Appendix 9A. Tables

Table 9-1. Spent Fuel Cooling System Component Design Parameters

SPENT FUEL POOL COOLING & MAINTENANCE EQUIPMENT	
FUEL POOL COOLING PUMP	
Number per unit	2
Type	Centrifugal
Design pressure, psig	175
Design temperature, F	200
Design flow rate, gpm	2840
Design head, ft @ design flow	275
Material of construction	SS
FUEL POOL COOLING HEAT EXCHANGER	
Number per unit	2
Type	U-Tube
Heat transfer per HX at design conditions (btu/hr)	15,000,000
Flow, tube side, gpm	2310
Flow, shell side, gpm	3000
Tube side inlet temperature, F	125
Tube side outlet temperature, F	112
Shell side inlet temperature, F	100
Shell side outlet temperature, F	110
Design pressure, shell/tube, psig	150/175
Design temperature, shell/tube, F	225/225
Material of Construction, shell/tube	CS/SS
FUEL TRANSFER CANAL AIR DRIVEN UNWATERING PUMP	
Number per unit	1
Type	Portable submersible air driven pump
Design pressure, psig	40
Design temperature, F	200
Design flow rate, gpm	225
Design head, ft	50

Material of Construction	SS
SPENT FUEL POOL PURIFICATION EQUIPMENT	
FUEL POOL COOLING PRE-FILTER	
Number per unit	2
Type	Disposable cartridge
Design pressure, psig	200
Design temperature, F	200
Design flow, gpm	265
Retention @ 6 micron and larger particle size	98%
Material of Construction	SS
FUEL POOL COOLING DEMINERALIZER	
Number per unit	1
Type	Flushable
Resin type	Bead Mixed Bed
Design pressure, psig	200
Design temperature, F	200
Design flow, gpm	530
Material of Construction	SS
FUEL POOL COOLING DEMIN RESIN STRAINER - (Unit 1 Only)	
Number per unit	1
Type	Cone
Design Pressure, psig	200
Design Temp, °F	200
Design Flow, gpm	530
Retention mesh	.092
Materials of Const.	SS
FUEL POOL COOLING POST-FILTER	
Number per unit	2
Type	Disposable cartridge
Design pressure, psig	200
Design temperature, F	200
Design flow rate, gpm	265

Retention @ 3 micron and larger particle size	98%
Material of Construction	SS
SPENT FUEL POOL SKIMMER EQUIPMENT	
FUEL POOL SKIMMER STRAINER	
Number per unit	1
Type	Basket
Design pressure, psig	20
Design temperature, F	200
Design flow, gpm	100
Perforation, dia, in	7/64
Material of Construction	SS
FUEL POOL SKIMMER PUMP	
Number per unit	1
Type	Centrifugal
Design pressure, psig	45
Design temperature, F	200
Design flow, gpm	100
Design head, ft	55
Material of Construction	SS
FUEL POOL SKIMMER FILTER	
Number per unit	1
Type	Disposable cartridge
Design pressure, psig	75
Design temperature, F	200
Design flow, gpm	100
Retention @ 3 micron and larger particle size	98%
Material of Construction	SS

Table 9-2. Nuclear Service Water System Component Design Parameters

NUCLEAR SERVICE WATER PUMPS	
Number per unit	2
Type	Vertical, wet pit, mixed flow with above floor discharge
Design Pressure, psig	150
Design Temperature, F	105
Design Flow, gpm	20,900
Design Head, ft.	174
Shutoff Head, ft.	260
Min. Flow Rate, gpm	8600 (continuous), 4000 (Intermittent, up to 2 hr per 10 hours)
Material of Construction	Carbon Steel
Motor horsepower, name plate	1000
Type	Vertical, totally enclosed, water cooled
Motor Cooler Design Flow, gpm	40
Deleted Per 2006 Update	
Motor Upper Bearing OilCooler Flow, gpm	4 (nominal), 1 (minimum)
Submergency Req. at Max Flow, ft.	5
NUCLEAR SERVICE WATER STRAINERS	
Number per unit	2
Type	Horizontal, continuous automatic backflush
Design Pressure, psig	100
Design Temperature, F	100
Design Flow, gpm	20,900
Strainer element type	slotted tubular stainless steel
Strainer element size openings, in.	1/32
Maximum pressure drop, psi	4
Material of construction	Carbon Steel
Deleted Per 2006 Update	
NUCLEAR SERVICE WATER SYSTEM UNWATERING PUMP	
Number per station	1
Type	Portable submersible pump
Design Flow, gpm	800

	minimum	400
	maximum	1200
Design Head, ft. at Design Flow		65
ft. at Shutoff		78
Design Pressure, psig		50
Design Temperature, F		108
Driver Type		Submersible electric motor
Casing Material		Carbon Steel
Impeller Material		Stainless Steel
Deleted Per 2006 Update		

Table 9-3. Nuclear Service Water System Flow Rates Outside the Nuclear Service Water Pumphouse

