in the LWMS shown on Figure 11.2-13. A single line is provided for radioactive plant discharges to minimize the potential for operator error.

The processed liquid radwaste that is not recycled in the plant is discharged into the cooling tower blowdown pipe on a batch basis. The flow rate is variable and controlled by a flow control valve. The discharges are mixed with the cooling tower blowdown (minimum dilution flow of 5000 gpm) to maintain the concentrations of radionuclides at the release point below the limits of 10CFR20. Expected average annual radionuclide concentrations in the discharge are compared to 10CFR20 limits in Table 11.2-14.

11.2.4 ESTIMATED DOSES

Dose calculations to assure compliance with Appendix I to 10CFR50, based on the liquid source term described above, were performed in accordance with USNRC Regulatory Guide 1.109 by use of the USNRC computer code "LADTAP." Doses were calculated to a maximum individual consuming aquatic biota, receiving shoreline exposure at the edge of the initial mixing zone, and drinking water from the nearest downstream supply (Danville). Input data for these calculations are given in Table 11.2-15.

The calculated maximum individual doses from liquid effluents are 0.34 mrem/yr/site to the total body of a child and 7.7 mrem/yr/site to the bone of a child. These doses are within the Appendix I design objectives of 6 and 20 mrem/yr/site to the total body and any organ, respectively and are a small fraction of the 10CFR20 dose limit for unrestricted access.

TABLE 11.2-1
EXPECTED DAILY INPUTS AND ACTIVITIES TO THE
LIQUID WASTE MANAGEMENT SYSTEM FROM TWO UNITS

SOURCE	EXPECTED AVERAGE FROM TWO UNITS IN NORMAL OPERATION (gpd)(1)	PRIMARY COOLANT ACTIVITY FRACTION(2) PCA	MAXIMUM EXPECTED WITH ONE UNIT COLD STARTUP, ONE UNIT NORMAL OPERATION (gpd)	NOTES
LIQUID RADWASTE				
Drywell Equipment Drains	4400	1.0	4400	About 3 gpm for the station. Recirc pump seal leak is only expected source
Drywell Floor Drains	4400		4400	About 3 gpm for the station.
Unident. floor drains	(1000)	0.001	(1000)	
Drywell cooler drains	(1400)	0.001	(1400)	
Steam valve seal leaks	(800)	1.0	(800)	
Recirc valve seal leaks	(1200)	1.0	(1200)	
Reactor Building Drains	17,248		17,248	About 12 gpm for the station.
Unident. floor drains	(2600)	0.001	(2600)	
Scram valve seal leaks	(540)	0.1	(540)	
Scram valve intern. leaks	(3800)	0.1	(3800)	
Steam valve seal leaks	(800)	0.1	(800)	
Sample drains	(9,504)	0.1	(9,504)	3.3 gpm per unit – 11 sample locations at 1200 cc/min
RCIC & HPCI line drains	(4)	0.1	(4)	
Turbine Building Central Area Drains	10,020		10,020	About 7.0 gpm for the station.
Unident. floor drains	(8000)	0.001	(8000)	
Cond. pump seal leaks	(1920)	0.001	(1920)	
CRD pump seal leaks	(100)	0.001	(100)	

TABLE 11.2-1 (Continued)
EXPECTED DAILY INPUTS AND ACTIVITIES TO THE LIQUID WASTE MANAGEMENT SYSTEM FROM TWO UNITS

SOURCE	EXPECTED AVERAGE FROM TWO UNITS IN NORMAL OPERATION (gpd)(1)	PRIMARY COOLANT ACTIVITY FRACTION(2) PCA	MAXIMUM EXPECTED WITH ONE UNIT COLD STARTUP, ONE UNIT NORMAL OPERATION (gpd)	NOTES
Turbine Building Outer Area Drains	2,000		2,000	About 2 gpm for the station not including condensate demineralizer operation.
Unident. floor drains	(2000)	0.001	(2000)	
Radwaste Building Drains	2080		2080	About 1.0 gpm for the station.
Unident. floor drains	(2000)	0.001	(2000)	
Off-gas system drains	(80)	0.1	(80)	
Reactor or Cavity Letdown to Radwaste	0		86,400	60 gpm during an outage or startup.
Suppression Pool Transfers to Radwaste	6,000	0.1	8,000	Normal 1-1/2 collection tank sets per week. Maximum 2 collection tank sets per week.
Inputs to Liquid Radwaste from Solid Radwaste				
RWCU Phase Separator Decant	340	0.002	340	
Waste Sludge Phase Separator Decant	3490	0.05	5,576	Maximum based on condensate filter operation

TABLE 11.2-1 (Continued)
EXPECTED DAILY INPUTS AND ACTIVITIES TO THE
LIQUID WASTE MANAGEMENT SYSTEM FROM TWO UNITS

SOURCE	EXPECTED AVERAGE FROM TWO UNITS IN NORMAL OPERATION (gpd)[1]	PRIMARY COOLANT ACTIVITY FRACTION[2] / PCA	MAXIMUM EXPECTED WITH ONE UNIT COLD STARTUP, ONE UNIT NORMAL OPERATION (gpd)	NOTES
Spent Resin Tank Decant	80	0.05	80	
TOTAL	50,058		140,544	Maximum based on Reactor Cavity letdown of 60 gpm..
CHEMICAL RADWASTE				
Lab and chemical drains	1000	0.02	1000	
Aux. boiler blowdown	0		1786	Max. for two boilers blowdown of 1% over 24 hr
TOTAL	1,000		2,786	
LAUNDRY RADWASTE				
Decontamination Drains	200	0.02[3]	200	Primarily floor washdown/mop water
TOTAL	200		200	

(1) These inputs are averaged. The expected batch sizes and frequencies are shown in Table 11.2-2.
(2) See Tables 11.1-through 5 and 11.2-9 (Reactor Coolant).

TABLE 11.2-2

EXPECTED BATCHED INPUTS TO THE LIQUID RADWASTE SYSTEM
FROM THE SOLID RADWASTE SYSTEM
FOR NORMAL OPERATION OF TWO UNITS

Source	First Intermediate Collectors Input, Batch Size Each/Time	Second Intermediate Collectors Input, Batch Size Each/Time	Liquid Radwaste Collection Tank Input From Each Second Intermediate Collector, Batch Size Each/Time
Four RWCU F/D's	Two RWCU backwash receiving tanks, 1,470 gallon/9 days	Alternating at 365 days' interval for one of two RWCU phase separators, 2,940 gallon/9days	3,049 gallon/9 day
Three Fuel Pool F/D's	One fuel pool backwash receiving tank, 1,450 gallon/120 days	Alternating at 365 days' interval for one of two RWCU phase separators, 1,450 gallon/120 days	
Sixteen Cond Demineralizers	Two regen waste surge tanks, 0 gallon/day	One waste sludge phase separator, 0 gallon/day	24,428 gallon/7 day
Fourteen Cond Filters	Two cond filter backwash receiving tanks, 35,392 gallon/21 days	One waste sludge phase separator, 70,784 gallon/21 days	
Two Radwaste Filters		One waste sludge phase separator, 500 gallon/4.2 day	
Sixteen Cond Demineralizers		One spent resin tank, 3,800 gallon/77.5 days	5,383 gallon/69 days
One Radwaste Demineralizer		One spent resin tank, 2,000 gallon/69 days	
Averaged Total Input to Radwaste Collection Tanks From Solid Radwaste System			3907 gallon/day

TABLE 11.2-3

LIQUID WASTE MANAGEMENT SYSTEM COMPONENT DESCRIPTION

A. PUMPS	EQUIPMENT NOS.	TYPE	QUANTITY	MATERIAL	DESIGN CAPACITY, EACH, GPM	DESIGN TDH FT.	USAGE FACTOR NORMAL	DRIVER HP	DESIGN PRESSURE/TEMP. PSIG/°F
Liquid Radwaste Processing									
Collection Tank	0P-301A,B,C	Horiz. Centr.	3	SS	272	238	0.16	50	150/155
Surge Tank	0P-302	Horiz. Centr.	1	SS	272	238	0	50	150/155
Sample Tank	0P-305A,B,C	Horiz. Centr.	3	SS	280	170	0.16	30	150/155
Filter Precoat	0P-324A,B	Horiz. Centr.	2	SS	357	97	0.005	25	150/108
Filter Aid Proport.	0P-303,311	Reciprocating	2	SS/Hypalon	1.25	230	A 0.35 B 0.025	1	175/120
Liquid Radwaste Chemical Processing									
Neutralizing Tank	1P-130A,B	Horiz. Centr.	2	SS	50	175	0.012	10	150/155
Neutralizing Tank	2P-130A,B	Horiz. Centr.	2	SS	50	175	0.012	10	150/155
Chem. Waste Tank	0P-326A,B	Horiz. Centr.	2	SS	100	170	0.007	10	150/155
Conc. Storage Tank	0P-328	Horiz. Centr.	1	SS	20	180	0	10	150/155
Evap. Dist. Sample Tank	0P-327A,B	Horiz. Centr.	2	SS	50	180	0.021	10	150/155
Evap. Concentrate	0P-329A,B	Horiz. Centr.	2	SS	52	68	0	5	150/228
Evap. Distillate	OP-330A,B	Horiz. Centr.	2	SS	36	217	0	8	150/125
Evap. Condensate Return	0P-333A,B	Horiz. Centr.	2	SS	50	155	0	7.5	150/212
Liquid Radwaste Laundry Drain Processing									
Collection Tank	0P-318A,B	Horiz. Centr.	2	SS	25	220	0.006	15	150/155
Sample Tank	0P-319A,B	Horiz. Centr.	2	SS	10	120	0.012	5	150/155

TABLE 11.2-3

LIQUID WASTE MANAGEMENT SYSTEM COMPONENT DESCRIPTION

B. TANKS	EQUIPMENT NOS.	TYPE	QUANTITY	MATERIAL	LIVE/NOMINAL CAPACITY, EACH, GAL	DESIGN PRESSURE/TEMP. PSIG/°F
Liquid Radwaste Processing						
Collection	0T-302A thru F	Vert. Cyl.	6	SS	14000/15000	Atmos./200
Surge	0T-304A thru D	Vert. Cyl.	4	SS	14000/15000	Atmos./200
Sample	0T-303A thru F	Vert. Cyl.	6	SS	14050/15000	Atmos./200
Filter Precoat	0T-305	Vert. Cyl.	1	SS	860/1280	Atmos./200
Filter Aid	0T-310	Vert. Cyl.	1	SS	540/800	Atmos./200
Liquid Radwaste Chemical Processing						
Neutralizing	1T-130A,B	Horiz. Cyl.	2	SS	15850/16000	Atmos./200
Neutralizing	2T-130A,B	Horiz. Cyl.	2	SS	15850/16000	Atmos./200
Collection	0T-314	Vert. Cyl.	1	SS	12000/15000	Atmos./200
Evap. Dist. Sample	0T-321	Vert. Cyl.	1	SS	6270/7500	Atmos./200
Evap. Conc.	0T-322	Vert. Cyl.	1	SS	4140/5000	Atmos./200
Liquid Radwaste Laundry Drain Processing						
Collection	0T-311A,B	Vert. Cyl.	2	SS	770/1000	Atmos./200
Sample	0T-312	Vert. Cyl.	1	SS	1680/2000	Atmos./200

