GE Nuclear Energy

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Attention: Charles L. Miller, Director
Standardization and Non-Power Reactor Project Directorate

Subject: GE Responses to Discussion Items from Conference Calls of June 3 1991 and June 5, 1991 with Plant Systems Branch

Enclosed are thirty-four (34) copies of the GE responses to the subject discussion items.

It is intended that GE will amend the SSAR, as appropriate, with the enclosed responses in a future amendment.

Sincerely,

R.C. Mitchell

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D038 1/34

PLANT SYSTEMS OPEN ITEMS FOR DISCUSSION

3.4.1 FLOOD PROTECTION

OPEN ITEM (1)

Safety-related systems and components that may be affected by external floods are protected either because of their location above the design flood level or because they are enclosed in reinforced concrete Seismic Category I structures which have a required wall thickness of not less than two feet for portions of the structures below the flood level. The ABWR Safety Analysis Report did not address the effects of standing water on the roofs of safety related buildings and the means to limit the amount of such water as required by the guidelines of RG 1.102. The ability of these structures to withstand the effects of standing water remains an open issue.

RESPONSE (1)

Response to this open item is provided in revised Subsection 3.4.1.1.1 (page 3.4-1).

OPEN ITEM (2)

Analysis of rupture of moderate-energy piping larger than one-inch diameter are performed in accordance with ANSI/ANS 56.11 "Standard Design Criteria for Protection Against the Effects of Compartment Flooding in Light Water Reactor Plants", and Crane Co., Technical Paper No. 410, #1973,"Flow of Fluids Through Valves, Fittings, and Pipe". High energy line breaks in the Main Steam Line (MSL) tunnel are excluded from evaluation, since this area is instrumented for detection of leaks before a line break. However, even in the event of feedwater line break, water will be contained in the Seismic Category I structure of the MSL tunnel and be allowed to drain to the High Conductivity Water (HCW) sumps. The applicant described the operator response period and type of flooding source. The staff believes that a leak-before-break analysis should use plant- specific data such as piping geometry, materials, fabrication procedures, and pipe support locations. Therefore the staff will evaluate the acceptability of the above exclusion on a plant-specific basis.

RESPONSE (2)

Response to this open item is provided in revised Subsection 3.4.1.1.2 (page 3.4-2).

OPEN ITEM (3)

Analysis of the worst flooding due to pipe and tank failures and their consequences are performed on a floor-by-floor basis within the Reactor Building to demonstrate the safe shutdown of the reactor. However, the applicant did not discuss if the safety-related equipment within this structure (or any of the other structures analyzed) is capable of normal function while subjected to liquid spill, and completely or partially flooded. This is an open issue.

RESPONSE (3)

Response to this open item is provided in revised Subsection 3.4.1.1.2 (page 3.4-2).

OPEN ITEM (4)

The ABWR SSAR did not include flood analysis for any structures outside the scope of the generic design housing systems or components performing a safety function, such as the ultimate heat sink pump house. The identified interface requirements, essentially identifying only the normal groundwater and flood levels, are insufficient to insure adequate flood protection design for these structures. Interface requirements that will insure the ability of the plant specific application to meet the flood protection requirements as described in SRP Section 3.4.1 (that is the requirements of GDC 2 and the guidance of RG 1.102) need to be provided. This is an open issue.

RESPONSE (4)

Response to this open item is provided in revised Subsection 3.4.1.1.2 (page 3.4-2).

OPEN ITEM 9.1.1 (NEW FUEL STORAGE)

GE has not included in the interface requirements that the design of the new fuel storage racks will be such that the K_{eff} will not exceed 0.98 with fuel of the highest anticipated reactivity in place assuming optimum moderator conditions (foam, small droplets, spray, or fogging) as described in SRP Section 9.1.1. This is considered an open issue.

RESPONSE 9.1.1

This open item is covered by response to Question 430.180.

9.1.2 SPENT FUEL STORAGE

OPEN ITEM (1)

The reactor building housing the facility is designed to seismic Category I criteria, as are the storage racks and other "fuel storage facilities", including the gates between the spent fuel pool and other pools. However, information on the seismic classification of the spent fuel pool liner is not contained in the SSAR. This is considered an open issue.

RESPONSE (1)

Response to this open item is provided in revised Table 3.2-1 (page 3.2-18) and Subsection 9.1.2.1.2 (page 9.1-?).

OPEN ITEM (2)

The design of the storage pool includes the provision of radiation monitoring systems described in SSAR Section 11.5, which were determined to satisfy in part the requirements of GDC 63, "Monitoring Fuel and Waste Systems." The SSAR and the GE response to the request for additional information (Response 430.191) do not include sufficient information to conclude that there are acceptable monitoring systems for pool water level and excessive pool liner leakage. This is considered an open issue.

RESPONSE (2)

Response to this open item is provided in revised Subsections 9.1.3.2 (page 9.1-4) and 9.1.3.3 (page 9.1-5).

9.1.4 LIGHT LOAD HANDLING SYSTEM

OPEN ITEM (1)

The refueling platform is designed to Seismic Category I standards and the entire system is housed within the reactor building which is a Seismic Category I, flood- and tornado-protected structure. However, the new fuel inspection stand is not classified as seismic Category I. It is not entirely clear from the SSAR description that in the event of an earthquake the fall of the new fuel stand would not be detrimental to criticality or radiological safety. This is considered an open issue.

RESPONSE (1)

The new fuel inspection stand is used to inspect the new fuel bundles before they are placed into the spent fuel pool. The fuel is moved by the jib crane from the new fuel pit to the new fuel inspection stand. The jib crane is always supporting

the fuel bundles. The jib crane is nonseismic but is designed not to drop its load in an SSE; therefore, it is unlikely that a new fuel assembly will fall into the spent fuel pool. The new fuel inspection stand is both supported off the floor and attached to the wall. It is also unlikely that the stand will fall into the spent fuel pool; therefore, there is no need to make the new fuel inspection stand Seismic Category I.

OPEN ITEM (2)

Dropped.

OPEN ITEM 9.2.5 (ULTIMATE HEAT SINK)

The conceptual design for the UHS is a spray pond. The requirements of RG 1.72 are applicable to the design of a spray pond as an UHS, but were not referenced as interface criteria. The identification of RG 1.72 design criteria as interface requirements remains an open issue.