Component	Header	Modulated Flow	"Nominal" Individual Component Flow Rates (GPM)	Mode A Startup No. in Operation	Mode B Normal (Power) Operation No. in Operation	Mode C Shutdown No. in Operation	Mode D Refueling No. in Operation	Mode E Engineered Safeguards (Safety Injection) No. in Operation	Mode F Engineered Safeguards (Sump Recirculation) No. in Operation
GROUP I -- COMPONENTS ON EACH UNIT WHICH RECEIVE RN FLOW WITH OR WITHOUT OFFSITE POWER									
1. Containment Spray Heat Exchangers	E	No	2800	0	0	0	0	0	2
2. Deleted Per 2007 Update									
3. Auxiliary Shutdown Panel Area Assured Source to Air Conditioning Units	E	Yes	10	0	0	0	0	0	0
4. Component Cooling Heating Exchangers	E	Yes	5200	2	1	2	2	2	2
Delete Per 2010 Update									
5. Assured Spent Fuel Pool Makeup	E	No	140	0	0	0	0	0	0
6. Assured Source of Auxiliary Feedwater	E	No	900	0	0	0	0	2	0

Component	Header	Modulated Flow	"Nominal" Individual Component Flow Rates (GPM)	Mode A Startup No. in Operation	Mode B Normal (Power) Operation No. in Operation	Mode C Shutdown No. in Operation	Mode D Refueling No. in Operation	Mode E Engineered Safeguards (Safety Injection) No. in Operation	Mode F Engineered Safeguards (Sump Recirculation) No. in Operation
7. Assured Component Cooling Makeup	E	No	340	0	0	0	0	0	0
Deleted Per 2006 Updated									
8. Assured Containment Valve Injection Makeup (Note 1: Long term CA makeup flow rate is 599 gpm.)	E	No	5	0	0	0	0	0	0
GROUP I FLOW TOTALS (PER UNIT--GPM)	—	—	—	10,400	5200	10,400	10,400	12220	17820
GROUP II -- SHARED COMPONENTS (UNIT 1 ONLY) WHICH RECEIVE FLOW WITH OR WITHOUT OFFSITE POWER									
1. Control Room Chiller Condenser	E	Yes	1300	1	1	1	1	1	1
Delete Per 2010 Update									

GROUP II FLOW TOTALS (GPM)	—	—	—	1300	1300	1300	1300	1300	1300
GROUP III -- COMPONENTS ON EACH UNIT WHICH RECEIVE FLOW UPON LOSS OF OFFSITE POWER									
1. Diesel Generator Engine Jacket Water Cooler	E	No	900	2	2	2	2	2	2
2. Reactor Coolant Pump Motor Coolers	N	No	150	4	4	4	4	4	0
3. Lower Containment Vent Units	N	Yes	800[2]	4	4	4	4	4	0
4. Upper Containment Vent Units	N	Yes	18	3	3	3	4	4	0
5. Incore Instrumentation Room Vent Units	N	Yes	10	2	2	2	2	2	0
6. Auxiliary Building Supply Vent Unit	N	Yes		2	2	2	2	0	0
GROUP III FLOW TOTALS (PER UNIT--GPM)	—	—	—	5874	5874	5874	5892	5692	1800
Deleted per 2006 Update									

Table 9-4. Nuclear Service Water System Failure Analysis

Component	Malfunction	Comments & Consequences
1. Lake Wylie	Loss of Dam	RN Pumphouse pit emergency low level in either train automatically aligns RN supply and return lines to the SNSWP, isolates the RN non-essential headers, and starts all of the RN pumps. The RN Pumphouse pit level interlocks are designed to operate during all modes of operation, including ESF modes.
2. Diesel Generator 1A, 1B, 2A, or 2B	Any failure causing diesel to not start or fail after starting	a. During normal station operation: If blackout occurs during normal operation, the RN pumps are such aligned that each one starts upon its respective diesel startup. Crossovers remain open so either pump can supply demands. Normal valve alignment prevents RN Pump runout.
		b. If diesel fails during regularly scheduled test, the shared EMO valves (RN Pumphouse Pit supply and all main return valves so noted on flow diagram) should be aligned to Unit 2 diesel of corresponding channel using switchover provided. Either unit ESF signal actuates all shared valves.
		c. Failure of diesel simultaneous with blackout and subsequent Loss of Lake and/or LOCA prevents the associated diesel supply and return valves (i.e., valves 1RN232A, 1RN846A and 1RN847A for Diesel Generator 1A) from supplying cooling water and realigning discharge from Lake Wylie to SNSWP. Lake discharge valves are interlocked with SNSWP discharge valves such that the Lake return and the SNSWP return valves can not be closed at the same time. This ensures a discharge flow path for RN through the KD heat exchangers. Operator action is required to position valves that fail to reposition automatically during a swap to the SNSWP.

Component	Malfunction	Comments & Consequences
		d. If a single diesel fails simultaneous with blackout and subsequent Loss of Lake and LOCA, no more than one channel of RN will be lost. The remaining channel in each unit is sufficient to shut down both units safely even with one pit (hence a Unit 1 and Unit 2 channel) out of operation. Separation of channels and isolation of non-safety class piping prevent seismic induced flooding and RN Pump runout should all control valves fail open on loss of air due to station blackout. When the NSW is aligned in Single Supply Header Operation (refer to Section 9.2.1.7) one RN supply header is isolated. The RN crossover valves in the RN pumphouse, Auxiliary Building, and Diesel Generator Rooms remain open, so RN cooling water flow is available to all four RN Essential Headers and Diesel Generators. In this alignment, if a single diesel fails simultaneous with loss-of-offsite-power, and subsequent Loss of Lake and LOCA, RN channel separation is not desired. This alignment does not result in a loss of a RN channel.
3. Lake supply to pit valve 1A, 2B, 5A or 6B or all valves of like channel	Failure to close on Loss of Lake	A and B valves are in series, so failure of any one valve or either complete channel will not prevent isolation of Lake Wylie. In conjunction with switchover to SNSWP, this means that SNSWP can never be lost to a "dry" Lake Wylie.