TABLE 11.2-3

LIQUID WASTE MANAGEMENT SYSTEM COMPONENT DESCRIPTION

C. PROCESSING EQUIPMENT	EQUIPMENT NO.	TYPE	QUANTITY	SIZE EACH	MATERIAL	DESIGN CAPACITY EACH, GPM	USAGE FACTOR NORMAL	DESIGN PRESSURE/TEMP.
Liquid Radwaste Processing								
Liquid Radwaste Filter	0F-302A,B	Vert., Centr. Drycake Discharge	2	300 ft^2	SS	200	0.37	150/150
Liquid Radwaste Demin.	0F-301	Mixed Bed, Non-regen.	1	140 ft^3	SS	200	0.35	150/140
Liquid Radwaste Chemical Processing								
Mobile Processing System	0F323A, B, & C	Resin/Charcoal F/Ds	3	30 ft^3	SS	30 gpm	0.027	150/200
Radwaste Evaporator	0E-302A,B	Horiz., Bowed Tubes. Forced Circulation	2	1200 ft^2 1500 gal	Shell: SS Channel: CS Tubes & Sheets: Ti	30/15	0	Shell: 50/300 Tubes: 65/350
Evap. Absorption Tower	0E-304A,B	Wire Mesh Trays	2	5'diam	SS	30/15	0	50/300
Evap. Condenser	0E-303A,B	Horiz., U-tubes	2	620 ft^2	SS	Shell: 16,400 lb/hr Tubes: 620,000 lb/hr	0	Shell: 50/300 Tubes: 150/200
Evap. Heating Steam Cond. Return Tank	0T-333A,B	Horiz., U-tubes	2	40 ft^2	Shell; Tubes & Sheet: SS; Channel: CS	Shell: 21,000 lb/hr Tubes: 68,500 lb/hr	0	Shell: 65/350 Tubes: 150/200

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TABLE 11.2-3

LIQUID WASTE MANAGEMENT SYSTEM COMPONENT DESCRIPTION

C. PROCESSING EQUIPMENT	EQUIPMENT NO.	TYPE	QUANTITY	SIZE EACH	MATERIAL	DESIGN CAPACITY EACH, GPM	USAGE FACTOR NORMAL	DESIGN PRESSURE/TEMP.
Liquid Radwaste Laundry Drain Processing								
Laundry Drain Filter	0F-313 A1,A2,A3 B1,B2 & B3	Triplex Vert., Cyl., Disposable Cartridge/Bag	2 Trains (3 Filters per Train)	Filter Element 7" Dia. x 28" Long	Shell: SS Cartridge/Bag: Disposable	50 maximum 25 Normal Operation	0.006	35/150 (Cartridge) 150/250 (Housing)

TABLE 11.2-4

LIQUID RADWASTE SYSTEM FLOWS (Refer to Figure 11.2-8)

Stream No.	Normal Operation of Both Units Average Number and Batch Frequency	Volume/ Batch (gal)	Nominal Flow Rate (gpm)	Normal Operation of Both Units Ave Volume/ day (gpd)	Maximum Number and Batch Frequency	Maximum Volume/ Day (gpd)	Comment
1. To Liquid Radwaste Filter & Demineralizer (From Coll. and Surge Tanks)	1/0.56 days	28,000	100	50,058	1/.14 days	140,544	Maximum includes cavity letdown, max suppression pool transfer and baseline leakage from both units
2. To Liquid Radwaste Sample Tanks (From Radwaste Demineralizer)	1/0.56 days	28,000	100	50,058	1/.14 days	140,544	Maximum includes cavity letdown, max suppression pool transfer and baseline leakage from both units
3. To Condensate Storage Storage Tanks (From Sample Tanks)	1/0.56 days	28,000	200	50,058	1/.14 days	140,544	Maximum includes cavity letdown, max suppression pool transfer and baseline leakage from both units
4. To Plant Discharge Pipe (From Sample Tanks)	1/17 days	28,000	100	1,640	1/1 days	28,000	Maximum during startup of one unit on aux. steam with additional discharge for inventory control.
5. To Mobile Processing System (From Chem Waste Neutralizer Tanks)	1/28 days	28,000	30	1,000	1/28 days	1,000	Maximum equal to normal operation since chemical input is not operation dependent without regeneration of condensate demineralizer resin.

Stream No.	Normal Operation of Both Units Average Number and Batch Frequency	Volume/ Batch (gal)	Nominal Flow Rate (gpm)	Normal Operation of Both Units Ave Volume/ day (gpd)	Maximum Number and Batch Frequency	Maximum Volume/ Day (gpd)	Comment
6. To Distillate Sample Tank (From Mobile Processing System)	1/5.7 days	5,700	30	1,000	1/5.7 days	1,000	Maximum equal to normal operation since chemical input is not operation dependent without regeneration of condensate demineralizer resin.
7. To Plant Discharge Pipe (From Distillate Sample Tank)	1/5.7 days	5,700	100	1,000	1/5.7 days	1,000	Same comment as line 6. All chemical waste is discharged.
8. To Laundry Drain Filters And Sample Tanks (From Laundry Drain Coll. Tanks)	1/4.1 days	820	25	200	1/4.1 days	200	Laundry input is not operation dependent since laundering is not done onsite, therefore maximum is equal to normal.
9. To Plant Discharge Pipe (From Laundry Drain Sample Tank)	1/7.1 days	1,420	52 (1 pump) 60 (2 pump)	200	1/7.1 days	200	Same comment as line 8. All laundry waste is discharged to the river.
10. To Cooling Tower Blowdown Line into River — LRW Chem Laund	1/17 days 1/5.7 days 1/7.1 days	28,000 5,700 1,420	100 100 60	1,640 1,000 200 2,840	1/1 days 1/5.7 days 1/7.1 days	28,000 1,000 200 29,200 144,000 (perm max)	Normal includes 2% discharge from LRW and 100% discharge from the laundry and chemical systems. The permissible maximum based on pump and piping capacities is continuous discharge at maximum rate of 100 gpm.

TABLE 11.2-5

EXPECTED RADIONUCLIDE ACTIVITY INVENTORIES OF LIQUID RADWASTE SYSTEM COMPONENTS
(Curies per Component)(2)(3)

	Liquid Radwaste Collection Tank	Liquid Radwaste Sample Tank	Chemical Waste Neutralizing Tank	Chemical Waste Tank	Evaporator Distillate Sample Tank	Mobile Processing System	Laundry Drain Collection Tank	Laundry Drain Sample Tank	Liquid Radwaste Filter	Liquid Radwaste Demineralizer	Laundry Drain Filter
TRITIUM											
H-3	4.52E+00	4.53E+00	-	-	-	-	-	-	-	-	-
CORROSION PRODUCTS											
Na-24	6.72E-02	6.39E-04	6.72E-04	6.67E-04	3.22E-06	6.60E-04	1.32E-04	2.82E-05	7.54E-01	8.29E-01	1.20E-04
P-32	1.74E-03	1.74E-05	1.61E-04	1.32E-04	6.87E-07	2.95E-04	1.02E-05	2.23E-06	1.81E-01	3.23E-01	9.80E-06
Cr-51	5.24E-02	5.25E-04	5.69E-03	4.51E-03	2.35E-05	1.69E-02	3.20E-04	7.00E-05	6.43E+00	1.41E+01	3.08E-04
Mn-54	6.14E-04	6.17E-06	7.92E-05	5.99E-05	3.13E-07	7.50E-04	3.87E-06	8.46E-07	8.93E-02	2.54E-01	3.75E-06
Mn-56	1.30E-01	9.69E-04	6.18E-04	6.13E-04	2.08E-06	6.06E-04	1.23E-04	2.33E-05	6.92E-01	7.61E-01	1.12E-05
Fe-55	8.80E-03	8.83E-05	1.14E-03	8.63E-04	4.50E-06	1.22E-02	5.56E-05	1.21E-05	1.29E+00	3.76E+00	5.37E-05
Fe-59	2.62E-04	2.63E-06	3.05E-05	2.38E-05	1.24E-07	1.29E-04	1.62E-06	3.54E-07	3.45E-02	8.35E-02	1.57E-06
Co-58	1.75E-03	1.76E-05	2.14E-04	1.64E-04	8.58E-07	1.22E-03	1.10E-05	2.40E-06	2.41E-01	6.24E-01	1.06E-05
Co-60	3.51E-03	3.53E-05	4.58E-04	3.47E-04	1.81E-06	5.05E-03	2.23E-05	4.87E-06	5.18E-01	1.51E+00	2.15E-05
Ni-63	-	-	-	-	-	-	-	-	-	-	-
Ni-65	7.63E-04	5.65E-06	3.61E-06	3.60E-06	1.21E-08	3.55E-06	7.22E-07	1.36E-07	4.05E-03	4.46E-03	6.55E-07
Cu-64	1.92E-01	1.81E-03	1.70E-03	1.70E-03	8.08E-06	1.68E-03	3.40E-04	7.19E-05	1.91E+00	2.10E+00	3.08E-04
Zn-65	1.76E-03	1.76E-05	2.26E-04	1.72E-04	8.93E-07	2.04E-03	1.11E-06	2.43E-06	2.54E-01	7.19E-01	1.07E-06
Zn-69m	1.31E-02	1.24E-04	1.23E-04	1.23E-04	5.88E-07	1.21E-04	2.44E-05	5.19E-06	1.38E-01	1.52E-01	2.22E-05
Zn-69	1.22E-02	1.24E-04	1.23E-04	1.23E-04	6.14E-07	1.21E-04	2.44E-05	5.30E-06	1.38E-01	1.52E-01	2.22E-05
Ag-110m	-	-	-	-	-	-	-	-	-	-	-
Ag-110	-	-	-	-	-	-	-	-	-	-	-
W-187	2.22E-03	2.15E-05	3.17E-05	3.16E-05	1.57E-07	3.12E-05	5.91E-06	1.27E-06	3.55E-02	3.90E-02	5.42E-06

TABLE 11.2-5

EXPECTED RADIONUCLIDE ACTIVITY INVENTORIES OF LIQUID RADWASTE SYSTEM COMPONENTS
(Curies per Component)(2)(3)