RESPONSE 9.2.5

Response to this open item is provided in new Subsection 9.2.17.2 (page 9.2-13).

9.2.14 TURBINE BUILDING COOLING WATER SYSTEM

OPEN ITEM (1)

The TCW system is a non-safety related system designed to provide heat removal capability for various turbine island auxiliary equipment. The TCW is a closed loop system consisting of two 100% pumps, two 100% heat exchangers, a surge tank and associated piping, valves and instrumentation. The description of the TCW in this section of the ABWR SSAR contains several inconsistencies. The component and system descriptions of Section 9.2.14.2.3 "System Operation" and of Figure 9.2-6a do not agree with the descriptions of Sections 9.2.14.2.1 "General Description" and 9.2.14.2.2 "Component Description" and the responses to RAIs. The discrepancies (number of heat exchangers, pump capacities) should be corrected. Because the descriptions in Sections 9.2.14.2.1 and 2 are more recent versions of the system description, they were analyzed as the TCW system. These discrepancies remain an open item.

RESPONSE (1)

Response to this open item is provided in revised Subsection 9.2.14.2.3 (pages 9.2-10.1 and 9.2-11) and revised Figure 9.2-6a (page 9.2-42).

OPEN ITEM (2)

The TCW is located in and near the turbine building away from safety related systems. In response to RAIs 430.206 and .207, GE asserted that failure of any TCW components, including the atmospheric surge tank, would not fail any safety-related equipment. From equipment layout diagrams this statement appears to be true for all equipment shown on the diagrams. The atmospheric surge tank does not appear on these diagrams. Verification that failure of this component will not affect safety-related systems is not possible. This remains an open issue.

RESPONSE (2)

Response to this open item is provided in revised Subsections 9.2.12.2 (page 9.2-7) and 9.2.14.2.1 (page 9.2-10).

9.2.15 REACTOR SERVICE WATER

OPEN ITEM (1)

The RSW is an open cycle system which provides cooling water to the RCW heat exchangers. No other heat loads are supported by the RSW system. The RSW system picks up heat from the RCW heat exchangers and rejects the heat to the ultimate heat sink which is to be designed by individual applicants referencing the ABWR. The GE scope of the RSW includes all the piping valves, pumps, heat exchangers, instrumentation, and controls from the system intake from the ultimate heat sink to the discharge back to the ultimate heat sink. Although the total heat rate, total flow rate, temperature drop and pressure drop at the RCW heat exchangers for all identified modes of operation were provided for the RCW system, similar parameters for the RSW system (including identification of sufficient net positive suction head at pump suction locations considering low water levels) were not provided. This is an open issue.

RESPONSE (1)

Response to this open item is provided in revised Subsection 9.2.15.2 (page 9.2-12) and new Subsection 9.2.17.4 (page 9.2-13).

OPEN ITEM (2)

GE stated that both the mechanical equipment and piping and electrical equipment including instrumentation and controls of the redundant divisions of the RSW system are sufficiently separated and protected to ensure availability of the needed equipment to perform reactor shutdown in the event of any of the following occurrences: pipe rupture or equipment failure induced flooding,

spraying steam release; pipe whip and jet forces from a postulated nearby high energy line break; missiles from equipment failure; fire; non-Category I equipment failure; or a single active component failure in the system. However insufficient detail has been provided to insure that this design criteria can be met. Specifically, location and design features for the RSW pump and associated equipment have not been specified.

RESPONSE (2)

Response to this open item is provided in revised Subsection 9.2.15.3 (page 9.2-12) and new Subsection 9.2.17.4 (page 9.2-13).

OPEN ITEM (3)

The ability of the RSW system to perform its function cannot be verified because pump design characteristics (flow, pressure, NPSH requirements) were not included in the SSAR (The required heat loads to be removed by the RSW system are identified.) While the design requirements of the RSW system meet the intent of GDC 44, the ability of the RSW system to meet the requirements of GDC 44 remain an open item.

RESPONSE (3)

Response to this open item is provided in new Subsection 9.2.17.4 (page 9.2-13).

OPEN ITEM 9.2.16 (TURBINE SERVICE WATER SYSTEM)

The TSW is located in the intake structure (the power cycle heat sink pump house) and the turbine building. The system does not appear to have any connections with safety related systems, although insufficient detail is provided in the system description and diagrams to verify that no such connections exist. The applicant must demonstrate that all safety related components, systems, and structures are protected from flooding in the event of a pipeline break in the TSW system in order to meet position C.2 of RG 1.29 and thus comply with GDC 2. (Due to the site specific nature of the location of some TSW components this requirement may need to be expressed as an interface requirement).

RESPONSE 9.2.16

Response to this open item is provided in revised Subsection 9.2.16.3 (page 9.2-12.2) and new Subsection 9.2.17.5 (page 9.2-13).

TABLE 3.2-1

CLASSIFICATION SUMMARY (Continued)

Principal Component[a]	Safety Class[b]	Location[c]	Quality Group Classification[d]	Quality Assurance Requirement[e]	Seismic Category[f]	Notes
F2 RPV Servicing Equipment						
1. Steamline plugs	N	SC	---	---	---	
2. Dryer and separator strongback and head strongback	N	SC	---	---	---	
F3 RPV Internal Servicing Equipment						
1. Control rod grapple	N	SC	---	---	---	
F4 Refueling Equipment						
430.195a 1. Refueling platform	N	SC	---	---	I	(bb) 210.13
2. Refueling bellows	N	SC	---	---	---	
F5 Fuel Storage Equipment						
1. Fuel storage racks - new and spent	N	SC	---	---	I	(bb) 210.15
2. Defective fuel storage container	N	SC	---	---	---	(bb)
9.1.2 #1 3. Spent fuel pool liner	N	SC	--	--	I	
G1 Reactor Water Cleanup System						
210.20 1. Vessels including supports (filter/demineralizer)	N	SC	C	---	---	
2. Regenerative heat exchangers including supports carrying reactor water	N	SC	C	---	---	
3. Cleanup recirculation pump, motors	N	SC	C	---	---	

3.4 WATER LEVEL (FLOOD) DESIGN

430 229 The types and methods used for protecting the ALWR safety-related structures, systems and components from external flooding shall conform to the guidelines defined in RG 1.102.

Criteria for the design basis for protection against external flooding shall conform to the requirements of RG 1.59. The design criteria for protection against the effects of compartment flooding shall conform to the requirements of ANSI/ANS-56.11. The design basis flood levels are specified in Table 3.4-1.