Component	Malfunction	Comments & Consequences
4. SNSWP supply to pit valve 3A or 4B	Failure to open on Loss of Lake	a. Each valve serves one pit of the RN Pumphouse, so failure of one SNSWP supply valve to open when Lake supply valves close results in failure of only that pit. Only one channel of RN is lost. The remaining channel in each unit is sufficient to shut down both units safely. The redundant channels automatically separate upon emergency low pit level concurrent with a safety injection signal on one of the units. Otherwise, the operator will need to manually isolate train. When the NSW is aligned in Single Supply Header Operation (refer to Section 9.2.1.7), one RN supply header is isolated. The RN crossover valves in the RN pumphouse, and the RN supply header crossover isolation valves in the Auxiliary, 1RN47A, 1RN48B, 2RN47A, and 2RN48B are prevented for auto-closing on an emergency low pumphouse pit level, since channel separation is not desired in this alignment. Similarly, the RN return header crossover header isolation valves 1RN53B and 1RN54A are prevented from auto-closing on an emergency low pumphouse pit level. This ensures that NSW cooling water flow is available to all four essential headers, even with the failure of one RN pit to transfer suction to the SNSWP. This alignment does not result in loss of a RN channel.
		b. If a diesel generator is known to be out of service, these valves are aligned to the other unit's operable diesel generator on the corresponding channel. However, failure of one SNSWP supply valve to open when the Lake supply valves close will result in failure of that pit. One channel of RN is lost. If the diesel generator out of service is on the RN channel unaffected by the SNSWP supply valve failure, only one RN pump will be operable. One pump is sufficient to provide for safe shutdown of the operating unit and maintaining the other unit in cold shutdown. If a diesel generator or RN pump is known to be out of service, the RN system can not be aligned in Single Supply Header Operation.

Component	Malfunction	Comments & Consequences
5. Main Lake return valves 1RN57A or 1RN843B	Failure to close on Loss of Lake	A and B valves are in series, so failure of either valve will not prevent isolation of Lake discharge. In conjunction with switchover to SNSWP, this means that SNSWP can never be lost to a "dry" Lake Wylie.
6. Main SNSWP return valves 1RN63A 1RN58B	Failure to open on Loss of Lake	Each valve serves one shared train of RN System return to SNSWP, so failure of one valve to open when Lake return valves close results in failure of only one channel in both units. The remaining channel in each unit is sufficient to shut down both units safely. If the valve failure occurs while the RN system is aligned in Single Supply Header Operation (refer to Section 9.2.1.7), channel separation does not occur and the RN return header crossover isolation valves, 1RN53B and 1RN54A, are prevented from auto-closing on an emergency low pumphouse pit level. This ensures that a NSW cooling water flow path is available to all four essential headers, even with the failure of one SNSWP return valve to reposition, and does not result in a loss of a RN channel. If a Unit 1 diesel is known to be out of service, these valves are aligned to the Unit 2 diesel of corresponding channel. If a diesel generator or RN pump is known to be out of service, alignment of the RN system in Single Supply Header Operation is prohibited.
7. Crossover valves 1RN36A or 1RN37B	Failure to close on ESF Signal, as applicable	Alignment of these non-nuclear safety valves is not required for any design basis event.

Component	Malfunction	Comments & Consequences
a) Crossover valves 1RN47A or 1RN48B	Failure to close on Loss of Lake or ESF Signal, as applicable	A and B valves are in series, so failure of either valve will not prevent channel separation when required. When the NSW is aligned in Single Supply Header Operation (refer to Section 9.2.1.7), the RN supply header crossover isolation valves 1RN47A, 1RN48B, 2RN47A, and 2RN48B are prevented from auto-closing on a Phase B containment isolation signal, or an emergency low pumphouse pit level. Similarly, the RN return header crossover isolation valves 1RN53B and 1RN54B are prevented from auto-closing on an emergency low pumphouse pit level. This ensures that NSW cooling water flow is available to all four essential headers if there is an event that generates either or both of these signals while the NSW system is aligned in Single Supply Header Operation.
8. Non-essential header isolation valves 1RN49A or 1RN50B 1RN51A or 1RN52B	Failure to close on Loss of Lake	A and B valves are in series, so failure of either valve will not prevent isolation of non-safety class piping when required.
9. Any or all Channel A valves actuated by Loss of Lake or ESF Signal	Failure to assume proper position upon signal	Channel B functions in its entirety and is sufficient to shut down the unit safely. Sufficient manual realignment via crossovers is provided for maintenance or a second failure in long term after LOCA. When the NSW is aligned in Single Supply Header Operation (refer to Section 9.2.1.7), the RN supply header crossover isolation valves 1RN47A, 1RN48B, 2RN47A, and 2RN48B are prevented from auto-closing on a Phase B containment isolation signal, or an emergency low pumphouse pit level. Similarly, the RN return header crossover isolation valves 1RN53B and 1RN54B are prevented from auto-closing on an emergency low pumphouse pit level. This ensures that NSW cooling water flow is available to all four essential headers if there is an event that generates either or both of these signals while the NSW system is aligned in Single Supply Header Operation.