	Liquid Radwaste Collection Tank	Liquid Radwaste Sample Tank	Chemical Waste Neutralizing Tank	Chemical Waste Tank	Evaporator Distillate Sample Tank	Mobile Processing System	Laundry Drain Collection Tank	Laundry Drain Sample Tank	Liquid Radwaste Filter	Liquid Radwaste Demineralizer	Laundry Drain Filter
HALOGENS											
Br-83	8.72E-03	6.35E-05	4.11E-05	4.10E-05	1.35E-07	4.04E-05	8.24E-06	1.53E-05	-	5.07E-02	-
Br-84	-	-	-	-	-	-	-	-	-	-	-
Br-85	-	-	-	-	-	-	-	-	-	-	-
I-129	1.02E-14	1.22E-16	3.94E-14	2.32E-14	1.23E-16	2.26E-12	4.95E-16	1.09E-15	-	2.98E-10	-
I-131	1.53E-02	1.53E-04	2.26E-03	1.94E-03	1.01E-05	2.98E-03	1.71E-04	3.72E-04	-	1.82E+00	-
I-132	8.52E-02	6.14E-04	4.03E-04	4.02E-04	1.31E-06	3.97E-04	8.03E-05	1.49E-04	-	4.97E-01	-
I-133	1.79E-01	1.73E-03	2.29E-03	2.28E-03	1.13E-05	2.25E-03	4.37E-04	9.35E-04	-	2.83E+00	-
I-134	6.83E-02	3.12E-04	3.14E-04	3.14E-04	5.57E-07	3.10E-04	6.29E-05	9.16E-05	-	3.89E-01	-
I-135	1.31E-01	1.17E-03	7.98E-04	7.99E-04	3.48E-06	7.88E-04	1.60E-04	3.31E-04	-	9.87E-01	-
CESIUM AND RUBIDIUM											
Rb-89	-	-	-	-	-	-	-	-	-	-	-
Cs-134	2.63E-04	2.64E-05	3.42E-05	2.59E-05	1.35E-06	3.27E-04	1.67E-06	3.64E-06	-	1.02E-01	-
Cs-136	6.95E-04	6.95E-05	6.24E-05	5.18E-05	2.70E-06	9.89E-05	4.04E-06	8.84E-06	-	1.11E-01	-
Cs-137	1.75E-04	1.76E-05	2.29E-05	1.73E-05	9.05E-07	2.35E-04	1.11E-07	2.43E-06	-	6.89E-02	-
Cs-138	-	-	-	-	-	-	-	-	-	-	-
OTHER FISSION PRODUCT RADIOISOTOPES											
Sr-89	8.77E-04	8.79E-06	1.04E-04	8.04E-05	4.19E-07	4.78E-04	5.44E-06	1.19E-05	-	2.89E-01	-
Sr-90	6.15E-05	6.17E-07	8.04E-06	6.08E-06	3.18E-08	9.07E-05	3.90E-07	8.52E-07	-	2.66E-02	-
Sr-91	2.32E-02	2.14E-04	1.72E-04	1.71E-04	7.87E-07	1.69E-04	3.43E-05	7.19E-05	-	2.11E-01	-
Sr-92	2.72E-02	2.05E-04	1.30E-04	1.29E-04	4.46E-07	1.27E-04	2.59E-05	4.92E-05	-	1.60E-01	-
Y-89m	1.31E-07	1.32E-09	1.55E-08	1.20E-08	6.28E-11	7.17E-08	8.18E-10	1.78E-09	-	4.33E-05	-
Y-90	-	-	-	-	-	-	-	-	-	-	-
Y-91m	1.26E-02	1.26E-04	9.84E-05	9.81E-05	4.79E-07	9.68E-05	1.96E-05	4.25E-05	-	1.21E-01	-
Y-91	4.32E-04	4.46E-06	5.40E-05	7.02E-05	2.82E-07	3.62E-04	3.46E-06	7.63E-06	-	2.03E-01	-
Y-92	4.24E-02	3.86E-04	2.28E-04	2.29E-04	1.00E-06	2.26E-04	4.60E-05	9.54E-05	-	2.83E-01	-

TABLE 11.2-5

EXPECTED RADIONUCLIDE ACTIVITY INVENTORIES OF LIQUID RADWASTE SYSTEM COMPONENTS
(Curies per Component)(2)(3)

	Liquid Radwaste Collection Tank	Liquid Radwaste Sample Tank	Chemical Waste Neutralizing Tank	Chemical Waste Tank	Evaporator Distillate Sample Tank	Mobile Processing System	Laundry Drain Collection Tank	Laundry Drain Sample Tank	Liquid Radwaste Filter	Liquid Radwaste Demineralizer	Laundry Drain Filter
Y-93	2.38E-02	2.20E-04	1.82E-04	1.82E-04	8.44E-07	1.79E-04	3.64E-05	7.63E-05	-	2.25E-01	-
Zr-93	-	-	-	-	-	-	-	-	-	-	-
Zr-95	7.03E-05	7.05E-07	8.46E-06	6.54E-06	3.39E-08	4.54E-05	4.37E-07	9.54E-07	-	2.45E-02	-
Zr-97	-	-	-	-	-	-	-	-	-	-	-
Nb-95m	2.84E-08	3.34E-10	4.60E-08	3.15E-08	1.65E-10	3.51E-07	1.00E-09	2.21E-09	-	1.72E-04	-
Nb-95	7.05E-05	7.08E-07	9.12E-06	6.90E-06	3.60E-08	6.63E-05	4.45E-07	9.73E-07	-	2.91E-02	-
Nb-97m	-	-	-	-	-	-	-	-	-	-	-
Nb-97	-	-	-	-	-	-	-	-	-	-	-
Nb-98	3.54E-06	1.76E-11	1.63E-08	1.63E-08	2.84E-14	1.61E-08	3.26E-09	7.44E-12	-	2.01E-05	-
Mo-99	1.65E-02	1.64E-04	5.68E-04	5.49E-04	2.82E-06	5.70E-04	7.19E-05	1.56E-04	-	7.14E-01	-
Tc-99m	1.01E-01	9.09E-04	1.04E-03	1.02E-03	4.83E-06	1.04E-03	1.69E-04	3.55E-04	-	1.30E+00	-
Tc-99	3.11E-10	3.54E-12	1.36E-10	9.81E-11	5.17E-13	1.79E-09	4.66E-12	1.03E-11	-	5.00E-07	-
Tc-101	-	-	-	-	-	-	-	-	-	-	-
Tc-104	-	-	-	-	-	-	-	-	-	-	-
Ru-103	1.75E-04	1.76E-06	2.01E-05	1.57E-05	8.20E-08	7.79E-05	1.08E-06	2.36E-06	-	5.37E-02	-
Ru-105	7.87E-03	6.62E-05	4.14E-05	4.12E-05	1.606E-07	4.07E-05	8.29E-06	1.66E-05	-	5.11E-02	-
Ru-106	2.63E-05	2.64E-07	3.40E-06	2.58E-06	1.35E-08	3.31E-05	1.66E-07	3.64E-07	-	1.10E-02	-
Rh-103m	1.58E-04	1.67E-06	1.57E-05	2.00E-05	8.18E-08	7.79E-05	1.07E-07	2.34E-06	-	5.36E-02	-
Rh-105m	1.65E-03	1.39E-05	8.70E-06	8.67E-06	3.51E-08	8.55E-06	1.74E-06	3.50E-06	-	1.07E-02	-
Rh-105	1.24E-03	1.38E-05	4.13E-05	4.11E-05	2.13E-07	4.07E-05	6.72E-06	1.48E-05	-	5.11E-02	-
Rh-106	2.63E-05	2.64E-07	3.40E-06	2.58E-06	1.34E-08	3.31E-05	1.66E-07	3.64E-07	-	1.10E-02	-
Te-129m	3.49E-04	3.50E-06	3.92E-05	3.08E-05	1.60E-07	1.35E-04	2.14E-06	4.68E-06	-	1.01E-01	-
Te-129	1.92E-04	2.06E-06	2.45E-05	1.92E-05	1.01E-07	8.49E-05	1.32E-06	2.91E-06	-	6.37E-02	-
Te-131m	7.65E-04	7.48E-06	1.33E-05	1.32E-05	6.61E-08	1.30E-05	2.33E-06	5.04E-06	-	1.63E.02	-
Te-131	1.63E-04	1.66E-06	2.94E-06	2.92E-06	1.48E-08	2.89E-06	5.18E-07	1.13E-06	-	3.63E-03	-
Te-132	8.35E-05	8.29E-07	3.32E-06	3.16E-06	1.62E-08	3.38E-06	3.84E-07	8.33E-07	-	4.24E-03	-
Ba-137m	1.64E-04	1.64E-05	2.15E-05	1.63E-05	8.48E-07	2.21E-04	1.04E-06	2.24E-06	-	6.48E-02	-
Ba-139	1.49E-02	8.81E-05	6.86E-05	6.90E-05	1.69E-07	6.76E-05	1.37E-05	2.30E-05	-	8.49E-02	-
Ba-140	3.47E-03	3.47E.05	2.56E-04	3.09E-04	1.33E-06	5.28E-04	2.02E-05	4.41E-05	-	5.96E.01	-
Ba-141	-	-	-	-	-	-	-	-	-	-	-

TABLE 11.2-5

EXPECTED RADIONUCLIDE ACTIVITY INVENTORIES OF LIQUID RADWASTE SYSTEM COMPONENTS
(Curies per Component)(2)(3)

	Liquid Radwaste Collection Tank	Liquid Radwaste Sample Tank	Chemical Waste Neutralizing Tank	Chemical Waste Tank	Evaporator Distillate Sample Tank	Mobile Processing System	Laundry Drain Collection Tank	Laundry Drain Sample Tank	Liquid Radwaste Filter	Liquid Radwaste Demineralizer	Laundry Drain Filter
Ba-142	-	-	2.75E-04	2.15E-04	1.13E-06	5.28E-04-	1.03E-05	2.28E-05	-	-	-
La-140	3.74E-04	4.37E-06					-	-	-	5.86E-01	-
La-141	-	-	-	-	-	-	-	-	-	-	-
La-142	8.45E-03	5.31E-05	3.91E-05	3.90E-05	1.05E-07	3.85E-05	7.835E-06	1.35E-05	-	4.82E-02	-
Ce-141	2.62E-04	2.63E-06	2.92E-05	2.30E-05	1.20E-07	9.81E-05	1.60E-06	3.50E-06	-	7.50E-02	-
Ce-143	2.32E-04	2.28E-06	4.37E-06	4.35E-06	2.19E-08	4.30E-06	7.48E-07	1.62E-06	-	5.39E-03	-
Ce-144	2.63E-05	2.64E-07	3.38E-06	2.57E-06	1.34E-08	3.15E-05	1.66E-07	3.63E-07	-	1.09E-02	-
Pr-143	3.50E-04	3.51E-06	3.37E-05	2.77E-05	1.44E-07	6.01E-05	2.11E-06	4.62E-06	-	6.67E-02	-
Pr-144m	3.72E-07	3.77E-09	4.83E-08	3.67E-08	1.92E-10	4.51E-07	2.37E-09	5.20E-09	-	1.55E-04	-
Pr-144	2.55E-05	2.63E-07	3.38E-06	2.57E-06	1.34E-08	3.15E-05	1.66E-07	3.63E-07	-	1.09E-02	-
Nd-144	-	-	-	-	-	-	-	-	-	-	-
Nd-147	2.59E-05	2.60E-07	2.18E-06	1.83E-06	9.53E-09	3.40E-06	1.49E-07	3.25E-07	-	3.97E-03	-
Pm-147	5.28E-09	6.21E-11	1.45E-08	8.94E-09	4.72E-11	3.87E-07	2.15E-10	4.76E-10	-	8.47E-05	-
Sm-147	-	-	-	-	-	-	-	-	-	-	-
Np-239	5.72E-02	5.66E-04	1.72E-03	1.68E-03	8.58E-06	1.71E-03	2.35E-04	5.11E-05	1.93E+00	2.14E+00	2.21E-04
Pu-239	1.29E-09	1.52E-11	1.70E-09	1.19E-09	6.26E-12	2.41E-08	4.22E-11	9.29E-12	1.93E-06	6.61E-06	4.26E-11
OTHERS	2.22E+00	2.23E-02	2.90E-01	2.20E-01	1.15E-03	3.30E+00	1.41E-02	3.08E-02	3.28E+02	9.63E+02	

(1) Typical: 6.72E-02 = 6.72×10^{-2}
(2) Values are Curies per Component filled to its live capacity.
(3) Noble gases are not included in tank inventories because they are assumed to escape from solution and are continuously vented to the Radwaste Building ventilation system.