3.4.1 Flood Protection

430 229 This section discusses the flood protection measures that are applicable to the standard ABWR plant Seismic Category I structures, systems, and components for both external flooding and postulated flooding from plant component failures. These protection measures also apply to other structures that house systems and components important to safety which fall within the scope of plant specific.

3.4.1.1 Flood Protection Measures for Seismic Category I Structures

430 229 The safety-related systems and components of the ABWR Standard Plant are located in the reactor, control, and radwaste buildings which are Seismic Category I structures. These structures together with those identified in Table 3.4-1 are protected against external flood damage. Flood protection of safety-related systems and components is provided for all postulated design flood levels and conditions 430 229 described in Table 2.0-1. Postulated flooding from component failures in the building compartments does not adversely affect plant safety nor does it represent any hazard to the public.

430 229 Structures which house the safety-related equipment and offer flood protection are identified in Table 3.4-1. Descriptions of these structures are provided in Subsection 3.8.4 and 3.8.5. Exterior or access openings and penetrations that are below the design flood level are identified in Table 6.2-9.

3.4.1.1.1 Flood Protection from External Sources

Seismic Category I structures that may be affected by design basis floods are designed to withstand the floods postulated in Table 2.0-1 430 230 using the hardened protection approach with structural provisions with incorporated in the plant design to protect safety-related structures, systems, and components from postulated flooding. Seismic Category I structures required for safe shutdown remain accessible during all flood conditions.

Safety-related systems and components are flood-protected either because of their location above the design flood level or because they are enclosed in reinforced concrete Seismic Category I structures which have the following requirements:

(1) wall thicknesses below flood level of not less than two feet;

(2) water stops provided in all construction joints below flood level;

(3) watertight doors and equipment hatches installed below design flood level; and

(4) waterproof coating of external surfaces. 430 232

(5) roofs are designed to prevent ponding of large amounts of water in accordance with RG 1.102.

Waterproofing of foundations and walls of Seismic Category I structures below grade is accomplished principally by the use of water stops at expansion and construction joints. In addition to water stops, waterproofing of the plant structures that house safety related systems and components is provided up to 8 cm (3 in) above the plant ground level to protect the external surfaces from exposure to water. 430 232

Additional specific provisions for flood protection include administrative procedures to assure that all watertight doors and hatch covers are locked in the event of a flood warning. If local seepage occurs through the walls, it is controlled by sumps and sump pumps.

In the event of a flood, flood levels take a relatively long time to develop. This allows

3.4.1 #1

3.4.1.1.2 Compartment Flooding from Postulated Component Failures

All piping, vessels, and heat exchangers with flooding potential in the reactor building are seismically qualified with one exception, and complete failure of a non-seismic tank or piping system is not applicable. The one exception is the radwaste building which contains no safe shutdown equipment.

In accordance with Reference 2, leakage cracks are postulated in any point of moderate-energy piping larger than nominal one-inch diameter. The leakage flow area is assumed to be a circular orifice with flow area equal to one-half of the pipe outside diameter multiplied by one-half of the pipe nominal wall thickness. Resulting leakage flow rates are approximated using Equation 3-2 from Reference 1 with a flow coefficient of 0.59 and a normal operating pressure in the pipe.

The dynamic effects of postulated high energy line breaks in the MSL tunnel area including flood analysis are excluded in the evaluation, assuming credit for detection of leaks before a line breaks with a good accuracy and reliability to permit shutdown and repair. The MSL tunnel area is instrumented with radiation and air temperature monitors that are used to automatically isolate the MSL isolation valves upon detection of high abnormal limits.

However, in the event of worst case flooding involving a feedwater line break, the maximum flow rate from this high energy line break will not exceed 3.6 cubic meters per minute (950 gpm) over a 2 hour period. Refer to Table 15.6-16 for feedwater line leakage parameters. Water discharged from a postulated feedwater line break will be contained in the Seismic Category I structure of the MSL tunnel area and will not flood any safety related equipment in the reactor building. The flooded area will be allowed to drain through the floor drains in the tunnel area which are routed to the HCW sumps in the reactor building for collection and discharge.

No credit is taken for operation of the drain sump pumps although they are expected to operate during some of the postulated flooding events.

After receiving a flood detection alarm, the operator has a ten-minute grace period to act in cases when flooding can be identified and terminated by a remote action from the control room. In cases involving visual inspection to identify the specific flooding source in the affected area (except ECCS areas) followed by a remote or local operator action, a minimum of 30 minutes is provided for the operator. ← INSERT 3.4.1.1.2 a (3.4.1 #2)

In all instances of compartment flooding, a single failure of an active component is considered for systems required to mitigate consequences of a particular flooding condition. The emergency core cooling system (ECCS) rooms are also evaluated on the basis of a loss-of- coolant accident (LOCA) and a single active failure or a LOCA combined with a single passive failure 10 minutes or more after the LOCA.

There are no interface requirements made upon the remainder of the plant from possible flooding in the ABWR Standard Plant buildings. Other lines, such as storm drains and normal waste lines, interface with plant yard piping. However, provisions are made in these lines that, should the yard piping become plugged, crushed, or otherwise inoperable, they will vent onto the ground relieving any flooded condition.

Considering the above criteria and assumptions, analyses of piping failures and their consequences are performed to demonstrate the adequacy of the ABWR design. These analyses are provided separately for the reactor and control buildings. (3.4.1 #3) ← INSERT 3.4.1.1.2 b

3.4.1.1.2.1 Evaluation of Reactor Building Flood Events

← INSERT 3.4.1.1.2 c (3.4.1 #4)

Analysis of potential flooding within the reactor building is considered on a floor-by-floor basis.

3.4.1.1.2.1.1 Evaluation of Floor 100 (B3F)

Worst case flooding on this floor level would result from leakage of the RHR 18" suction line between the containment wall and the system isolation valve (this applies also to the HPCF, RCIC, and SPCU suction lines, although in

dynamic force due to flood. The lateral hydrostatic pressure on the structures due to the design flood water level, as well as ground water and soil pressures, are calculated.