Component	Malfunction	Comments & Consequences
10. Any or all Channel B valves actuated by Loss of Lake or ESF Signal	Failure to assume proper position upon signal	Channel A functions in its entirety and is sufficient to shut down the unit safely. Sufficient manual realignment via crossovers is provided for maintenance or a second failure in the long term after LOCA. When the NSW is aligned in Single Supply Header Operation (refer to Section 9.2.1.7), the RN supply header crossover isolation valves 1RN47A, 1RN48B, 2RN47A, and 2RN48B are prevented from auto-closing on a Phase B containment isolation signal, or an emergency low pumphouse pit level. Similarly, the RN return header crossover isolation valves 1RN53B and 1RN54B are prevented from auto-closing on an emergency low pumphouse pit level. This ensures that NSW cooling water flow is available to all four essential headers if there is an event that generates either or both of these signals while the NSW system is aligned in Single Supply Header Operation.
11. Diesel Generator Engine Jacket Water Cooler discharge to Lake 1RN847A, 1RN849B, 2RN847A, or 2RN849B	Failure to close on Loss of Lake	a. Most likely cause is diesel failure, which means supply valve 1RN232A, 1RN292B, 2RN232A, or 2RN292B will not open either. In this case, see item 2 above. b. Lake discharge valves are interlocked with SNSWP discharge valves 1RN846A, 1RN848B, 2RN846A, and 2RN848B such that the Lake return and the SNSWP return valves can not be closed at the same time. This ensures a discharge flowpath for RN through the KD heat exchangers. Operator action is required to position valves that fail to reposition automatically during a swap to the SNSWP.
12. Either RN Pump 1A or 2A	Any failure causing RN Pump to not start or fail after starting	RN Pumps 1B and 2B provide 100% redundancy. Before crossover isolation, they can be used to supply all loads previously aligned to train A pumps. After crossover isolation, train B essential heat exchangers in both units allow safe shutdown.

Component	Malfunction	Comments & Consequences
13. Any Channel A safety related heat exchanger or equipment	Tube rupture or plug or shell rupture	Channel B heat exchangers and RN Pump provide 100% redundancy. Before crossover isolation, any RN Pump in operation can supply any channel heat exchanger, or a mixture of A and B channel heat exchangers. After channel separation, the B RN Pumps supply only Channel B essential heat exchangers, which are sufficient for safe shutdown of both units. When the RN system is aligned in Single Supply Header Operation (refer to Section 9.2.1.7), the RN channels remain cross-connected. The crossover valves are prevented from closing on a Phase B containment isolation signal or an emergency low pumphouse pit level. This ensures that NSW cooling water flow is available to all four essential headers and Diesel Generators if there is an event that generates either, or both, of these signals while the NSW system is aligned in Single Supply Header Operation, even with the failure of one Channel A safety-related heat exchanger. Isolation valves can be repositioned to isolate the affected component.

Component	Malfunction	Comments & Consequences
14. RN Pump 1A and 2A discharge piping to heat exchangers	Rupture or plug	Use Channel B intake line from Lake or SNSWP, Pumphouse Pit B, RN Pumps 1B and 2B, and all Channel B heat exchangers until repairs can be made. When the NSW is aligned in Single Supply Header Operation (refer to Section 9.2.1.7), one buried RN supply header is isolated, so redundant RN supply header is not immediately available to provide flow to essential components. Pipe rupture is an initiating event and concurrent design-basis events are not required to be considered, unless they result from rupture. Postulated leakage rates for a pipe rupture of the in-service supply header piping can be tolerated, and still provide adequate RN flow to essential components on a long term bais to enable safe shut down of both units. Plugging, blockage or collapse of the buried RN supply header is not considered credible since there are no internal components and the piping internal pressure exceeds soil pressure. In the event of a catastrophic failure of the in-service supply header while in Single Supply Header Operation, plant procedures exist to allow safe shut down of both units.
15. RN Pumphouse Intake line A from SNSWP	Collapse or plug	Use Channel B intake line from SNSWP, Pumphouse Pit B, and all Channel B heat exchangers unit repairs can be made. When the RN system is aligned in Single Supply Header Operation (refer to Section 9.2.1.7), the RN channels remain cross-connected. The crossover valves are prevented from closing on a Phase B containment isolation signal or an emergency low pumphouse pit level. This ensures that NSW cooling water flow is available to all four essential headers and Diesel Generators if there is an event that generates either, or both, of these signals while the NSW system is aligned in Single Supply Header Operation, even with the failure of one intake line form the SNSWP. This alignment does not result in a loss of a RN channel.

Component	Malfunction	Comments & Consequences
16. RN Pumphouse Shared Intake line from Lake	Collapse or plug	RN Pumphouse Pit emergency low level will automatically realign to SNSWP and start all RN Pumps for temporary operation until line is repaired, or for shutdown.
17. Either RN Strainer 1A or 2A	Rupture or plug	Isolate affected RN Strainer and RN Pump. Use another pump to satisfy cooling water requirements through normally open crossovers.
18. Any non-safety related component	Any failure which would prevent normal operation of the component.	Isolate component and perform required maintenance.
19. Shared discharge line to Lake Wylie	Rupture or plug	Manually align all RN Pumphouse Intake line valves and all return line isolation valves to SNSWP for temporary operation until line is repaired or for shutdown.
20. Channel A shared return line to SNSWP Deleted Per 2006 Update	Rupture or plug	Isolate affected return line A and utilize backup train return line B until train A is repaired.
21. Crossover valves 1RN53B or 1RN54A	Failure to close on Loss of Lake.	A and B valves are in series, so failure of either valve will not prevent channel separation when required. When the NSW is aligned in Single Supply Header Operation (refer to Section 9.2.1.7), the RN supply header crossover isolation valves 1RN53B and 1RN54A are prevented from auto-closing on an emergency low pumphouse pit level. This ensures that NSW cooling water flow is available to all four essential headers if there is an event that generates these signals while the NSW system is aligned in Single Supply Header Operation.