TABLE 11.2-6

DESIGN BASIS RADIONUCLIDE ACTIVITY INVENTORIES OF LIQUID RADWASTE SYSTEM COMPONENTS
(Curies per Component)(2)(3)

	Liquid Radwaste Collection Tank	Liquid Radwaste Sample Tank	Chemical Waste Neutralizing Tank	Chemical Waste Tank	Evaporator Distillate Sample Tank	Mobile Processing System	Laundry Drain Collection Tank	Laundry Drain Sample Tank	Liquid Radwaste Filter	Liquid Radwaste Demineralizer	Laundry Drain Filter
TRITIUM											
H-3	4.52E+00	4.53E+00	-	-	-	-	-	-	-	-	-
CORROSION PRODUCTS											
Na-24	1.70E-02	1.65E-04	1.37E-04	1.37E-04	3.56E-07	1.35E-04	2.70E-05	5.83E-05	2.70E-01	2.70E-01	2.70E-05
P-32	1.83E-04	1.83E-06	1.67E-05	1.38E-05	6.94E-08	3.07E-05	1.06E-06	2.32E-06	4.72E-02	6.15E-02	1.12E-06
Cr-51	4.58E-03	4.59E-05	4.95E-04	3.92E-04	2.01E-06	1.47E-03	2.77E-05	6.06E-05	1.57E+00	2.84E+00	2.94E-05
Mn-54	3.67E-04	3.68E-06	4.72E-05	3.58E-05	1.87E-07	4.48E-04	2.32E-06	5.07E-06	1.73E-01	6.36E-01	2.47E-06
Mn-56	3.05E-01	2.53E-03	5.86E-04	5.86E-04	3.27E-07	5.77E-04	1.17E-04	2.38E-04	1.16E+00	1.16E+00	1.17E-04
Fe-55	-	-	-	-	-	-	-	-	-	-	-
Fe-59	7.31E-04	7.34E-06	8.52E-05	6.63E-05	3.41E-07	3.61E-04	4.51E-06	9.88E-06	2.86E-01	6.50E-01	4.80E-06
Co-58	4.58E-02	4.60E-04	5.56E-03	4.29E-03	2.22E-05	3.17E-02	2.86E-04	6.24E-04	1.94E+01	5.31E+01	3.03E-04
Co-60	4.58E-03	4.60E-05	5.98E-04	4.53E-04	2.37E-06	6.59E-03	2.91E-05	6.35E-05	2.23E+00	8.88E+00	3.09E-05
Ni-63	-	-	-	-	-	-	-	-	-	-	-
Ni-65	1.81E-03	1.50E-05	3.44E-06	3.43E-06	1.87E-09	3.38E-06	6.90E-07	1.39E-06	6.79E-03	6.79E-03	6.87E-07
Cu-64	-	-	-	-	-	-	-	-	-	-	-
Zn-65	1.83E-05	1.84E-07	2.35E-06	1.78E-06	9.29E-09	2.13E-05	1.16E-07	2.53E-07	8.59E-03	3.07E-02	1.23E-07
Zn-69m	2.53E-04	2.45E-06	1.88E-06	1.87E-06	4.62E-09	1.85E-06	3.72E-07	8.01E-07	3.70E-03	3.70E-03	3.72E-07
Zn-69	1.62E-04	1.96E-06	1.88E-06	1.87E-06	4.93E-09	1.85E-06	3.72E-07	8.14E-07	3.70E-03	3.70E-03	3.72E-07
Ag-110m	5.51E-04	5.53E-06	7.02E-05	5.36E-05	2.80E-07	6.41E-04	3.46E-06	7.57E-06	2.58E-01	9.26E-01	3.69E-06
Ag-110	7.31E-06	7.34E-08	9.36E-07	7.13E-07	3.72E-09	8.52E-06	4.63E-08	1.01E-07	3.44E-03	1.23E-02	4.91E-08
W-187	2.62E-02	2.58E-04	3.25E-04	3.24E-04	1.06E-06	3.20E-04	6.05E-05	1.32E-04	6.42E-01	6.42E-01	6.12E-05

TABLE 11.2-6

DESIGN BASIS RADIONUCLIDE ACTIVITY INVENTORIES OF LIQUID RADWASTE SYSTEM COMPONENTS
(Curies per Component)[(2)(3)]

	Liquid Radwaste Collection Tank	Liquid Radwaste Sample Tank	Chemical Waste Neutralizing Tank	Chemical Waste Tank	Evaporator Distillate Sample Tank	Mobile Processing System	Laundry Drain Collection Tank	Laundry Drain Sample Tank	Liquid Radwaste Filter	Liquid Radwaste Demineralizer	Laundry Drain Filter
HALOGENS											
Br-83	8.90E-02	7.29E-04	1.63E-04	1.63E-04	8.41E-08	1.60E-04	3.26E-05	6.61E-05	-	3.22E-01	-
Br-84	5.72E-02	2.55E-04	6.54E-05	6.49E-05	7.47E-09	6.41E-05	1.30E-05	2.02E-05	-	1.29E-01	-
Br-85	3.28E-03	1.55E-06	3.70E-06	3.68E-06	3.82E-11	3.64E-06	7.39E-07	1.98E-07	-	7.29E-03	-
I-129	1.93E-15	3.01E-17	4.12E-14	2.42E-14	1.41E-16	2.36E-12	5.15E-16	1.13E-15	-	2.70E-09	-
I-131	2.38E-01	2.38E-03	1.70E-02	1.47E-02	7.20E-05	2.24E-02	1.29E-03	2.82E-03	-	4.50E+01	-
I-132	8.64E-01	7.87E-03	1.81E-02	1.73E-02	7.47E-05	1.84E-02	2.15E-03	4.67E-03	-	3.69E+01	-
I-133	7.74E-01	7.55E-03	8.40E-03	2.33E-03	2.61E-05	8.28E-03	1.61E-03	3.48E-03	-	1.66E-01	-
I-134	7.84E-01	4.66E-03	9.54E-04	9.53E-04	1.81E-07	9.40E-04	1.91E-04	3.38E-04	-	1.89E+00	-
I-135	1.01E+00	9.42E-03	3.91E-03	6.45E-04	5.45E-06	3.85E-03	7.83E-04	1.66E-03	-	7.73E+00	-
CESIUM AND RUBIDIUM											
Rb-89	-	-	-	-	-	-	-	-	-	-	-
Cs-134	1.47E-03	1.47E-04	1.91E-04	1.44E-04	7.54E-06	1.82E-03	9.28E-06	2.03E-05	-	2.75E+00	-
Cs-136	1.00E-03	1.01E-04	8.94E-05	7.40E-05	3.72E-06	1.41E-04	5.79E-06	1.27E-05	-	3.11E-01	-
Cs-137	2.20E-03	2.21E-04	2.88E-04	2.18E-04	1.14E-05	2.95E-03	1.40E-05	3.05E-05	-	4.34E+00	-
Cs-138	4.05E-01	1.83E-02	4.64E-04	4.63E-04	5.38E-07	4.15E-04	9.28E-05	1.44E-04	-	9.16E-01	-
OTHER FISSION PRODUCTS											
Sr-89	2.84E-02	2.85E-04	3.34E-03	2.60E-03	1.34E-05	1.54E-02	1.76E-04	3.84E-04	-	2.73E+01	-
Sr-90	2.11E-03	2.12E-05	2.76E-04	2.09E-04	1.09E-06	3.11E-03	1.34E-05	2.93E-05	-	4.16E+00	-
Sr-91	5.62E-01	5.32E-03	2.98E-03	2.97E-03	5.62E-05	2.93E-03	5.97E-04	1.27E-03	-	5.86E+00	-
Sr-92	6.84E-01	5.69E-03	1.36E-03	1.35E-03	7.94E-07	1.33E-03	2.71E-04	5.52E-04	-	2.67E+00	-
Y-89m	4.25E-06	4.27E-08	5.02E-07	3.89E-07	2.01E-09	2.32E-06	2.64E-08	5.76E-08	-	4.10E-03	-
Y-90	-	-	-	-	-	-	-	-	-	-	-
Y-91m	2.17E-01	2.57E-03	1.71E-03	1.70E-03	3.51E-06	1.68E-03	3.40E-04	7.44E-04	-	3.36E+00	-
Y-91	3.43E-04	5.17E-06	4.92E-04	3.76E-04	2.01E-06	2.59E-03	2.24E-05	4.92E-05	-	4.46E+00	-
Y-92	2.00E-01	2.54E-03	1.36E-03	1.35E-03	1.82E-06	1.33E-03	2.71E-04	5.91E-04	-	2.67E+00	-
Y-93	-	-	-	-	-	-	-	-	-	-	-

TABLE 11.2-6

DESIGN BASIS RADIONUCLIDE ACTIVITY INVENTORIES OF LIQUID RADWASTE SYSTEM COMPONENTS
(Curies per Component)(2)(3)

	Liquid Radwaste Collection Tank	Liquid Radwaste Sample Tank	Chemical Waste Neutralizing Tank	Chemical Waste Tank	Evaporator Distillate Sample Tank	Mobile Processing System	Laundry Drain Collection Tank	Laundry Drain Sample Tank	Liquid Radwaste Filter	Liquid Radwaste Demineralizer	Laundry Drain Filter
Zr-93	-	-	-	-	-	-	-	-	-	-	-
Zr-95	3.67E-04	3.68E-06	4.41E-05	3.41E-05	1.76E-07	2.38E-04	2.28E-06	4.99E-06	-	4.04E-01	-
Zr-97	2.75E-04	2.68E-06	2.46E-06	2.45E-06	6.47E-08	2.42E-06	4.80E-07	1.04E-06	-	4.86E-03	-
Nb-95m	3.72E-08	5.37E-10	2.41E-07	1.64E-07	9.24E-10	1.84E-06	5.24E-09	1.15E-08	-	3.08E-03	-
Nb-95	3.85E-04	3.87E-06	4.97E-05	3.77E-05	6.83E-07	3.54E-04	2.44E-06	5.33E-06	-	5.74E-01	-
Nb-97m	2.59E-04	2.54E-06	2.33E-06	2.32E-06	7.30E-09	2.29E-06	4.57E-07	9.86E-07	-	4.60E-03	-
Nb-97	1.52E-04	1.91E-06	2.46E-06	2.45E-06	2.75E-08	2.42E-06	4.80E-07	1.05E-06	-	4.86E-03	-
Nb-98	-	-	-	-	-	-	-	-	-	-	-
Mo-99	1.99E-01	1.98E-03	6.48E-03	6.27E-03	3.51E-05	6.49E-03	8.21E-04	1.79E-03	-	1.30E+01	-
Tc-99m	2.17E+00	2.02E-02	1.33E-02	1.30E-02	6.87E-05	1.31E-02	2.20E-03	4.70E-03	-	2.64E+01	-
Tc-99	1.41E-09	1.98E-11	1.74E-09	1.26E-09	0.00E+00	2.26E-08	6.17E-11	1.35E-10	-	2.99E-05	-
Tc-101	1.34E-01	3.08E-04	1.51E-04	1.50E-04	7.70E-09	1.48E-04	3.03E-05	3.23E-05	-	2.97E-01	-
Tc-104	-	-	-	-	-	-	-	-	-	-	-
Ru-103	1.74E-04	1.74E-06	1.99E-05	1.55E-05	8.01E-08	7.71E-05	1.07E-06	2.33E-06	-	1.42E-01	-
Ru-105	-	-	-	-	-	-	-	-	-	-	-
Ru-106	2.39E-05	2.39E-07	3.07E-06	2.33E-06	1.22E-08	3.00E-05	1.51E-07	3.29E-07	-	4.22E-02	-
Rh-103m	1.09E-04	1.35E-06	1.99E-05	1.55E-05	8.01E-08	7.71E-05	1.05E-06	2.31E-06	-	1.42E-02	-
Rh-105m	-	-	-	-	-	-	-	-	-	-	-
Rh-105	-	-	-	-	-	-	-	-	-	-	-
Rh-106	2.37E-05	2.39E-07	3.07E-06	2.33E-06	1.22E-08	3.00E-05	1.51E-07	3.29E-07	-	4.22E-02	-
Te-129m	3.66E-04	3.68E-06	4.09E-05	3.21E-05	1.65E-07	1.41E-04	2.24E-06	4.89E-06	-	2.66E-01	-
Te-129	1.29E-04	1.64E-06	2.57E-05	2.01E-05	1.04E-07	8.87E-05	1.38E-06	3.03E-06	-	1.67E-01	-
Te-131m	-	-	-	-	-	-	-	-	-	-	-
Te-131	-	-	-	-	-	-	-	-	-	-	-
Te-132	4.43E-01	4.42E-03	1.69E-02	1.60E-02	7.20E-05	1.72E-02	1.95E-03	4.25E-03	-	3.45E+01	-
Ba-137m	2.01E-03	2.04E-04	2.71E-04	2.05E-04	1.07E-05	2.78E-03	1.31E-05	2.82E-05	-	4.08E+00	-
Ba-139	7.21E-01	5.13E-03	1.01E-03	1.00E-03	3.01E-07	9.92E-04	2.02E-04	3.85E-04	-	1.99E+00	-
Ba-140	8.22E-02	8.25E-04	7.26E-03	5.99E-03	3.01E-05	1.24E-02	4.74E-04	1.03E-03	-	2.48E+01	-
Ba-141	2.09E-01	6.06E-04	2.36E-04	2.35E-04	1.55E-08	0.00E+00	4.71E-05	5.82E-05	-	-	-
Ba-142	1.22E-01	2.15E-04	1.38E-04	1.38E-04	5.31E-09	1.36E-04	2.76E-05	2.45E-05	-	2.72E-01	-
La-140	2.29E-03	3.30E-05	6.48E-03	5.04E-03	2.73E-05	1.24E-02	2.42E-04	5.32E-04	-	2.48E+01	-
La-141	8.16E-02	8.30E-04	2.36E-04	8.35E-05	2.16E-07	2.32E-04	4.71E-05	1.02E-04	-	-	-