Structures, systems, and components in the ABWR Standard Nuclear Island designed and analyzed for the maximum hydrostatic and hydrodynamic forces in accordance with the loads and load combinations indicated in Subsection 3.8.4.3 and 3.8.5.3 using well established methods based on the general principles of engineering mechanics. All Seismic Category I structures are in stable condition due to either moment or uplift forces which result from the proper load combinations including the design basis flood.

3.4.3 Interfaces

3.4.3.1 Flood Elevation

The design basis flood elevation for the ABWR Standard Plant structures is one foot below grade.

3.4.3.2 Ground Water Elevation

The design basis ground water elevation for the ABWR Standard Plant structures is two feet below grade.

3.4.4 References

1. Crane Co., *Flow of Fluids Through Valves, Fittings, and Pipe*, Technical Paper No. 410, 1973.

2. ANSI/ANS 56.11, Standard, *Design Criteria for Protection Against the Effects of Compartment Flooding in Light Water Reactor Plants.*

3. Regulatory Guide 1.59, Rev. 2 *Design Basis Floods for Nuclear Power Plants.*

INSERT 3.4.3.3 (3.4.1 #2)

INSERT 3.4.3.4 (3.4.1 #4)

INSERTS 3.4.1.1.2

3.4.1 #2

INSERT 3.4.1.1.2a

All leak-before-break analysis will use plant-specific data such as piping geometry, materials, fabrication procedures, and pipe support locations. See Subsection 3.4.3 for interface requirements.

3.4.1 #3

INSERT 3.4.1.1.2b

Analysis of the worst flooding due to pipe and tank failures and their consequences are performed in this subsection for the reactor building, control building, radwaste building and the service building. No credit is taken for safety-related equipment within these structures if the equipment becomes partially flooded. However, in accordance with Section 3.11, all safety-related equipment is qualified to high relative humidity.

3.4.1 #4

INSERT 3.4.1.1.2c

For those structures outside the scope of the ABWR Standard Plant (e.g., the ultimate heat sink pump house), the applicant referencing the ABWR design will demonstrate the structures outside the scope will meet the requirements of GDC 2 and the guidance of RG 1.102. See subsection 3.3.3 for interface requirements.

3.4.1 #2

INSERT 3.4.3

3.4.3 Leak-Before-Break Analysis

Leak-before break analysis will be submitted to the NRC using plant-specific data such as piping geometry, materials, fabrication procedures, and support locations. Any piping qualifying for the leak-before-break approach will meet the requirements of Subsection 3.6.3. (See Subsection 3.4.1.1.2)

3.4.1 #4

INSERT 3.4.4 Flood Protection Requirements for Other Structures

The applicant referencing the ABWR design will demonstrate, for the structures outside the scope of the ABWR Standard Plant, that they meet the requirements of GDC 2 and the guidance of RG 1.102. (See Subsection 3.4.1.1.2)

9.1.2 Spent Fuel Storage

9.1.2.1 Design Bases

9.1.2.1.1 Nuclear Design

(1) A full array in the loaded spent fuel rack is designed to be subcritical, by at least 5% Δk. Neutron-absorbing material, as an integral part of the design, is employed to assure that the calculated k_{eff}, including biases and uncertainties, will not exceed 0.95% under all normal and abnormal conditions.

(a) Monte Carlo techniques are employed in the calculations performed to assure that k_{eff} does not exceed 0.95 under all normal and abnormal conditions.

(b) The assumption is made that the storage array is infinite in all directions. Since no credit is taken for neutron leakage, the values reported as effective neutron multiplication factors are, in reality, infinite neutron multiplication factors.

(c) The biases between the calculated results and experimental results, as well as the uncertainty involved in the calculations, are taken into account as part of the calculational procedure to assure that the specific k_{eff} limit is met.

9.1.2.1.2 Storage Design

The fuel storage racks provided in the spent fuel storage pool provide storage for 270% of one full core fuel load.

9.1.2.1.3 Mechanical and Structural Design

The spent fuel storage racks in the reactor building contain storage space for fuel assemblies (with channels) or bundles (without channels). They are designed to withstand all credible static and seismic loadings. The racks are designed to protect the fuel assemblies and bundles from excessive physical damage which may cause the release of radioactive materials in excess of 10CFR20 and 10CFR100 requirements, under normal and abnormal conditions caused by impacting from either fuel assemblies, bundles or other equipment.

The fuel storage pool liner seismic clasification is provided in Table 3.2-1.

9.1.2 #1

The spent fuel pool is a reinforced concrete structure with a stainless steel liner. The bottoms of all pool gates are sufficiently high to maintain the water level over the spent fuel storage racks form adequate shielding and cooling. All pool fill and drain lines enter the pool above the safe shielding water level. Redundant anti-siphon vacuum breakers are located at the high point of the pool circulation lines to preclude a pipe break from siphoning the water from the pool and jeopardizing the safe water level.

The racks include individual solid tube storage compartments, which provide lateral restraints over the entire length of the fuel assembly or bundle. The weight of the fuel assembly or bundle is supported axially by the rack fuel support. Lead-in guides at the top of the storage spaces provide guidance of the fuel during insertion.

The racks are fabricated from materials used for construction are specified in accordance with the latest issue of applicable ASTM specifications. The racks are constructed in accordance with a quality assurance program that ensures the design, construction and testing requirements are met.

The racks are designed to withstand, while maintaining the nuclear safety design basis, the impact force generated by the vertical free-fall drop of a fuel assembly from a height of 6 feet. The rack is designed to withstand a pullup force of 4000 pounds and a horizontal force of 1000 pounds. There are no readily definable horizontal forces in excess of 1000 pounds, and in the event a fuel assembly should jam, the maximum lifting force of the fuelhandling platform grapple (assumes limit switches fail) is 3000 pounds.

The fuel storage racks are designed to handle irradiated fuel assemblies. The expected radiation levels are well below the design levels.

In accordance with Regulatory Guide 1.29, the fuel storage racks are designated Safety class 2 and Seismic Category I. The structural integrity of the rack has been demonstrated for the load combinations described below using linear elastic design methods.

The applied loads to the rack are:

(1) dead loads, which are weight of rack and fuel assemblies, and hydrostatic loads;

(2) surface dirt dislodged from equipment immersed in the pool;

(3) crud and fission products emanating from the reactor or fuel bundles during refueling;

(4) debris from inspection or disposal operations; and

(5) residual cleaning chemicals or flush water.