Table 9-5. Nominal Nuclear Service Water System Flow Rates in the Nuclear Service Water Pumphouse

Component	Individual Component Flow Rate (GPM)
GROUP I -- RECEIVE FLOW ONLY WHEN ITS RESPECTIVE RN PUMP IS IN OPERATION	
1. RN Pump Motor Coolers (2 Flow Paths per Cooler)	40
2. RN Pump Motor Upper Bearing Oil Coolers	4 (nominal), 1 (minimum)
GROUP I TOTAL FLOW (Per Pump)	44 GPM
GROUP II -- STRAINER BACKFLUSH FLOW	
1. RN Strainers (1 Per Pump)	1000 (Periodic)
GROUP II Totals (for the entire pumphouse)	
a. Periodic	Up to 4000 GPM

No of Pumps in Operation	No of Pumps x Group I Total Flow	Group II Periodic Flow Total	Total Flow Required By RN Pumphouse
1	44 GPM	Up to 4000 GPM	Up to 4044 GPM
2	88	4000	4088
3	132	4000	4132
4	176	4000	4176

Table 9-6. Component Cooling System Heat Load and Flow Requirements

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
	Unit Startup				
Residual Heat Removal HXs	1	1	37.4	5000	1
Residual Heat Removal Pumps	1	2	.443	50	2
Component Cooling Pumps	4	4	.216	120	3
Auxiliary Feedwater Pumps	2	2	.136	60	3
Containment Spray Pumps	0	-	-	60	3
Safety Injection Pumps	0	2	-	80	4
Centrifugal Charging Pumps	0	2	-	140	4
Letdown HX	1	1	16.0	1000	
Sealwater HX	1	1	1.98	250	
Reciprocating Charging Pump Brg. Oil Cooler	0	0	-	-	11
Fuel Pool Cooling Pumps	1	2	.620	80	3
Fuel Pool Cooling HXs	1	1	18.5	3000	5
Recycle Evaporator Package	1	1	9.019	810	6
Waste Evaporator Package	1	1	9.019	810	6
Waste Gas Compressor Package	1	2	.134	100	
Waste Gas Hyd. Recombiner Pack.	1	2	.07	20	
Reactor Coolant Drain Tank HX	0	1	-	225	
Excess Letdown HX	1	1	5.18	250	
Reactor Vessel Support Coolers	0	0			7

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
Reactor Coolant Pumps	4	4	4.80	824	8
Post Accident Liquid Sample Cooler	1	1	0.331	10	9
Radiation Monitors	0	2	-	6	
ASPSUs	2	2	.06	20	10
TOTALS			103.908	12915	

Notes:

1. Discontinued after Reactor Coolant Pumps are started.
2. The pump motor coolers and mechanical seal heat exchanger of each pump receive cooling flow.
3. The pump motor coolers of each pump receive cooling flow.
4. The pump motor coolers and oil cooler(s) of each pump receive cooling flow.
5. Only one Fuel Pool Cooling HX is assumed to be in service. However, the Component Cooling System has sufficient capacity to place both KF HXs in service if necessary.
6. Each evaporator package consists of an evaporator condenser, vent condenser, distillate cooler, concentrate heat exchanger, concentrate sample cooler, and the concentrate pumps bearing coolers. Only one of the two concentrate pumps bearing coolers is assumed to be in service.
7. The Reactor Vessel Support Coolers have been abandoned in place per CD100872 (Unit 1) and CD200950 (Unit 2).
8. The Thermal Barrier, Upper and Lower Bearing Oil Coolers of each Reactor Coolant Pump receive cooling flow.
9. The PALS Panel is normally in operation only during Engineered Safeguards; however, the panel may be tested at any time. Following train separation, the PALS panel receives cooling flow from one (but not both) KC Essential Headers.
10. ASPSU cooling water supplied by RN on ASP event.
11. Reciprocating Charging Pump No. 1 has been abandoned in place per NSM CN-11392/00.
    Reciprocating Charging Pump No. 2 has been abandoned in place per NSM CN-21392/00.