TABLE 11.2-6

DESIGN BASIS RADIONUCLIDE ACTIVITY INVENTORIES OF LIQUID RADWASTE SYSTEM COMPONENTS
(Curies per Component)(2)(3)

	Liquid Radwaste Collection Tank	Liquid Radwaste Sample Tank	Chemical Waste Neutralizing Tank	Chemical Waste Tank	Evaporator Distillate Sample Tank	Mobile Processing System	Laundry Drain Collection Tank	Laundry Drain Sample Tank	Liquid Radwaste Filter	Liquid Radwaste Demineralizer	Laundry Drain Filter
La-142	8.90E-02	7.50E-04	1.38E-04	1.38E-04	5.29E-08	1.36E-04	2.76E-05	5.72E-05	-	2.72E-01	-
Ce-141	4.72E-04	5.28E-06	1.06E-04	8.35E-05	4.34E-07	3.61E-04	5.65E-06	1.24E-05	-	6.83E-01	-
Ce-143	3.11E-04	3.07E-06	5.26E-06	5.22E-06	1.94E-08	5.17E-06	9.02E-07	1.96E-06	-	1.04E-02	-
Ce-144	3.21E-04	3.22E-06	4.12E-05	3.13E-05	1.63E-07	3.85E-04	2.03E-06	4.43E-06	-	5.50E-01	-
Pr-143	3.48E-04	3.50E-06	3.39E-05	2.79E-05	1.41E-07	6.05E-05	2.12E-06	4.62E-06	-	1.21E-01	-
Pr-144m	4.35E-06	4.58E-08	5.89E-07	4.48E-07	2.33E-09	5.50E-06	2.90E-08	6.33E-08	-	7.87E-03	-
Pr-144	2.80E-04	3.11E-06	4.12E-05	3.13E-05	1.63E-07	3.85E-04	2.02E-06	4.43E-06	-	5.50E-01	-
Nd-144	-	-	-	-	-	-	-	-	-	-	-
Nd-147	1.28E-04	1.28E-06	1.06E-05	8.90E-06	4.43E-08	1.65E-05	7.25E-07	1.58E-06	-	3.31E-02	-
Pm-147	6.31E-09	9.15E-11	7.08E-08	4.35E-08	2.51E-10	1.88E-06	1.05E-09	2.30E-09	-	2.44E-03	-
Sm-147	-	-	-	-	-	-	-	-	-	-	-
Np-239	2.16E+00	2.14E-02	6.12E-02	5.95E-02	2.54E-04	6.07E-02	8.35E-03	1.82E-02	-	1.22E+02	8.63E-03
Pu-239	1.17E-08	1.69E-10	6.06E-08	4.23E-08	2.36E-10	8.57E-07	1.50E-09	3.29E-09	-	1.13E-03	1.66E-09
OTHERS	-	-	-	-	-	-	-	-	-	-	-

(1) Typical: 1.70E-02 means 1.70×10^{-2}
(2) Values are Curies per Component filled to its live capacity.
(3) Noble gases are not included in tank inventory because they are assumed to escape from solution and are continuously vented to the Radwaste Building ventilation system.

TABLE 11.2-8

ASSUMPTIONS AND PARAMETERS USED FOR EVALUATION OF RADIOACTIVE RELEASES

ITEM	VALUE OF REFERENCE	SOURCE
1. GENERAL		
a) Maximum core thermal power (Mwt) evaluated for safety considerations.	4032	FSAR 15
b) Total quantity of tritium released from one unit (Ci/yr)	59	SSES Data
Liquid Effluents		
Gaseous Effluents		
2. NUCLEAR STEAM SUPPLY SYSTEM	92	
a) Total steam flow (lb/hr) for 100% power	1.65+7[(1)]	FSAR 10.1
b) Mass of reactor coolant (lb) in vessel at full power.	3.8+5	NUREG16
3. REACTOR WATER CLEANUP SYSTEM		
a) Average flow rate (lb/hr)	1.46+5	FSAR 5.4.8
b) Powdex demineralizer size (lb of dry resin incl. 10 w/o crud)	30	FSAR 5.4.8
c) Replacement frequency (days)	10.5	FSAR 11.2
d) Backwash volume (gal/event)	1470	FSAR 11.2
4. CONDENSATE DEMINERALIZERS		
a) Average flow rate (lb/hr) total for 8 vessels (VWO)	1.65+7	FSAR 10.1
b) Deep bed demineralizer size (ft^3 of resin per vessel)	276	FSAR 10.4.6
c) Number of demineralizers	8 per unit	FSAR 10.4.6
d) Resin discharge frequency	1/3.8 years	FSAR 11.2

TABLE 11.2-8

ASSUMPTIONS AND PARAMETERS USED FOR EVALUATION OF RADIOACTIVE RELEASES

ITEM	VALUE OF REFERENCE	SOURCE
5. CONDENSATE FILTERS		
a) Filter Vessel	7 filter vessels per unit	FSAR 10.4.7
b) Normal Filter Vessel Flow Rate	4,267 gpm per vessel (7 vessels in service)	FSAR 10.4.7
c) Backwash frequency (days)	7	FSAR 11.4.2
d) Backwash volume (gallons)	5,056	FSAR 11.4.2
6. LIQUID WASTE PROCESSING SYSTEM		
a) 1) Sources, flow rates, and expected activities in flow streams 11.2-13	Tables 11.2-4; 11.2-7; 11.2-10;	FSAR 11.2
2) Holdup times for collection, processing, and discharge	Table 11.2-11	FSAR 11.2
3) Capacities of tanks and processing equipment	Table 11.2-3	FSAR 11.2
4) Decontamination factors	Table 11.2-12	FSAR 11.2
5) Fraction from each stress discharged		
Liquid Radwaste Processing System	0.02	FSAR 11.2
Liquid Radwaste Chemical Processing System	1.0	FSAR 11.2
Liquid Radwaste Laundry Drain Proc. Sys.	1.0	FSAR 11.2
6) Radwaste demineralizer regeneration frequency (days)	None(2)	FSAR 11.2
Radwaste demineralizer regeneration volume (gal/event)	None(2)	FSAR 11.2
7) Liquid source terms for normal operation (Ci/yr)	Table 11.2-14	FSAR 11.2
b) P&IDS and process flow drawings for liquid radwaste system.	Figures 11.2-8 through 11.2-13	FSAR 11.2

TABLE 11.2-8

ASSUMPTIONS AND PARAMETERS USED FOR EVALUATION OF RADIOACTIVE RELEASES

ITEM	VALUE OF REFERENCE	SOURCE
7. MAIN CONDENSER AND TURBINE GLAND SEAL AIR REMOVAL SYSTEMS		
a) Holdup time for offgas prior to offgas treatment system (hr)	0.12	FSAR 11.3
b) Description of offgas treatment system	FSAR 11.3	FSAR 11.3
c) Offgas treatment system		
1) Mass of charcoal (lb)	148,000	FSAR 11.3
2) Operating/dew point (°F)	60-65/40	FSAR 11.3
3) Dynamic adsorption coeff. Xe,Kr(cm^3/g)	516/36.0	FSAR 11.3
d) Gland seal steam flow (lb/hr) and source	25,000 (normal) steam from condensate (clean steam)	FSAR 10.4.3
e) Radioactive iodine reduction systems for the gland seal system	N/A	N/A
f) P&IDs and process flow drawings for gaseous waste systems	Figures 11.3-1 through 11.3-3	FSAR 11.3
8. VENTILATION AND EXHAUST SYSTEMS		
a) Provisions to reduce releases in individual buildings	Table 11.3-4	FSAR 9.4, 11.3
b) Decontamination factors in individual buildings	Table 11.3-4	FSAR 11.3
c) Release rates Ci/yr	Table 11.3-1	FSAR 11.3
d) Release points – heights, temperatures, size, and shape of orifices	Figures 11.3-4	FSAR 11.3
e) Containment purge frequency (per year)	4	FSAR 11.3

TABLE 11.2-8

ASSUMPTIONS AND PARAMETERS USED FOR EVALUATION OF RADIOACTIVE RELEASES

ITEM	VALUE OF REFERENCE	SOURCE
9. EXPECTED RADIONUCLIDE ACTIVITY CONCENTRATIONS IN REACTOR COOLANT AND MAIN STEAM USED FOR EVALUATION OF RADIOACTIVE RELEASES	Table 11.2-9	NUREG 16, FSAR 11.2.3

(1) Typical: 1.45+7 means 1.45×10^{7}

(2) Regeneration of condensate demineralizer resin is not performed. Resin is discharged to the radwaste solidification system rather than regenerated. Without regeneration, the radwaste evaporators are not run. Soluble activity removed by the resin is therefore discharged through the solid waste management system. A fraction of the suspended solids from condensate filtration backwash receiving tank is carried over to the LRW collection tanks in the decant from the water sludge phase separator. These suspended solids are removed by the LRW filters and discharged during filter backwash to the waste mixing tanks and waste sludge phase separator.

(3) Spent resins from the radwaste demineralizer are sluiced to the solid waste management system.