A post-strainer in the effluent stream of the filter-demineralizer limits the migration of filter material. The filter-holding element can withstand a differential pressure greater than the developed pump head for the system.

The filter-demineralizer units are located separately in shielded cells with enough clearance to permit removing filter elements from the vessels.

Each cell contains only the filter-demineralizer and piping. All valves (inlet, outlet, recycle, vent, drain, etc.) are located on the outside of one shielding wall of the room, together with necessary piping and headers, instrument elements and controls. Penetrations through shielding walls are located so as not to compromise radiation shielding requirements.

The filter-demineralizers are controlled from a local panel. A differential pressure and conductivity instruments provided for each filter-demineralizer unit indicate when backwash is required. Suitable alarms, differential pressure indicators and flow indicators monitor the condition of the filter-demineralizers.

System instrumentation is provided for both automatic and remote-manual operations. A low-low level switch stops the circulating pumps when the fuel pool drain tank reserve capacity is reduced to the volume that can be pumped in approximately one minute with one pump at rated capacity (250 m^3/hr). A level switch is provided in the fuel pool to alarm on high and low level. A temperature element is provided to display pool temperature in the main control room.

The circulating pumps are controlled from the control room and a local panel. Pump low suction pressure automatically turns off the pumps. A pump low discharge pressure alarm is indicated in the control room and on the local panel. The circulating pump motors can be powered from the diesel- generators if normal power is not available. Circulating pump motor loads are considered nonessential loads and will be operated as required under accident conditions.

The water level in the spent fuel storage pool is maintained at a height which is sufficient to provide shielding for normal building occupancy. Radioactive particulates removed from the fuel pool are collected in filter-demineralizer units which are located in shielded cells. For these reasons, the exposure of plant personnel to radiation from the FPC system is minimal. Further details of radiological considerations for this system are described in Chapter 12.

The circulation patterns within the reactor well and spent fuel storage pool are established by placing the diffusers and skimmers so that particles dislodged during refueling operations are swept away from the work area and out of the pools.

Check valves prevent the pool from siphoning in the event of a pipe rupture.

Heat from pool evaporation is handled by the building ventilation system. Makeup water is provided through a remote-operated valve.

9.1.3.3 Safety Evaluation

The maximum possible heat load is the decay heat of the full core load of fuel at the end of the fuel cycle plus the remaining decay heat of the spent fuel discharged at previous refuelings; the maximum capacity of the spent fuel storage pool is 270% of a core. The temperature of the fuel pool water may be permitted to rise to approximately 140°F under these conditions. During cold shutdown conditions, if if appears that the fuel pool temperature will exceed 125°F, the operator can connect the FPC system to the RHR system. Combining the capacities enables the two systems to keep the

9.1.2
#2

In addition, leakage flow detectors in the pool drains and pool liners are provided and alarmed in the control room.

water temperature below 125^{O}F. The RHR system will be used only to supplement the fuel pool cooling when the reactor is shut down. The reactor will not be started up whenever portions of the RHR systems are needed to cool the fuel pool. The connecting piping from the fuel storage pool to the RHR system is designed Seismic Category I and can be isolated, assuming a single active failure, from the remainder of the fuel pool system.

These connections may also be utilized during emergency conditions to assure cooling of the spent fuel regardless of the availability of the fuel pool cooling system. The volume of water in the storage pool is such that there is enough heat absorption capability to allow sufficient time for switching over to the RHR system for emergency cooling.

The 140^{O}F temperature limit is set to assure that the fuel building environment does not exceed equipment environmental limits.

The spent fuel storage pool is designed so that no single failure of structures or equipment will cause inability to: (1) maintain irradiated fuel submerged in water; (2) re-establish normal fuel pool water level; or (3) remove decay heat from the pool. In order to limit the possibility of pool leakage around pool penetrations, the pool is lined with stainless steel. In addition to providing a high degree of integrity, the lining is designed to withstand abuse that might occur when equipment is moved about. No inlets, outlets or drains are provided that might permit the pool to be drained below a safe shielding level. Lines extending below this level are equipped with siphon breakers, check valves, or other suitable devices to prevent inadvertent pool drainage. Interconnected drainage paths are provided behind the liner welds. These paths are designed to: (1) prevent pressure buildup behind the liner plate; (2) prevent the uncontrolled loss of contaminated pool water to other relatively cleaner locations within the containment or fuel-handling area; and (3) provide liner leak detection and measurement. These drainage paths are designed to permit free gravity drainage ~~or pumping~~ to the equipment drain tank,s or sumps of sufficient capacity and/or pumped to the liquid radwaste facility.

9.1.2 #2

A makeup water system and pool water level instrumentation are provided to replace evaporative and leakage losses. Makeup water during normal operation will be supplied from condensate. The suppression pool cleanup system can be used as a source of makeup water in case of failure of the normal makeup water system.

Connections from the RHR system to the FPC system provide a Seismic Category I, safety-related makeup capability to the spent fuel pool. The FPC system from the RHR connections to the spent fuel pool are Seismic Category I, safety-related.

From the foregoing analysis, it is concluded that the FPC system meets its design bases.

9.1.3.4 Inspection and Testing Requirements

No special tests are required because, normally, one pump, one heat exchanger and one filter-demineralizer are operating while fuel is stored in the pool. The spare unit is operated periodically to handle abnormal heat loads or to replace a unit for servicing. Routine visual inspection of the system components, instrumentation and trouble alarms is adequate to verify system operability.

9.1.3.5 Radiological Considerations

The water level in the spent fuel storage pool is maintained at a height which is sufficient to provide shielding for normal building occupancy. Radioactive particulates removed from the fuel pool are collected in filter-demineralizer units which are located in shielded cells. For these reasons, the exposure of plant personnel to radiation from the FPC system is minimal. Further details of radiological considerations for this and other systems are described in Chapters 11, 12, and 15.

9.2.12 HVAC Normal Cooling Water System

9.2.12.1 Design Bases

9.2.12.1.1 Power Generation Design Bases

The HVAC normal cooling water system (nonsafety-related) shall provide chilled water to the cooling coils of the drywell coolers, of each building supply unit and of local air conditioners to maintain design thermal environments during normal and upset conditions. The supply temperature is 44.6°F. The return temperature is 53.6°F.

9.2.12.1.2 Safety Design Bases

The HVAC normal cooling water system does not perform any safety functions, except for the containment penetration and isolation valves.

