9.2 LIQUID RADWASTE SYSTEM

9.2.1 Power Generation Objective

The Liquid Radwaste System collects, treats, and returns processed radioactive liquid wastes to the plant for reuse. Treated radioactive wastes not suitable for reuse and the suitable liquid waste for reuse whose volume is not needed for plant operations or not desired for reuse are discharged from the plant or packaged for offsite disposal.

9.2.2 Power Generation Design Basis

The Liquid Radwaste System shall be designed so that the liquid radwastes which are discharged from the plant are within the limits specified in the ODCM and the operation or availability of the plant is not limited thereby.

9.2.3 Safety Design Basis

The Liquid Radwaste System shall be designed to prevent the inadvertent release of significant quantities of liquid radioactive material from the restricted area of the plant so that resulting exposures are within the guideline values of 10 CFR 20, Appendix I of 10 CFR 50, and/or 40 CFR 190.

9.2.4 Description

The Liquid Radwaste System collects, processes, stores, and disposes of all radioactive liquid wastes. The system is sized to handle the radioactive liquid wastes from all three units of the plant. The radwaste facility is located in the radioactive waste building. The Radwaste Building is located and the radwaste equipment is arranged as shown in Figures 1.6-23 and 1.6-24.

Included in the Liquid Radwaste System are the following:

a. Piping and equipment drains carrying potential radioactive wastes,

b. Floor drain systems in controlled access areas and/or those areas which may contain potentially radioactive wastes, and

c. Tanks, piping, pumps, process equipment, instrumentation, and auxiliaries necessary to collect, process, store, and dispose of potentially radioactive wastes.

Equipment is selected, arranged, and shielded to permit operation, inspection, and maintenance with personnel exposures within the limits specified in 10 CFR 20 and applicable plant procedures. For example, sumps, pumps, valves, and instruments are located in controlled access areas. A resin trap with differential pressure instrumentation is installed in the effluent line for the radwaste waste demineralizer. Details of the radwaste system are shown in Figures 9.2-3a through t. Operation of the waste system is essentially manual start-automatic stop.

The system is divided into several subsystems so that the liquid wastes from various sources can be kept segregated and processed separately. Cross connections between the subsystems provide additional flexibility for processing of the wastes by alternate methods. The liquid radwastes are classified, collected, and treated as either high purity, low purity, chemical, or detergent wastes. The terms "high" purity and "low" purity refer to conductivity and not radioactivity. These liquid radwastes are referred to in the figures as "CRW" (clean radwaste) and "DRW" (dirty radwaste).

9.2.4.1 High Purity Wastes

High purity (low conductivity) liquid wastes which are collected in the waste collector tank are from the following main sources:

a. Drywell equipment drain sumps,

b. Radwaste Building equipment drain sump,

c. Turbine Building equipment drain sumps,

d. Reactor cleanup systems,

e. Decantate from cleanup phase separators,

f. Decantate from condensate phase separators,

g. Waste package drain tank,

h. Turbine Building condensate pump pit equipment drain sumps,

i. Standby Gas Treatment Building sumps,

j. Floor drain filter and sample tank pump discharge,

k. Residual Heat Removal System.

The high purity wastes are processed by filtration and ion exchange through the waste filter and waste demineralizer. After processing, the waste is pumped to a waste sample tank where it is sampled and then, if satisfactory for reuse, and there is sufficient available volume in the condensate storage tanks to accept the waste it is transferred to the condensate storage tanks as makeup water.

An alternate method of processing high purity wastes is the use of vendor supplied skid mounted equipment interconnected with the Radwaste System. After processing, depending on effluent quality and plant needs, the water can be sent to either the waste sample tank, floor drain sample tank, waste surge tank, or waste collector tank.

If the analysis of the sample reveals water of high conductivity (>1 μs/cm) or high radioactivity concentration (>10^{-3} μCi/ml), it may be returned to the system for additional processing. These wastes may be released to the discharge canal if allowable discharge canal concentrations are not exceeded.