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
		Normal Unit Operation			
Residual Heat Removal HXs	0	0	-	-	
Residual Heat Removal Pumps	0	2	-	50	1
Component Cooling Pumps	2	4	.108	120	2
Auxiliary Feedwater Pumps	0	2	-	60	2
Containment Spray Pumps	0	2	-	60	2
Safety Injection Pumps	0	2	-	80	3
Centrifugal Charging Pumps	0	2	-	140	3
Letdown HX	1	1	10.42	1000	4
Sealwater HX	1	1	1.98	250	
Reciprocating Charging Pump Brg. Oil Cooler	0	0	-	-	10
Fuel Pool Cooling Pumps	1	2	.620	80	2
Fuel Pool Cooling HXs	1	1	18.5	3000	
Recycle Evaporator Package	1	1	9.019	810	5
Waste Evaporator Package	1	1	9.019	810	5
Waste Gas Compressor Package	1	2	.134	100	
Waste Gas Hyd. Recombiner Pack.	1	2	.07	20	
Reactor Coolant Drain Tank HX	1	1	2.23	225	
Excess Letdown HX	0	0	-	-	
Reactor Vessel Support Coolers	0	0			6
Reactor Coolant Pumps	4	4	4.80	824	7

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
Post Accident Liquid Sampler Cooler	1	1	0.331	10	8
Radiation Monitors	0	2	-	6	
ASPSUs	2	2	.06	20	9
TOTALS			57.291	7665	

Notes:

1. The pump motor coolers and mechanical seal heat exchanger of each pump receive cooling flow.
2. The pump motor coolers of each pump receive cooling flow.
3. The pump motor coolers and oil coolers of each pump receive cooling flow.
4. Heat load on the Letdown HX may vary from 6.52 x 10^6 Btu/hr to 10.42 x 10^6 Btu/hr. Normally the cooling flow is throttled to between 250 and 660 GPM. 1000 GPM would be expected if the control valve failed open.
5. Each evaporator package consists of an evaporator condenser, vent condenser, distillate cooler, concentrate heat exchanger, concentrate sample cooler, and the concentrate pumps bearing coolers. Only one of the two concentrate pumps bearing coolers is assumed to be in service.
6. The Reactor Vessel Support Coolers have been abandoned in place per CD100872 (Unit 1) and CD200950 (Unit 2).
7. The thermal barrier, upper and lower bearing oil coolers of each reactor coolant pump receive cooling flow.
8. The PALS Panel is normally in operation only during Engineered Safeguards; however, the panel may be tested at any time. Following train separation, the PALS panel receives cooling flow from one (but not both) KC Essential Headers.
9. ASPSU cooling water supplied by RN on ASP event.
10. Reciprocating Charging Pump No. 1 has been abandoned in place per NSM CN-11392/00.
    Reciprocating Charging Pump No. 2 has been abandoned in place per NSM CN-21392/00.

Normal Unit Shutdown (Two trains of ND)					
Residual Heat Removal HXs	2	2	234.36	10000	1
Residual Heat Removal Pumps	2	2	.886	50	2

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
Component Cooling Pumps	4	4	.216	120	3
Auxiliary Feedwater Pumps	2	2	.136	60	3
Containment Spray Pumps	0	2	-	60	3
Safety Injection Pumps	0	2	-	80	4
Centrifugal Charging Pumps	1	2	.577	140	4
Letdown HX	1	1	10.42	1000	5
Sealwater HX	1	1	1.604	250	
Reciprocating Charging Pump Brg. Oil Cooler	0	0	-	-	11
Fuel Pool Cooling Pumps	0	2	-	80	3
Fuel Pool Cooling HXs	0	0	-	-	
Recycle Evaporator Package	1	1	9.019	810	6
Waste Evaporator Package	1	1	9.019	810	6
Waste Gas Compressor Packages	1	2	.134	100	
Waste Gas Hyd. Recombiner Pack.	1	2	.07	20	
Reactor Coolant Drain Tank HX	1	1	2.23	225	
Excess Letdown HX	0	0	-	-	
Reactor Vessel Support Coolers	0	0			7
Reactor Coolant Pumps	1	4	2.508	824	8
Post Accident Liquid Sampler Cooler	1	1	0.331	10	9
Radiation Monitors	0	2	-	6	
ASPSUs	2	2	.06	20	10

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
TOTALS			271. 570	14665	

Notes:

1. Heat load determined as follows:

Core decay heat load at 4 hours	120.21×10^6 Btu/hr
Reactor Coolant System sensible heat load (2.01×10^6 Btu/°F at 50°F/hr cooldown rate)	100.50×10^6 Btu/hr
One Reactor Coolant Pump heat input	13.65×10^6 Btu/hr
	234.36×10^6 Btu/hr

2. The pump motor coolers and mechanical seal heat exchanger of each pump receive cooling flow.
3. The pump motor coolers of each pump receive cooling flow.
4. The pump motor coolers and oil cooler(s) of each pump receive cooling flow.
5. Heat load on the Letdown HX may vary from 6.52×10^6 Btu/hr to 10.42×10^6 Btu/hr. Normally, the cooling flow is throttled to between 250 and 660 GPM. 1000 GPM would be expected if the control valve failed open.
6. Each evaporator package consists of an evaporator condenser, vent condenser, distillate cooler, concentrate heat exchanger, concentrate sample cooler, and the concentrate pumps bearing coolers. Only one of the two concentrate pumps bearing coolers is assumed to be in service.
7. The Reactor Vessel Support Coolers have been abandoned in place per CD100872 (Unit 1) and CD200950 (Unit 2).
8. The thermal barrier, upper and lower bearing oil coolers of each reactor coolant pump receive cooling flow.
9. The PALS Panel is normally in operation only during Engineered Safeguards; however, the panel may be tested at any time. Following train separation, the PALS panel receives cooling flow from one (but not both) KC Essential Headers.
10. ASPSU cooling water supplied by RN on ASP event.
11. Reciprocating Charging Pump No. 1 has been abandoned in place per NSM CN-11392/00.