TABLE 11.2-9

EXPECTED RADIONUCLIDE ACTIVITY CONCENTRATIONS IN REACTOR COOLANT AND MAIN STEAM USED FOR EVALUATION OF RADIOACTIVE RELEASES(1)

ISOTOPE	REACTOR WATER (μCi/gm)	REACTOR STEAM (μCi/gm)
Noble Gases		
Kr-83m	-	9.1-3(2)
Kr-85m	-	1.6-3
Kr-85	-	5.0-6
Kr-87	-	5.5-3
Kr-88	-	5.5-3
Kr-89	-	3.4-2
Xe-131m	-	3.9-6
Xe-133m	-	7.5-5
Xe-133	-	2.1-3
Xe-135m	-	7.0-3
Xe-135	-	6.0-3
Xe-137	-	3.9-2
Xe-138	-	2.3-2
Halogens		
Br-83	5.11-3	7.66-5(3)
I-131	2.31-3	3.47-5
I-132	5.16-2	7.74-4
I-133	3.27-2	4.91-4
I-134	1.07-1	1.60-3
I-135	3.59-2	5.39-4
Corrosion and Noncoolant Activation Products		
Na-24	1.33-2	1.33-5
P-32	2.59-4	2.59-7
Cr-51	7.77-3	7.77-6
Mn-54	9.05-5	9.05-8
Mn-56	7.11-2	7.11-5
Fe-55	1.29-3	1.29-6
Fe-59	3.88-5	3.88-8
Co-58	2.59-4	2.59-7
Co-60	5.18-4	5.18-7
Ni-65	4.26-4	4.26-7
Cu-64	4.00-2	4.00-5
Zn-65	2.59-4	2.59-7
Zn-69m	2.66-3	2.66-6
W-187	3.95-4	3.95-7
Np-239	9.12-3	9.12-6

TABLE 11.2-9

EXPECTED RADIONUCLIDE ACTIVITY CONCENTRATIONS IN REACTOR COOLANT AND MAIN STEAM USED FOR EVALUATION OF RADIOACTIVE RELEASES(1)

ISOTOPE	REACTOR WATER (µCi/gm)	REACTOR STEAM (µCi/gm)
Fission Products		
Sr-89	1.29-4	1.29-7
Sr-90	9.05-6	7.99-9
Sr-91	5.36-3	5.36-6
Y-91	5.18-5	5.18-8
Sr-92	1.42-2	1.42-5
Y-92	8.39-3	8.39-6
Y-93	5.36-3	5.36-6
Zr-95	1.04-5	1.04-8
Nb-95	1.04-5	1.04-8
Nb-98	6.01-3	6.01-6
Mo-99	2.61-3	2.61-6
Tc-99m	2.73-2	2.73-5
Ru-103	2.59-5	2.59-8
Ru105	2.77-3	2.77-6
Ru106	3.88-6	3.88-9
Te129m	5.18-5	5.18-8
Te-131m	1.31-4	1.31-7
Te-132	1.30-5	1.30-8
Cs-134	3.88-5	3.88-8
Cs-136	1.04-4	1.04-7
Cs-137	2.58-5	2.58-8
Ba-139	1.47-2	1.47-5
Ba-140	5.19-4	5.19-7
Ce-141	3.88-5	3.88-8
La-142	7.03-3	7.03-6
Ce-143	3.93-5	3.93-8
Pr-143	5.18-5	5.18-8
Ce-144	3.88-6	3.88-9
Nd-147	3.89-6	3.89-9
Coolant Activation Products(4)		
N-13	4.00-2	3.50-2
N-16	5.00+1	2.50+2
N-17	6.00-3	1.00-1
O-19	7.00-1	8.00-1
F-18	4.00-3	4.00-3
Tritium(5)		
H-3	1.0-2	1.0-2`

(1) The values in this table are calculated based on the GALE code in NUREG-0016 Rev. 1 (November, I979) except as noted.
(2) Typical: 9.1-3 = 9.1×10^{-3}
(3) The halogen concentrations listed in reactor steam are based on a carryover of 0.015, which was used to calculate the maximum expected liquid activity release using the NUREG-0016. For adjustment in halogen steam concentrations due to HWC implementation refer to Table 11.1-2.
(4) Coolant activation products are as presented in Table 11.1-4 for operation with hydrogen water chemistry.
(5) The tritium concentration in the reactor coolant and steam are controlled by the loss of water from the reactor coolant system by evaporation or leakage. The estimated total appearance rate in effluents is estimated per NUREG-0016 at 0.03 Ci/MWt (or ~120 Ci/yr). Reactor coolant concentrations are shown based on NUREG-0016 measured values increased to account for liquid recycle. The reactor coolant tritium concentrations shown are consistent with SSES measured values. However, historically the production rate of tritium in the reactor coolant and the release rate in effluents at SSES have been higher (~ 150 curies) than the NUREG-0016 estimates. Therefore estimates of radioactive tritium releases in liquid and gaseous effluent have been conservative based upon measured data.

TABLE 11.2-10

RADWASTE SYSTEM FLOW RATES AND STREAM ACTIVITIES
USED FOR EVALUATION OF RADIOACTIVE RELEASES

Source	Expected Daily Input Flow Rate per Unit (gal/day)	Fraction of Primary Coolant Activity (PCA)
Liquid Radwaste Processing System		
Drywell Drains	2200	0.73
Reactor Building Drains	8624	0.085
Turbine Building Drains	6010	0.001
Turbine Building - Condensate Demineralizer Operation	0	0
Radwaste Building Drains	1040	0.005
Suppression Pool Transfers	3000	0.10
Solid Radwaste Processing Input to Liquid Radwaste Processing System		
RWCU Phase Separator	170	0.002
Waste Sludge Phase Separator	1745	0.05
Spent Resin Tank	40	0.05
TOTAL	25029	0.173
Liquid Radwaste Chemical Waste Processing System		
Lab and chemical drains	500	0.02
Laundry Radwaste Laumdry Drain Processing System		
Decontamination Drains	100	0.02

TABLE 11.2-11

EXPECTED HOLDUP TIMES FOR COLLECTION, PROCESSING, AND DISCHARGE USED FOR EVALUATION OF RADIOACTIVE RELEASES

PROCESS	HOLDUP TIME (DAYS)
1. Liquid Radwaste Processing System	
a) Collection	0.64
b) Processing	0.19
c) Discharge	0.27
d) Total	1.10
2. Liquid Radwaste Chemical Processing System Neutralizing Tanks	
a) Collection	28.00
b) Processing	0.65
c) Discharge	0.61
d) Total	29.30
3. Liquid Radwaste Laundry Drain Processing System	
a) Collection	8.20
b) Processing	0.04
c) Discharge	0.10
d) Total	8.34

TABLE 11.2-12

DECONTAMINATION FACTORS USED FOR EVALUATION OF RADIOACTIVE RELEASES

1. Liquid Radwaste Processing System

	Filter	Demineralizer	Total DF
Halogens	1	100	100
Cs, Rb	1	10	10
Other Nuclides	1	100	100

2. Liquid Radwaste Chemical Processing System

	Mobile Processing System Filter/Demineralizer	Total DF
Halogens	100	100
Cs, Rb	10	10
Other Nuclides	100	100

3. Liquid Radwaste Laundry Drain Processing System

	Filter	Total DF
Halogens	1	1
Cs, Rb	1	1
Other Nuclides	1	1

TABLE 11.2-13

EXPECTED YEARLY ACTIVITY RELEASED FROM LIQUID WASTE MANAGEMENT SYSTEMS USED FOR EVALUATION OF COMPLIANCE WITH APPENDIX I OF 10CFR50 (Ci/yr/site)[1]

NUCLIDE	LIQUID RADWASTE PROCESSING (Curies/Site)	LAUNDRY RADWASTE (Curies/Site)	LRW CHEMICAL PROCESSING (Curies/Site)	TOTAL LWR (Curies/Site)	ADJUSTED TOTAL (Ci/yr/Site)[2]	DETERGENT WASTES (Ci/yr/Site)	TOTAL (Ci/yr/Site)
CORROSION AND ACTIVATION PRODUCTS							
Na-24	1.11E-02[3]	5.22E-03	4.00E-05	1.64E-02	2.72E-02	0.00E+00	2.80E-02
P-32	4.40E-04	8.60E-04	2.00E-05	1.34E-03	2.24E-03	0.00E+00	2.20E-03
Cr-51	1.35E-02	2.87E-02	1.12E-04	4.33E-02	7.20E-02	0.00E+00	7.20E-02
Mn-54	1.60E-04	3.60E-04	2.00E-05	5.40E-04	9.00E-04	0.00E+00	9.00E-04
Mn-56	2.68E-03	2.54E-03	0.00E+00	5.20E-03	8.66E-03	0.00E+00	8.60E-03
Fe-55	2.30E-03	5.28E-03	2.60E-04	7.82E-03	1.30E-02	0.00E+00	1.30E-02
Fe-59	6.00E-05	1.40E-04	0.00E+00	2.20E-04	3.80E-04	0.00E+00	3.80E-04
Co-58	4.60E-04	1.02E-03	4.00E-05	1.52E-03	2.52E-03	0.00E+00	2.60E-03
Co-60	9.20E-04	2.12E-03	1.00E-04	3.14E-03	5.22E-03	0.00E+00	5.20E-03
Ni-65	2.00E-05	2.00E-05	0.00E+00	4.00E-05	6.00E-05	0.00E+00	4.00E-05
Cu-64	2.95E-02	1.31E-02	8.00E-05	4.27E-02	7.11E-02	0.00E+00	7.20E-02
Zn-65	4.60E-04	1.04E-03	6.00E-05	1.56E-03	2.58E-04	0.00E+00	2.60E-03
Zn-69m	2.08E-03	9.60E-04	0.00E+00	3.04E-03	5.06E-03	0.00E+00	5.00E-03
Zn-69	2.24E-03	1.02E-03	0.00E+00	3.26E-03	5.42E-03	0.00E+00	5.40E-03
W-187	4.40E-04	2.60E-04	0.00E+00	7.00E-04	1.16E-03	0.00E+00	1.16E-03
Np-239	1.32E-02	1.36E-02	1.80E-04	2.69E-02	4.48E-02	0.00E+00	4.40E-02
FISSION PRODUCTS							
Br-83	1.60E-04	1.60E-04	0.00E+00	3.20E-04	5.20E-04	0.00E+00	5.20E-04
Sr-89	2.40E-04	5.00E-04	2.00E-05	7.60E-04	1.26E-03	0.00E+00	1.26E-03
Sr-90	2.00E-05	4.00E-05	0.00E+00	6.00E-05	1.00E-04	0.00E+00	1.00E-04
Y-90	0.00E+00	2.00E-05	0.00E+00	2.00E-05	4.00E-05	0.00E+00	4.00E-05
Sr-91	3.02E-03	1.26E-03	0.00E+00	4.30E-03	7.14E-03	0.00E+00	7.20E-03
Y-91m	1.96E-03	8.00E-04	0.00E+00	2.76E-03	4.60E-03	0.00E+00	4.60E-03
Y-91	1.40E-04	3.40E-04	2.00E-05	5.00E-04	8.20E-04	0.00E+00	8.20E-04
Sr-92	6.20E-04	5.60E-04	0.00E+00	1.18E-03	1.96E-03	0.00E+00	1.96E-03

TABLE 11.2-13

EXPECTED YEARLY ACTIVITY RELEASED FROM LIQUID WASTE MANAGEMENT SYSTEMS USED FOR EVALUATION OF COMPLIANCE WITH APPENDIX I OF 10CFR50 (Ci/yr/site)[1]