9.2.12.2 System Description

The HVAC normal cooling water system components are listed in Table 9.2-6 and shown in Figure 9.2-2.

System components consist of five 25% chillers, each with pumps, serving a common chilled water distribution system connected to the chilled water cooling coils in the drywell coolers, the cooling coils of each building supply unit and cooling coils of local air conditioners. Condenser cooling is from the turbine building cooling water system. Each chiller and pump set has either a three-way mixing valve for automatically controlling the temperature of the chilled water delivered or a flow control valve to maintain the desired temperature. Each chiller evaporator is designed, fabricated and certified in accordance with the ASME Code Section VIII, Division 1. A chemical feed tank is provided. Makeup water is from the ~~turbine building cooling water system~~ surge tank * which receives water from the MUWP system. Isolation valves and piping for primary containment penetrations are designed to seismic Category I, ASME code, Section III, class 2, Quality Group B, Quality Assurance B requirements. The supply line penetration has a Division 1 isolation valve outside containment and Class 2 piping into the drywell. The return line penetration has divisional isolation valves inside and outside containment. These valves are motor operated.

No diesel-generator power is available to this system during a LOPP or a LOCA.

9.2.12.3 Safety Evaluation

Operation of the HVAC normal cooling water system is not required to assure the following conditions:

(1) integrity of the reactor coolant pressure boundary;

(2) capability to shut down the reactor and maintain it in a safe shutdown condition; and

(3) ability to prevent or mitigate the consequences of events which could result in potential offsite radiological exposures.

The HVAC normal cooling water system is not safety-related. However, it does incorporate features that assume reliable operation over the full range of normal plant operations.

Portions of the chilled water system which penetrate the containment and drywell are provided with isolation valves and penetrations which are Seismic Category I, Safety class 2. The valves may be manually operated from the control room, except when a LOCA signal assumes control.

9.2.1A #2

* , which is shared between the HNCW and TCW systems,

evaporator. If the temperature of the chilled water drops below a specified lev:i, the controller automatically adjusts the position of the compressor inlet guide vanes. Flow switches prohibit the chiller from operating unless there is water flow through both evaporator and condenser.

9.2.14 Turbine Building Cooling Water System

9.2.14.1 Design Bases

9.2.14.1.1 Safety Design Bases

The turbine building cooling water (TCW) system serves no safety function and has no safety design basis.

430.208 There are no connections between the TCW system and any other safety-related systems.

9.2.14.1.2 Power Generation Design Bases

(1) The TCW system provides corrosion-inhibited, demineralized cooling water to all turbine island auxiliary equipment listed in Table 9.2-11.

(2) During power operation, the TCW system operates to provide a continuous supply of cooling water, at a maximum temperature of 105°F, to the turbine island auxiliary equipment, with a service water inlet temperature not exceeding 95°F.

(3) The TCW system is designed to permit the maintenance of any single active component without interruption of the cooling function.

(4) Makeup to the TCW system is designed to permit continuous system operation with design failure leakage and to permit expeditious post-maintenance system refill.

(5) The TCW system is designed to have an atmospheric surge tank located at the highest point in the system.

(6) The TCW system is designed to have a higher pressure than the power cycle heat sink water to ensure leakage is from the TCW system to the power cycle heat sink in the event a tube leak occurs in the TCW system heat exchanger.

9.2.14.2 System Description

9.2.14.2.1 General Description

The TCW system is illustrated on Figure 9.2-6. The system is a single loop system and consists of one surge tank, one chemical addition tank, two pumps with a capacity of 29,000 gpm each, two heat exchangers with heat removal capacity of 130 x 10^6 Btu/h each (connected in parallel), and associated coolers, piping, valves, controls, and instrumentation. Heat is removed from the TCW system and transferred to the non-safety related turbine service water system (Subsection 9.2.16). 430.207b

Typo

A TCW system sample is periodically taken for analysis to assure that the water quality meets the chemical specifications.

9.2.14.2.2 Component Description

Codes and standards applicable to the TCW system are listed in Table 3.2-1. The system is designed in accordance with quality group D specifications.

The chemical addition tank is located in the turbine building in close proximity to the TCW system surge tank.

The TCW pumps are 100% capacity each and are constant speed electric motor driven, horizontal centrifugal pumps. The three pumps are connected in parallel with common suction and discharge lines.

The TCW heat exchangers are 100% capacity each and are designed to have the TCW water circulated on the shell side and the power cycle heat sink water circulated on the tube side. The surface area is based on normal heat load.

The ~~TCW~~ surge tank * is an atmospheric carbon steel tank located at the highest point in the TCW system. The surge tank is provided with a level control valve that controls makeup water addition.

9.2.14 #2 INSERT 9.2.14.?

Those parts of the TCW system in the turbine building are located in areas that do not contain any safety-related systems. All 430.207a

9.2.14 #2 *, which is shared between the HNCW and TCW systems,

INSERT 9.2.14.2.2 (9.2.14 #2)

The surge tank is located above the TCW pumps and heat exchangers in the turbine building in a location away from any safety-related components. Failure of the surge tank will not affect any safety-related systems.

430.207a

safety-related systems in the turbine building are located in special areas to prevent any damage from non-safety-related systems during seismic events. Those parts of the TCW system outside the turbine building are located away from any safety-related systems.

9.2.14.2.3 System Operation

During normal power operation, one of the two ~~50~~ 100% capacity TCW system pumps circulate

9.2.14 #1

9.2.14 #1

inhibited demineralized water through the shell side of two of the three 50% capacity TCW heat exchangers in service. The heat from the TCW system is rejected to the turbine service water system which circulates water on the tube side of the TCW system heat exchangers.

The standby TCW system pump is automatically started on detection of low TCW system pump discharge pressure. The standby TCW system heat exchanger is placed in service manually.

The cooling water flow rate to the electro-hydraulic control (EHC) coolers, the turbine lube oil coolers and aftercoolers, and generator exciter air cooler is regulated by control valves. Control valves in the cooling water outlet from these units are throttled in response to temperature signals from the fluid being cooled.

The flow rate of cooling water to all of the other coolers is manually regulated by individual throttling valves located on the cooling water outlet from each unit.

The minimum system cooling water temperature is maintained by adjusting the TCW system heat exchanger bypass valve.

The surge tank provides a reservoir for small amounts of leakage from the system and for the expansion and contraction of the coolant fluid with changes in the system temperature and is connected to the pump suction.