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
Reciprocating Charging Pump No. 2 has been abandoned in place per NSM CN-21392/00.					
Normal Unit Shutdown at 20 Hours					
Residual Heat Removal HXs	2	2	74.75	10000	
Residual Heat Removal Pumps	2	2	.886	50	1
Component Cooling Pumps	4	4	.216	120	2
Auxiliary Feedwater Pumps	2	2	.136	60	2
Containment Spray Pumps	0	2	-	60	2
Safety Injection Pumps	0	2	-	80	3
Centrifugal Charging Pumps	1	2	.577	140	3
Letdown HX	1	1	10.42	1000	4
Sealwater HX	1	1	1.604	250	
Reciprocating Charging Pump Brg. Oil Cooler	0	0	-	-	10
Fuel Pool Cooling Pumps	0	2	-	80	2
Fuel Pool Cooling HXs	0	0	-	-	
Recycle Evaporator Package	1	1	9.019	810	5
Waste Evaporator Package	1	1	9.019	810	5
Waste Gas Compressor Packages	1	2	.134	100	
Waste Gas Hyd. Recombiner Pack.	1	2	.07	20	
Reactor Coolant Drain Tank HX	1	1	2.23	225	
Excess Letdown HX	0	0	-	-	
Reactor Vessel Support Coolers	0	0			6

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
Reactor Coolant Pumps	0	4	-	824	7
Post Accident Liquid Sampler Cooler	1	1	0.331	10	8
Radiation Monitors	0	2	-	6	
ASPSUs	2	2	0.06	20	9
TOTALS			109.452	14665	

Notes:

1. The pump motor coolers and mechanical seal heat exchanger of each pump receive cooling flow.
2. The pump motor coolers of each pump receive cooling flow.
3. The pump motor coolers and oil cooler(s) of each pump receive cooling flow.
4. Heat load on the Letdown HX may vary from 6.52 x 10^6 Btu/hr to 10.42 x 10^6 Btu/hr. Normally the cooling flow is throttled to between 250 and 660 GPM. 1000 GPM would be expected if the control valve failed open.
5. Each evaporator package consists of an evaporator condenser, vent condenser, distillate cooler, concentrate heat exchanger, concentrate sample cooler, and the concentrate pumps bearing coolers. Only one of the two concentrate pumps bearing coolers is assumed to be in service.
6. The Reactor Vessel Support Coolers have been abandoned in place per CD100872 (Unit 1) and CD200950 (Unit 2).
7. The thermal barrier, upper and lower bearing oil coolers of each reactor coolant pump receive cooling flow.
8. The PALS Panel is normally in operation only during Engineered Safeguards; however, the panel may be tested at any time. Following train separation, the PALS panel receives cooling flow from one (but not both) KC Essential Headers.
9. ASPSU cooling water supplied by RN on ASP event.
10. Reciprocating Charging Pump No. 1 has been abandoned in place per NSM CN-11392/00.
    Reciprocating Charging Pump No. 2 has been abandoned in place per NSM CN-21392/00.

Unit Shutdown at 4 Hours (LOCA on Other Unit)					
Residual Heat Removal HXs	1	1	133.86	5000	1

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
Residual Heat Removal Pumps	1	2	.443	50	2
Component Cooling Pumps	2	4	.108	120	3
Auxiliary Feedwater Pumps	1	2	.068	60	3
Containment Spray Pumps	0	2	-	60	3
Safety Injection Pumps	0	2	-	80	4
Centrifugal Charging Pumps	1	2	.577	140	4
Letdown HX	1	1	10.42	1000	5
Sealwater HX	1	1	1.604	250	
Reciprocating Charging Pump Brg. Oil Cooler	0	0	-	-	11
Fuel Pool Cooling Pumps	0	2	-	80	3
Fuel Pool Cooling HXs	0	0	-	-	
Recycle Evaporator Package	0	1	-	810	6
Waste Evaporator Package	0	1	-	810	6
Waste Gas Compressor Packages	1	2	.134	100	
Waste Gas Hyd. Recombiner Pack.	1	2	.07	20	
Reactor Coolant Drain Tank HX	1	1	2.23	225	
Excess Letdown HX	0	0	-	-	
Reactor Vessel Support Coolers	0	0			7
Reactor Coolant Pumps	1	4	2.508	824	8
Post Accident Liquid Sample Cooler	1	1	0.331	10	9
Radiation Monitors	0	2	-	6	

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
ASPSUs	2	2	.06	20	10
TOTALS			152.413	9665	

Notes:

1. Heat load determined as follows:
   Core decay heat load at 4 hours — 120.21×10^6 Btu/hr
   One Reactor Coolant Pump heat input — 13.65×10^6 Btu/hr
   Total — 133.86×10^6 Btu/hr

   The cooldown will proceed slowly as the decay heat load decreases.
2. The pump motor coolers and mechanical seal heat exchanger of each pump receive cooling flow.
3. The pump motor coolers of each pump receive cooling flow.
4. The pump motor coolers and oil cooler(s) of each pump receive cooling flow.
5. Heat load on the Letdown HX may vary from 6.52×10^6 Btu/hr to 10.42×10^6 Btu/hr. Normally, the cooling flow is throttled to between 250 and 660 GPM. 1000 GPM would be expected if the control valve failed open.
6. Each evaporator package consists of an evaporator condenser, vent condenser, distillate cooler, concentrate heat exchanger, concentrate sample cooler, and the concentrate pumps bearing coolers. Only one of the two concentrate pumps bearing coolers is assumed to be in service.
7. The Reactor Vessel Support Coolers have been abandoned in place per CD100872 (Unit 1) and CD200950 (Unit 2).
8. The thermal barrier, upper and lower bearing oil coolers of each reactor coolant pump receive cooling flow.
9. The PALS Panel is normally in operation only during Engineered Safeguards; however, the panel may be tested at any time. Following train separation, the PALS panel receives cooling flow from one (but not both) KC Essential Headers.
10. ASPSU cooling water supplied by RN on ASP event.
11. Reciprocating Charging Pump No. 1 has been abandoned in place per NSM CN-11392/00.
    Reciprocating Charging Pump No. 2 has been abandoned in place per NSM CN-21392/00.