NUCLIDE	LIQUID RADWASTE PROCESSING (Curies/Site)	LAUNDRY RADWASTE (Curies/Site)	LRW CHEMICAL PROCESSING (Curies/Site)	TOTAL LWR (Curies/Site)	ADJUSTED TOTAL (Ci/yr/Site)[2]	DETERGENT WASTES (Ci/yr/Site)	TOTAL (Ci/yr/Site)
Y-92	3.20E-03	1.50E-03	0.00E+00	4.70E-03	7.82E-03	0.00E+00	7.80E-03
Y-93	3.20E-03	1.34E-03	0.00E+00	4.56E-03	7.58E-03	0.00E+00	7.60E-03
Zr-95	2.00E-05	4.00E-05	0.00E+00	6.00E-05	1.00E-04	0.00E+00	1.00E-04
Nb-95	2.00E-05	4.00E-05	0.00E+00	6.00E-05	1.00E-04	0.00E+00	1.00E-04
Nb-97	0.00+00	2.00E-05	0.00E+00	2.00E-05	2.00E-05	0.00E+00	2.00E-05
Nb-98	3.88E-03	4.42E-03	6.00E-05	8.36E-03	1.39E-02	0.00E+00	1.40E-02
Mo-99	1.10E-02	7.46E-03	6.00E-05	1.85E-02	3.08E-02	0.00E+00	3.00E-02
Tc-99m	4.00E-05	1.00E-04	0.00E+00	1.40E-04	2.40E-04	0.00E+00	2.40E-04
Ru-103	4.00E-05	1.00E-04	0.00E+00	1.40E-04	2.40E-04	0.00E+00	2.40E-04
Rh-103m	4.60E-04	2.40E-04	0.00E+00	7.00E-04	1.14E-03	0.00E+00	1.14E-03
Ru-105	4.60E-04	2.40E-04	0.00E+00	7.00E-04	1.16E-03	0.00E+00	1.16E-03
Rh-105m	4.40E-04	3.40E-04	0.00E+00	7.80E-04	1.32E-03	0.00E+00	1.32E-03
Rh-105	0.00E+00	2.00E-05	0.00E+00	2.00E-05	4.00E-05	0.00E+00	4.00E-05
Ru-106	0.00E+00	2.00E-05	0.00E+00	2.00E-05	4.00E-05	0.00E+00	4.00E-05
Te-129m	1.00E-04	2.00E-04	0.00E+00	3.00E-04	4.80E-04	0.00E+00	4.80E-04
Te-129	6.00E-05	1.20E-04	0.00E+00	1.80E-04	3.20E-04	0.00E+00	3.20E-04
Te-131m	1.60E-04	1.00E-04	0.00E+00	2.60E-04	4.40E-04	0.00E+00	4.40E-04
Te-131	2.00E-05	2.00E-05	0.00E+00	4.00E-05	8.00E-05	0.00E+00	8.00E-05
I-131	3.86E-03	6.74E-03	1.60E-04	1.08E-02	1.79E-02	0.00E+00	1.80E-02
Te-132	2.00E-05	2.00E-05	0.00E+00	4.00E-05	8.00E-05	0.00E+00	8.00E-05
I-132	1.32E-03	1.52E-03	0.00E+00	2.84E-03	4.72E-03	0.00E+00	4.80E-03
I-133	3.37E-02	1.87E-02	1.60E-04	5.26E-02	8.74E-02	0.00E+00	8.80E-02
I-134	2.00E-05	3.00E-04	0.00E+00	3.00E-04	5.00E-04	0.00E+00	5.00E-04
Cs-134	6.80E-04	1.60E-04	8.00E-05	9.20E-04	1.54E-03	0.00E+00	1.54E-03
I-135	1.25E-02	5.36E-03	2.00E-05	1.79E-02	2.98E-02	0.00E+00	3.00E-02
Cs-136	1.78E-03	3.40E-04	1.00E-04	2.22E-03	3.70E-03	0.00E+00	3.60E-03
Cs-137	4.60E-04	1.00E-04	6.00E-05	6.20E-04	1.02E-03	0.00E+00	1.02E-03

TABLE 11.2-13

EXPECTED YEARLY ACTIVITY RELEASED FROM LIQUID WASTE MANAGEMENT SYSTEMS USED FOR EVALUATION OF COMPLIANCE WITH APPENDIX I OF 10CFR50 (Ci/yr/site)(1)

NUCLIDE	LIQUID RADWASTE PROCESSING (Curies/Site)	LAUNDRY RADWASTE (Curies/Site)	LRW CHEMICAL PROCESSING (Curies/Site)	TOTAL LWR (Curies/Site)	ADJUSTED TOTAL (Ci/yr/Site)(2)	DETERGENT WASTES (Ci/yr/Site)	TOTAL (Ci/yr/Site)
Ba-137m	4.20E-04	1.00E-04	4.00E-05	5.80E-04	9.60E-04	0.00E+00	9.60E-04
Ba-139	4.00E-05	1.40E-04	0.00E+00	1.80E-04	3.00E-04	0.00E+00	3.00E-04
Ba-140	8.80E-04	1.70E-03	6.00E-05	2.64E-03	4.38E-03	0.00E+00	4.40E-03
La-140	2.20E-04	1.30E-03	6.00E-05	1.58E-03	2.62E-03	0.00E+00	2.60E-03
La-141	1.60E-04	1.00E-05	0.00E+00	2.60E-04	4.20E-04	0.00E+00	4.20E-04
Ce-141	8.00E-05	1.60E-04	0.00E+00	2.60E-04	4.20E-04	0.00E+00	4.20E-04
La-142	4.00E-05	1.00E-04	0.00E+00	1.40E-04	2.40E-04	0.00E+00	2.40E-04
Ce-143	4.00E-05	4.00E-05	0.00.E+00	8.00E-05	1.40E-04	0.00E+00	1.40E-04
Pr-143	1.00E-05	1.80E-04	0.00E+00	2.80E-04	4.60E-04	0.00E+00	4.60E-04
Ce-144	0.00E+00	2.00E-05	0.00E+00	2.00E-05	4.00E-05	0.00E+00	4.00E-05
Pr-144	0.00E+00	2.00E-05	0.00E+00	2.00E-05	4.00E-05	0.00E+00	4.00E-05
Nd-147	0.00E+00	2.00E-05	0.00E+00	2.00E-05	4.00E-05	0.00E+00	4.00E-05
ALL OTHERS	2.00E-05	2.00E-05	0.00E+00	6.00E-05	1.00E-04	0.00E+00	1.00E-04
TOTAL (EXCEPT H-3)	1.65E-01	1.33E-01	2.96E-03	3.02E-01	5.02E-01	0.00E+00	5.00E-01
TRITIUM RELEASE	118 CURIES PER YEAR						

NOTES:

(1) Liquid radwaste processing systems are common systems. Therefore, system releases are per site rather than per reactor unit.
(2) Per NUREG-0016 Revision 1, Adjusted Total column is based on an increase of 0.1 Ci/yr per unit, using the same isotopic distribution, to account for anticipated operational occurrences such as operator errors that result in unplanned releases.
(3) 9.48E-03 = 9.48x10-3

TABLE 11.2-14

CALCULATED EXPECTED EFFLUENT ACTIVITY CONCENTRATIONS FOR EVALUATION OF RADIOACTIVE RELEASES TO THE SUSQUEHANNA RIVER

Nuclide	Average Annual Concentration After Dilution (μCi/ml)	10CFR20 Table II, Column 2 Effluent Concentration (μCi/ml)	Fraction of Effluent Concentration Limits (dimensionless)
<u>Corrosion and Activation Products</u>			
Na-24	3.52E-09	5.0E-05	7.0E-05
P-32	2.76E-10	9.0E-06	3.1E-05
Cr-51	9.05E-09	5.0E-04	1.8E-05
Mn-54	1.13E-10	3.0E-05	3.8E-06
Mn-56	1.08E-10	7.0E-05	1.5E-05
Fe-55	1.63E-09	1.0E-04	1.6E-05
Fe-59	4.77E-11	1.0E-05	4.8E-06
Co-58	3.27E-10	2.0E-05	1.6E-05
Co-60	6.53E-10	3.0E-06	2.2E-04
Ni-65	5.03E-12	1.0E-04	5.0E-08
Cu-64	9.05E-09	2.0E-04	4.5E-05
Zn-65	3.27E-10	5.0E-06	6.5E-05
Zn-69m	6.28E-10	6.0E-05	1.0E-06
Zn-69	6.79E-10	8.0E-04	8.5E-07
W-187	1.46E-10	3.0E-05	4.9E-06
Np-239	5.53E-09	2.0E-05	2.8E-04
<u>Fission Products</u>			
Br-83	6.53E-11	9.0E-04	7.3E-08
Sr-89	1.58E-10	8.0E-06	2.0E-05
Sr-90	1.26E-11	5.0E-07	2.5E-05
Y-90	5.03E-12	7.0E-06	7.2E-07
Sr-91	9.05E-10	2.0E-05	4.5E-05
Y-91m	5.78E-10	2.0E-03	2.9E-07
Y-91	1.03E-10	8.0E-06	1.3E-05
Sr-92	2.46E-10	4.0E-05	6.2E-06
Y-92	9.80E-10	4.0E-05	2.5E-05
Y-93	9.55E-10	2.0E-05	4.8E-05
Zr-95	1.26E-11	2.0E-05	6.3E-07
Nb-95	1.26E-11	3.0E-05	4.2E-07
Nb-98	2.51E-12	2.0E-04	1.3E-08
Mo-99	1.76E-09	2.0E-05	8.8E-05
Tc-99m	3.77E-09	1.0E-03	3.8E-06
Ru-103	3.02E-11	3.0E-05	1.0E-06
Rh-103m	3.02E-11	6.0E-03	5.0E-09

Nuclide	Average Annual Concentration After Dilution (μCi/ml)	10CFR20 Table II, Column 2 Effluent Concentration (μCi/ml)	Fraction of Effluent Concentration Limits (dimensionless)
Ru-105	1.43E-10	7.0E-05	2.0E-06
Rh-105m	1.46E-10	N/A	-
Rh-105	1.66E-10	5.0E-05	3.3E-06
Ru-106	5.03E-12	3.0E-06	1.7E-06
Rh-106	5.03E-12	N/A	-
Te-129m	6.03E-11	7.0E-06	8.6E-06
Te-129	4.02E-11	4.0E-04	1.0E-07
Te-131m	5.53E-11	8.0E-06	6.9E-06
Te-131	1.01E-11	8.0E-05	1.3E-07
I-131	2.26E-09	1.0E-06	2.3E-03
Te-132	1.01E-11	9.0E-06	1.1E-06
I-132	6.03E-10	1.0E-04	6.0E-06
I-133	1.11E-08	7.0E-06	1.6E-03
I-134	6.28E-11	4.0E-04	1.6E-07
Cs-134	1.94E-10	9.0E-07	2.2E-04
I-135	3.77E-09	3.0E-05	1.3E-04
Cs-136	4.52E-10	6.0E-06	7.5E-05
Cs-137	1.28E-10	1.0E-06	1.3E-04
Ba-137m	1.21E-10	N/A	-
Ba-139	3.77E-11	2.0E-04	1.9E-07
Ba-140	5.53E-10	8.0E-06	6.9E-05
La-140	3.27E-10	9.0E-06	3.6E-05
La-141	5.28E-11	5.0E-05	1.1E-06
Ce-141	5.28E-11	3.0E-05	1.8E-06
La-142	3.02E-11	1.0E-04	3.0E-07
Ce-143	1.76E-11	2.0E-05	8.8E-07
Pr-143	5.78E-11	2.0E-05	2.9E-06
Ce-144	5.03E-12	3.0E-06	1.7E-06
Pr-144	5.03E-12	6.0E-04	8.4E-09
Nd-147	5.03E-12	2.0E-05	2.5E-07
Others	1.26E-11	2.03-09	6.3E-03
<u>Totals</u>	6.31E-08	1.46E-02	1.19E-02
H-3	1.48E-05	1.00E-03	1.48E-02
<u>Total with H-3</u>	1.49E-05	1.56E-02	2.67E-02

<u>NOTES:</u>

(1) Annual average concentration after dilution by the cooling tower blowdown.
(2) N/A = Not Applicable. 10CFR20 Table II, Column 2 does not define ECL limit.

TABLE 11.2-15

INPUT DATA FOR AQUATIC DOSE CALCULATIONS

LOCATION	PATHWAY		
	CONSUMPTION OF AQUATIC BIOTA	SHORELINE EXPOSURE	DRINKING WATER
	Edge of Initial Mixing Zone	Edge of Initial Mixing Zone	Danville
Dilution Factor	15.9*	15.9*	321
Transit Time	25.0 hr	1.0 hr	25.8 hr
Shore Width Factor		0.2	

* Site-specific study indicates that a value of 15.9 is appropriate for the Susquehanna Station. That value is used for determining operational compliance with the SSES Technical Specifications and reporting doses via the Annual Effluent and Waste Disposal Report.