Demineralized makeup water to the TCW system is controlled automatically by a level control valve which is actuated by sensing surge tank level. A corrosion inhibitor is manually added to the system.

9.2.14.3 Safety Evaluation

The TCW system has no safety design bases and serves no safety function.

9.2.14.4 Tests and Inspections

All major components are tested and inspected as separate components prior to installation, and as an integrated system after installation to ensure design performance. The systems are preoperationally tested in accordance with the requirements of Chapter 14.

The components of the TCW system and associated instrumentation are accessible during plant operation for visual examination. Periodic inspections during normal operation are made to ensure operability and integrity of the system. Inspections include measurements of cooling water flows, temperatures, pressures, water quality, corrosion-erosion rate, control positions, and set points to verify the system condition.

9.2.14.5 Instrumentation Application

Pressure and temperature indicators are provided where required for testing and balancing the system. Flow indicator taps are provided at strategic points in the system for initial balancing of the flows and verifying flows during plant operation.

Surge tank high and low level and TCW pump discharge pressure alarms are retransmitted to the main control room from the TCW local control panels.

Makeup flow to the TCW system surge tank is initiated automatically by low surge tank water level and is continued until the normal level is reestablished.

Provisions for taking TCW system water samples are included.

9.2.15 Reactor Service Water System

9.2.15.1 Design Bases

9.2.15.1.1 Safety Design Bases

(1) The reactor service water (RSW) system shall be designed to remove heat from the reactor cooling water system which is required for safe reactor shutdown, and which also cools those auxiliaries whose operation is desired following a LOCA, but not essential to safe shutdown.

(2) The RSW system shall be designed to

Seismic Category I and ASME Code, Section III, Class 3, Quality Assurance B, Quality Group C, IEEE-279 and IEEE-308 requirements.

(3) The RSW system shall be protected from flooding, spraying, steam impingement, pipe whip, jet forces, missiles, fire and the effect of failure of any non-Seismic Category I equipment, as required.

(4) The RSW system shall be designed to meet the foregoing design bases during a loss of preferred power.

9.2.15.1.2 Power Generation Design Bases

The RSW system shall be designed to cool the reactor building cooling water (RCW) as required during: (a) normal operation; (b) emergency shutdown; (c) normal shutdown; and (d) testing.

9.2.15.2 System Description

The RSW system provides cooling water during various operating modes, during shutdown and post-LOCA operations. The system removes heat from the RCW system and transfers it to the ultimate heat sink. Figure 9.2-7 shows the RSW system diagram.

The RSW system is able to function during abnormally high or low water levels and steps are taken to prevent organic fouling that may degrade system performance. These steps include trash racks and provisions for biocide treatment (where discharge is allowed). Where discharge of biocide is not allowed, non-biocide treatment will be provided. Thermal backwashing capability will be provided at sea water sites where infestations of macrobial growth can occur.

9.2.15.3 Safety Evaluation

The components of the RSW system are separated and protected to the extent necessary to assure that sufficient equipment remains operating to permit shutdown of the unit in the event of any of the following (Separation is applied to electrical equipment and instrumentation and controls as well as to mechanical equipment and piping.):

(1) flooding, spraying or steam release due to pipe rupture or equipment failure;

(2) pipe whip and jet forces resulting from postulated pipe rupture of nearby high energy pipes;

(3 missiles which result from equipment failure; and

(4) fire.

Liquid radiation monitors are provided in the RCW system. Upon detection of radiation leakage in a division of the RCW system, that system is isolated by operator action from the control room, and the cooling load is met by another division of the RCW system. Consequently, radioactive contamination released by the RSW system to the environment does not exceed allowable limits defined by 10CFR100.

System low point drains and high point vents are provided as required.

System components and piping materials are selected to be compatible with the available site cooling water in order to minimize corrosion. Adequate corrosion safety factors are used to assure the integrity of the system during the life of the plant.

During all plant operating modes each division shall have at least one service water pump operating. Therefore, if a LOCA occurs, the system is already in operation. If a loss of offsite power occurs during a LOCA, the pumps momentarily stop until transfer to standby diesel-generator power is completed. The pumps are restarted automatically according to the diesel loading sequence. No operator action is required, following a LOCA, to start the RSW system in its LOCA operating mode.

¶ See subsection 9.2.17.4, items (1), (2) and (3) for interface requirements. (9.2.15 #)

9.2.15.4 Testing and Inspection Requirements

The RSW system is designed for periodic pressure and functional testing to assure:

(1) the structural and leaktight integrity by visible inspection of the components;

¶ See Subsection 9.2.17.4, items (4) and (5) for interface requirements. (9.2.15 #2)

continuously during normal power operation conditions.

The standby pump is started automatically in the event the normally operating pump trips or the discharge header pressure drops below a preset limit.

9.2.16.3 Safety Evaluation

9.2.16

The TSW system does not serve or support any safety function and has no safety design bases. The TSW system is not interconnected with any safety-related systems. See subsection 9.2.17.5 for interface requirements.

9.2.16.4 Tests and Inspections

All major components are tested and inspected as separate components prior to installation, and as an integrated system after installation to ensure design performance. The systems are preoperationally tested in accordance with the requirements of Chapter 14.

The components of the TSW system and associated instrumentation are accessible during plant operation for visual examination. Periodic inspections during normal operation are made to ensure operability and integrity of the system. Inspections include measurement of the TSW system flow, temperatures, pressures, differential pressures and valve positions to verify the system condition.

9.2.16.5 Instrumentation Application

Pressure and temperature indicators are provided where required for testing the system.

TSW system pump status is indicated in the main control room.

TSW system trip is alarmed and the automatic startup of the standby pump is annunciated in the main control room.

High differential pressure across the duplex filters is alarmed in the main control room.

9.2.17 Interfaces

9.2.17.1 Ultimate Heat Sink Capability

Interface requirements pertaining to ultimate heat sink capability are delineated in Subsection 9.2.5 as follows:

430.204

Subsection	Title
9.2.5.1	Safety Design Bases
9.2.5.2	Power Generation Design Bases
9.2.5.6	Evaluation of UHS Performance
9.2.5.7	Safety Evaluation
9.2.5.8	Conformance to Regulatory Guide 1.27
9.2.5.9	Instrumentation and Alarms
9.2.5.10	Tests and Inspections

9.2.17.2 Makeup Water System Capability

The raw water treatment and preparation of the demineralized water is sent to the makeup water system (purified) described in Subsection 9.2.10.