9.2.4.2 Low Purity Wastes

Low purity (high conductivity) liquid wastes which are collected in the floor drain collector tank are from the following sources:

a. Drywell floor drain sumps,

b. Reactor Building floor drain sumps,

c. Radwaste Building floor drain sumps,

d. Turbine Building floor drain sumps,

e. Chemical waste tank,

f. RHR Systems,

g. Turbine Building backwash and receiver pit floor drain sumps,

h. Turbine Building condensate pump pit floor drain sumps, and

i. Offgas condensate collector sump.

These wastes generally have low concentrations of radioactive impurities; therefore, processing consists of demineralization, filtration, and subsequent transfer to the floor drain sample tank for sampling and analysis. An alternate method of processing low purity wastes is the use of vendor supplied skid mounted equipment interconnected to the permanent Radwaste System. After processing, depending on effluent quality and plant needs, the water can be sent to either the waste sample tank, floor drain sample tank, waste surge tank, or waste collector tank.

If the analysis indicates that the concentration of radioactive contaminants is sufficiently low and the water is not needed for plant reuse, the sample tank batch is transferred to the circulating water discharge canal for dilution with condenser circulating water as necessary to meet plant effluent discharge requirements of the ODCM. Manual valves are present between the floor drain sample tank and the discharge to preclude the possibility of unanalyzed radioactive water leaking directly to the river. Large-mesh, basket-type strainers are located in the floor drain and waste subsystems to prevent surge tank eductors from becoming plugged.

The ODCM provides the methodology to administratively control limits below regulatory limits.

Tritium is typically present in the radwaste effluents. The 10 CFR 20 limit for tritium is 1E-3μCi/ml - and the incremental contribution of the plant release is insignificant compared to current regulatory guidance.

Liquid wastes are released at a rate to give Effluent Concentration Limit (ECL) fraction of ≤10 in the discharge canal during the period of the discharge. Since the discharge is on a batch basis, the daily average concentration in the canal is correspondingly less. The discharge from the canal to the environs, therefore, is equal to or less than an ECL fraction of 10. Mixing in Wheeler Reservoir provides additional dilution.

Average annual concentrations of released isotopes and the resulting dose to members of the public are provided in the Annual Release Report.

9.2.4.3 <u>Chemical Wastes</u>

Chemical wastes are collected in the chemical waste tank and are from the following main sources:

a. Shop decontamination solutions,

b. Laboratory drains,

c. Reactor Building decontamination drains,

d. Chemical waste from cleanup and condensate precoat tanks,

e. Radwaste Building floor drain sump,

f. Radwaste floor drain and waste filter decontamination drain, and

g. Fuel pool filters decontamination drain.

Chemical wastes are typically transferred in small quantities to the floor drain collector tank for processing. The chemical contaminants and radioactivity concentrations are variable and largely dependent on plant operational activities which drain to the chemical waste tank. Normally, the radioactivity concentrations are low enough to meet discharge canal concentration limits (after dilution). These wastes may also be transferred to the floor drain collector tank and processed in the same manner and with the same equipment as low purity wastes.

9.2.4.4 Detergent Wastes

Detergent and other plant cleaning wastes are collected in the laundry drain tanks. These wastes are primarily from plant cleaning and decontamination activities and are typically of low radioactivity concentration. The laundry drain tanks may be crosstied with the cask decontamination tank. Prior to discharge, tank contents are recirculated through the laundry drain filter, sampled, and discharged into the circulating water canal at a rate not to exceed the limits of the ODCM. As an alternative, tank contents may be transferred to the floor drain collector tank and be processed in the same manner and with the same equipment as low purity waste.

Cask decontamination liquid is collected in the 15,000-gallon cask decontamination tank. This liquid is essentially high conductivity water of low radioactivity concentration. The liquid is sampled, filtered through the laundry drain filter, and discharged into the circulating water canal at a rate such that the limits of the ODCM are not exceeded. As an alternative, tank contents may be transferred to the floor drain collector tank and be processed in the same manner and with the same equipment as low purity waste.

9.2.5 Power Generation Evaluation

Liquids having levels of radioactivity above technical specification limits are not discharged from the plant. Pumpout rates of the liquid radwastes are variable. Prior to discharge, wastes are sampled and analyzed in batches. The liquid waste is then discharged at a rate such that technical specifications are not exceeded. Discharge is into the discharge canal of Units 1, 2, and 3 or into the cooling tower blowdown. A monitor on the waste system discharge line will alarm on excessive activity concentration and will automatically stop the discharge. The tank level and laboratory analysis records are retained as a record of waste discharge from the plant (see Subsection 7.12).