Table 11.2-16

TANKS OUTSIDE PRIMARY CONTAINMENT WHICH CONTAIN POTENTIALLY RADIOACTIVE LIQUIDS[(1)]

Security-Related Information
Table Withheld Under 10 CFR 2.390

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-270, Sh. 1

FSAR REV. 65

SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Figure 11.2-1 replaced by dwg.
M-270, Sh. 1

FIGURE 11.2-1, Rev. 55

AutoCAD Figure 11_2_1.doc

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-271, Sh. 1

FSAR REV. 65

SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Figure 11.2-2 replaced by dwg. M-271, Sh. 1 FIGURE 11.2-2, Rev. 55

AutoCAD Figure 11_2_2.doc

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-272, Sh. 1

FSAR REV. 65

SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Figure 11.2-3 replaced by dwg.
M-272, Sh. 1

FIGURE 11.2-3, Rev. 55

AutoCAD Figure 11_2_3.doc

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-273, Sh. 1

FSAR REV. 65

SUSQUEHANNA STEAM ELECTRIC STATION
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FINAL SAFETY ANALYSIS REPORT

Figure 11.2-4 replaced by dwg.
M-273, Sh. 1

FIGURE 11.2-4, Rev. 55

AutoCAD Figure 11_2_4.doc

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-274, Sh. 1

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SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Figure 11.2-5 replaced by dwg.
M-274, Sh. 1

FIGURE 11.2-5, Rev. 55

AutoCAD Figure 11_2_5.doc

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-220, Sh. 1

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SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Figure 11.2-6 replaced by dwg.
M-220, Sh. 1

FIGURE 11.2-6, Rev. 55

AutoCAD Figure 11_2_6.doc

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-230, Sh. 1

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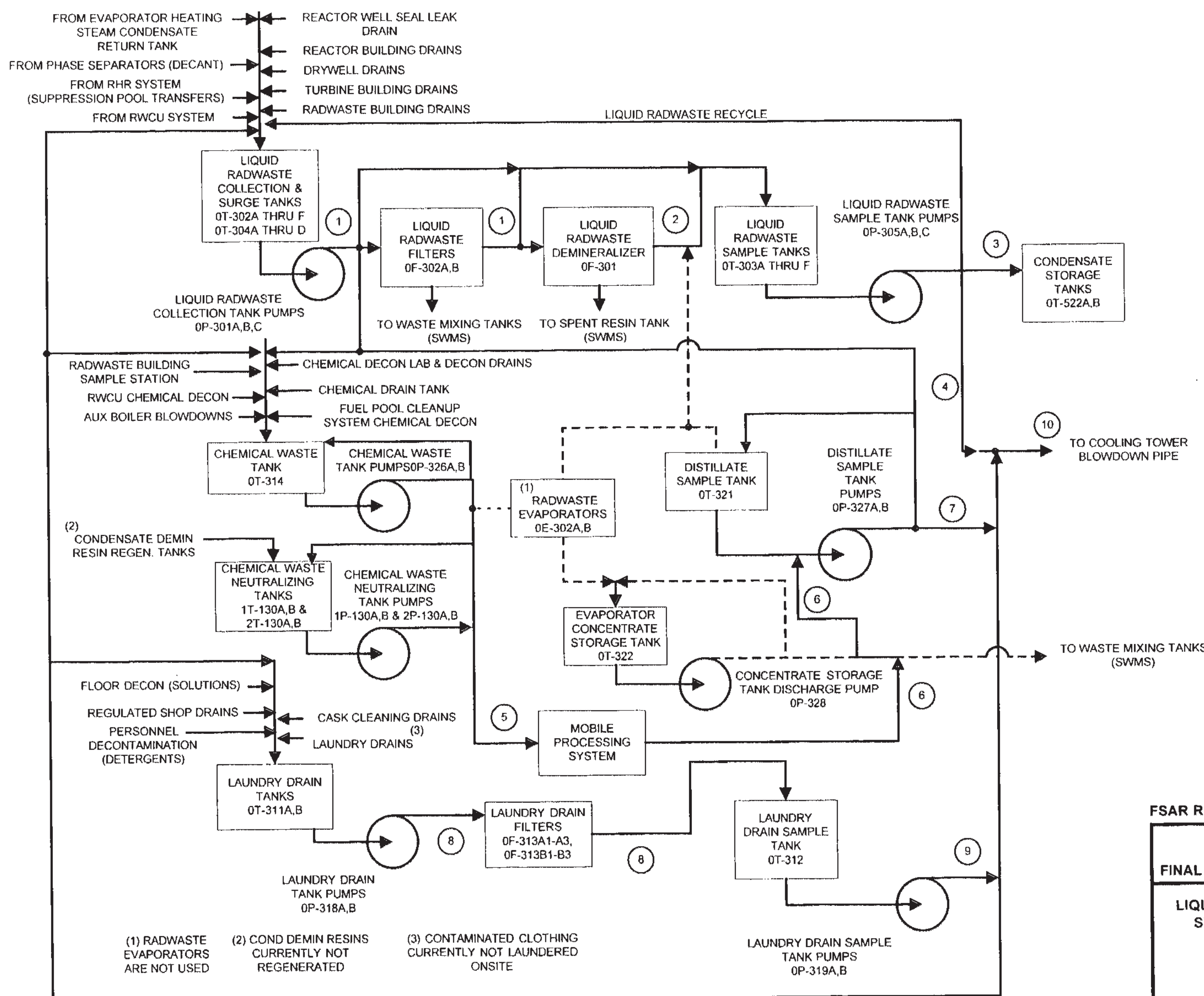
SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Figure 11.2-7 replaced by dwg. M-230, Sh. 1 FIGURE 11.2-7, Rev. 55

AutoCAD Figure 11_2_7.doc



FSAR REV 53, 12/98

SUSQUEHANNA SES
UNITS 1 AND 2
FINAL SAFETY ANALYSIS REPORT

LIQUID WASTE MANAGEMENT SYSTEM FLOW DIAGRAM

FSAR FIGURE 11.2-8

PPL DRAWING VISO T11208.VSD

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-162, Sh. 1

FSAR REV. 65

SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Figure 11.2-9-1 replaced by dwg.
M-162, Sh. 1

FIGURE 11.2-9-1, Rev. 55

AutoCAD Figure 11_2_9_1.doc

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-162, Sh. 2

FSAR REV. 65

SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Figure 11.2-9-2 replaced by dwg. M-162, Sh. 2 FIGURE 11.2-9-2, Rev. 56

AutoCAD Figure 11_2_9_2.doc

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-162, Sh. 3

FSAR REV. 65

SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Figure 11.2-9-3 replaced by dwg. M-162, Sh. 3 FIGURE 11.2-9-3, Rev. 55

AutoCAD Figure 11_2_9_3.doc

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-163, Sh. 1

FSAR REV. 65

SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Figure 11.2-11-1 replaced by dwg. M-163, Sh. 1 FIGURE 11.2-11-1, Rev. 55

AutoCAD Figure 11_2_11_1.doc

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-163, Sh. 2

FSAR REV. 65

SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Figure 11.2-11-2 replaced by dwg. M-163, Sh. 2 FIGURE 11.2-11-2, Rev. 55

AutoCAD Figure 11_2_11_2.doc

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-163, Sh. 3

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SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 & 2
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Figure 11.2-11-3 replaced by dwg.
M-163, Sh. 3

FIGURE 11.2-11-3, Rev. 55

AutoCAD Figure 11_2_11_3.doc

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-164, Sh. 1

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SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 & 2
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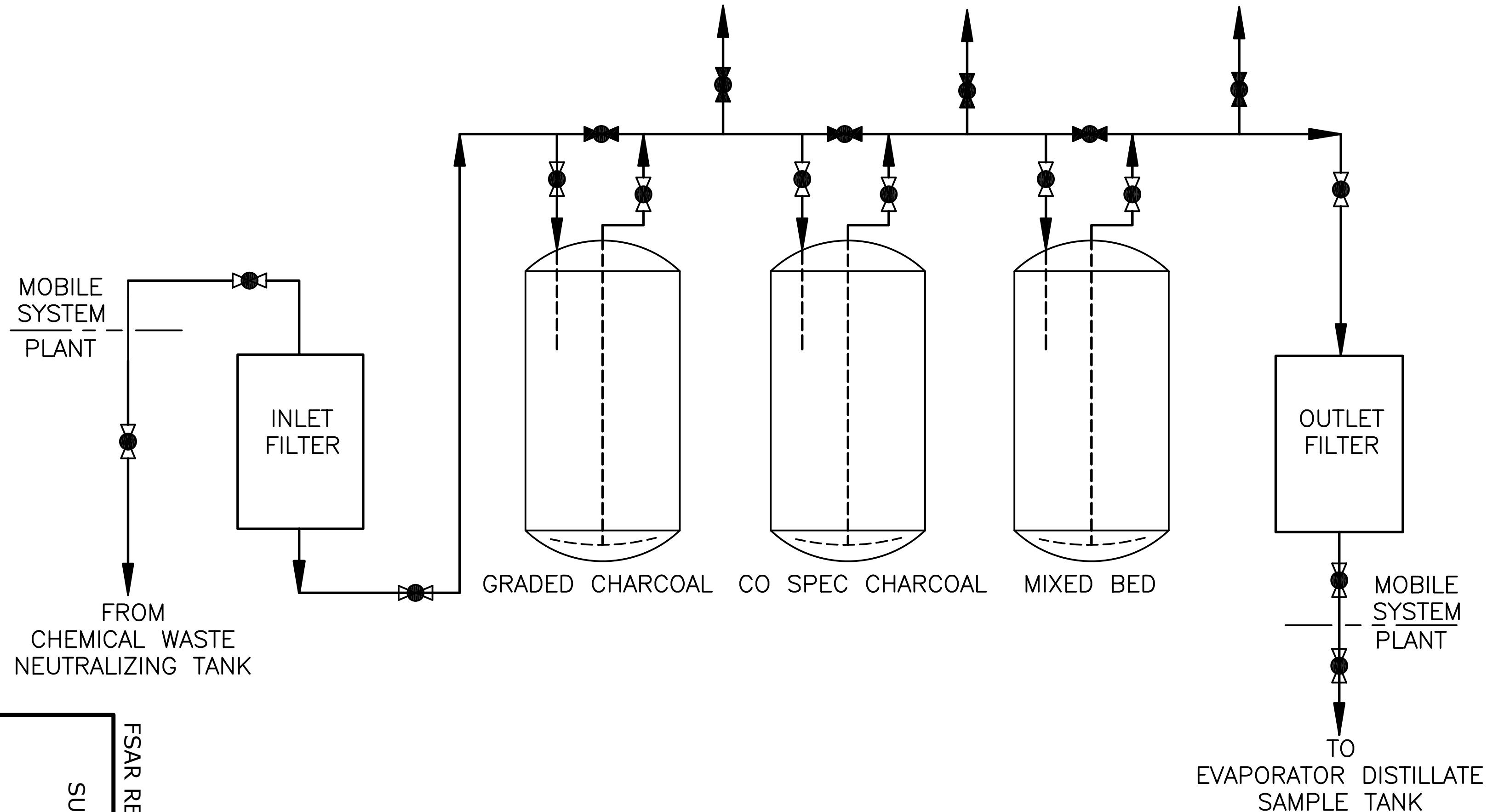
Figure 11.2-12 replaced by dwg.
M-164, Sh. 1

FIGURE 11.2-12, Rev. 55

AutoCAD Figure 11_2_12.doc

Security-Related Information
Figure Withheld Under 10 CFR 2.390

SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
LIQUID WASTE MANAGEMENT SCHEME FIGURE 11.2-13



FSAR REV.65

SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

TYPICAL MOBILE PROCESSING
SYSTEM FLOW DIAGRAM

FIGURE 11.2-14, Rev 54

AutoCAD: Figure Fsar 11_2_14.dwg