← INSERT 9.2.17.2 (9.2.5)

430.205 The makeup water preparation system shall be located in a building which does not contain any safety-related structures, systems or components. If the system is not available, demineralized water can be obtained from mobile equipment. The system shall be designed so that any failure in the system, including any that cause flooding, shall not result in the failure of any safety-related structure, system or component.

9.2.17.3 Potable and Sanitary Water System

430.201 The potable and sanitary water system shall be designed with no interconnections with systems having the potential for containing radioactive materials. Protection shall be provided through the use of air gaps, where necessary. (See Subsection 9.2.4).

← INSERT 9.2.17.4/9.2.17.5 (9.2.15*1,2,3)

9.2.5

INSERT 9.2.17.2

If any spray pond piping is made from fiberglass-reinforced thermosetting resin, the applicant shall provide information to show that all applicable requirements of Regulatory Guide 1.72 are met.

INSERT 9.2.17.4 / 9.2.17.5

9.2.17.4 Reactor Service Water System

9.2.15 #1,2,3 The RSW pump[illegible] described in table 9.2-13. The applicant shall provide [illegible] following additional information which is site dependent. (See Subsection 9.2.15.2 and 9.2.15.3)

(1) temperature increase and pressure drop across the heat exchangers

(2) the required and available net positive suction head for the RSW pumps at pump suction locations considering anticipated low water levels

(3) the location of the RSW pump house

(4) the design features to assure that the requirements in section 9.2.15.1.1(3) are met

(5) an analysis of a pipeline break and a single active component failure shall show that flooding shall not affect the main control room or more than one division of the RSW system.

9.2.17.5 Turbine Service Water System

9.2.16 The applicant shall demonstrate that all safety-related components, systems, and structures are protected from flooding in the event of a pipeline break in the TSW system. (See Subsection 9.2.16.3)

Table 9.2-13

Reactor Service Water System

RSW Pumps (two per division)	
Discharge Flow Rate	7,920 gpm
Pump Total Head	50 psi
Design Pressure	115 psi
Design Temperature	122 F
RSW Piping and Valves	
Design Pressure	115 psi
Design Temperature	122 F

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APRIL 26, 1991

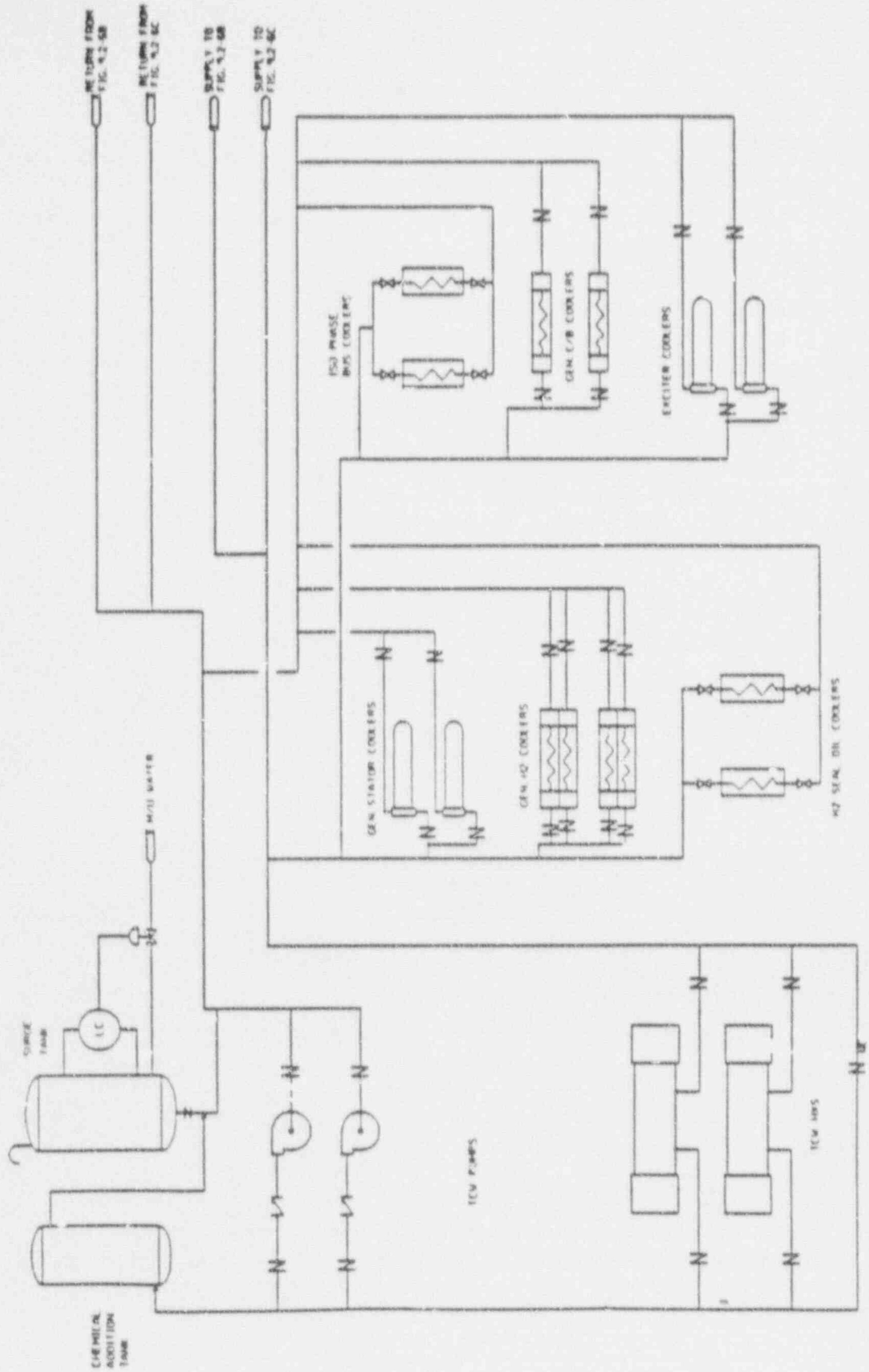

Figure 9.2-6a TURBINE COOLING WATER SYSTEM DIA(..M

9.2.14
1