The monitor will be set to trip at a total ECL fraction of less than or equal to 10 in the plant effluent. When in the open cooling tower mode, the minimum dilution flow rate will be approximately 400,000 gpm or approximately 360,000 gpm in the helper mode. (One unit in operation, with two of the three circulating water pumps running.) The monitor will be set to limit the canal concentrations to less than the applicable regulatory limits. At this level, the monitor will close valves 77-58B and 77-58A (Figure 9.2-3c of the FSAR). In all cooling modes, discharge from the radwaste system is accomplished by a 3-inch and a 1-inch line upstream of the radiation monitor.

In the open mode, interlocks are provided which prevent the discharge of liquid waste into a condenser cooling water discharge conduit when fewer than two of the associated circulating water pumps are in operation. When the cooling towers are in the helper mode, additional interlocks are provided which prevent discharging liquid waste into a discharge conduit in which the flow is being routed to the towers. An additional waste discharge line connects with the cooling tower blowdown line. A flow restricting valve is installed in the waste discharge line which connects to the tower blowdown line. The valve will be used to vary the flow rate, depending upon the radioactivity of the waste, to assure that the canal concentration is within technical specifications and the ODCM.

The processing equipment is located within concrete buildings to provide secondary enclosures for the wastes in the event of leaks or overflows. Tanks and equipment which contain wastes with high radioactive concentrations that could be determined to result in increased dose to personnel are shielded. Except where flanges are required for maintenance, most pipe connections are welded to reduce the probability of leaks. Process lines which penetrate shield walls are routed to prevent a direct radiation path from the tanks or equipment. Control of the waste system is from local panels in the Radwaste Building.

Because the radioactivity concentrations in the plant discharge canal do not exceed the limits of the ODCM and the technical specifications and because the operation and availability of the plant is not limited, the Liquid Radwaste System fulfills the power generation design basis.

9.2.6 Safety Evaluation

Table 9.2-3 shows the total activity of liquid and solid radwaste that could be stored within the radwaste system if all operating tanks were full to working level. The tanks are located inside the Radwaste Building which extends 20 feet below grade to its lowest floor. The total maximum activity of solid and liquid contents of all tanks, when full to their maximum operating levels, is also shown.

Loss of tank contents within the Radwaste Building will result in the water flowing to the lowest floor level within the radwaste structure by way of stairwells and other openings. Using the approximate floor surface area of 12,232 square feet at elevation 546.5', a maximum volume of 383,060 gallons will result in a liquid depth of 50 inches above elevation 546'. At an average concentration of 0.2 microcurie/cc, the liquid activities will be 290 curies for the maximum volume conditions.

The concrete walls and slabs of the Radwaste Building have been examined for seismic loading. It has been determined that the Radwaste Building walls and slabs housing radioactive equipment can withstand the Design Basis Earthquake (DBE). Should a failure of the tanks, vessels and piping containing radioactivity occur, the spilled liquid would be retained in the Radwaste Building.

In order to assess the impact of a liquid radwaste spill on the nearest potable water supply surrounding the BFNP site, a study was conducted to determine if the limits of 10CFR20, Appendix B, Table 2, Column 2 will be exceeded. The results of the study involving a postulated release of liquid radwaste from the worst offending tank indicates that the limits of 10CFR20 will not be exceeded. The worst offending tank identified is the waste collector tank with a maximum operating volume of approximately 38,000 gallons and maximum activity of 1.4E+8 microcuries. The isotopic distribution contained in Table 9.2-4 served as the basis of the study. Actual isotopic distribution may vary with plant operation and related support activities.

Since a postulated release of liquid radwaste from the worst offending tank resulted in radionuclide concentrations well below the limits of 10CFR20 in the unrestricted area around the BFNP site then it can be concluded that the design basis is met.

9.2.7 Inspection and Testing

The Liquid Radwaste System is normally operating on an "as required" basis during operation of the nuclear plant thereby demonstrating operability without any special inspections or testing.