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
	Refueling				
Residual Heat Removal HXs	2	2	42.97	10000	1
Residual Heat Removal Pumps	2	2	.886	50	2
Component Cooling Pumps	4	4	.216	120	3
Auxiliary Feedwater Pumps	0	2	-	60	3
Containment Spray Pumps	0	2	-	60	3
Safety Injection Pumps	0	2	-	80	4
Centrifugal Charging Pumps	0	2	-	140	4
Letdown HX	0	1	-	1000	5
Sealwater HX	0	1	-	250	
Reciprocating Charging Pump Brg. Oil Cooler	0	0	-	-	12
Fuel Pool Cooling Pumps	1	2	.620	80	3
Fuel Pool Cooling HXs	1	1	18.5	3000	6
Recycle Evaporator Package	1	1	9.019	810	7
Waste Evaporator Package	1	1	9.019	810	7
Waste Gas Compressor Packages	1	2	.134	100	
Waste Gas Hyd. Recombiner Pack.	1	2	.07	20	
Reactor Coolant Drain Tank HX	0	1	-	225	
Excess Letdown HX	0	0	-	-	
Reactor Vessel Support Coolers	0	0			8
Reactor Coolant Pumps	0	4	-	824	9

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
Post Accident Liquid Sample Cooler	1	1	0.331	10	10
Radiation Monitors	0	2	-	6	
ASPSUs	2	2	0.06	20	11
TOTALS			81.825	17665	

Notes:

1. Heat load is core decay heat at 4 days after zero power, at which time transfer of fuel assemblies is expected to begin.
2. The pump motor coolers and mechanical seal heat exchanger of each pump receive cooling flow.
3. The pump motor coolers of each pump receive cooling flow.
4. The pump motor coolers and oil cooler(s) of each pump receive cooling flow.
5. 1000 GPM cooling flow would be expected if the control valve failed open. Normally, with no heat load the flow would tend towards zero.
6. One Fuel Pool Cooling HX is assumed for normal refueling. Flow should be blocked to nonessential equipment with no heat load if both Fuel Pool Cooling HXs are necessary.
7. Each evaporator package consists of an evaporator condenser, vent condenser, distillate cooler, concentrate heat exchanger, concentrate sample cooler, and the concentrate pumps bearing coolers. Only one of the two concentrate pumps bearing coolers is assumed to be in service.
8. The Reactor Vessel Support Coolers have been abandoned in place per CD100872 (Unit 1) and CD200950 (Unit 2).
9. The thermal barrier, upper and lower bearing oil coolers of each reactor coolant pump receive cooling flow.
10. The PALS Panel is normally in operation only during Engineered Safeguards; however, the panel may be tested at any time. Following train separation, the PALS panel receives cooling flow from one (but not both) KC Essential Headers.
11. ASPSU cooling water supplied by RN on ASP event.
12. Reciprocating Charging Pump No. 1 has been abandoned in place per NSM CN-11392/00.
    Reciprocating Charging Pump No. 2 has been abandoned in place per NSM CN-21392/00.

Equipment Cooled by the Component Cooling System	**Number With Heat Load**	**Number Receiving Flow**	**Total Heat Load (Btu/Hr 10^6)**	**Total Flow (GPM)**	**Notes**
Engineered Safeguards (Safety Injection)					
Residual Heat Removal HXs	0	2	-	10000	1
Residual Heat Removal Pumps	2	2	.886	50	2
Component Cooling Pumps	4	4	.216	120	3
Auxiliary Feedwater Pumps	2	2	.136	60	3
Containment Spray Pumps	2	2	.772	60	3
Safety Injection Pumps	2	2	1.132	80	4
Centrifugal Charging Pumps	2	2	1.154	140	4
Letdown HX	0	0	-	-	
Sealwater HX	0	0	-	-	
Reciprocating Charging Pump Brg. Oil Cooler	0	0	-	-	11
Fuel Pool Cooling Pumps	0	0	-	-	
Fuel Pool Cooling HXs	0	0	-		
Recycle Evaporator Package	0	0	-		
Waste Evaporator Package	0	0	-		
Waste Gas Compressor Packages	0	0	-		
Waste Gas Hyd. Recombiner Pack.	0	0	-		
Reactor Coolant Drain Tank HX	0	1	-	250	5
Excess Letdown HX	0	1	-	225	6
Reactor Vessel Support Coolers	0	0	-		7
Reactor Coolant Pumps	0	4	-	824	8

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
Post Accident Liquid Sample Cooler	1	1	0.331	10	9
Radiation Monitors	0	2	-	6	
ASPSUs	2	2	0.06	20	10
TOTALS			4.687	11845	

Notes:

1. Cooling flow is supplied although there is no heat load on the Residual Heat Removal HXs during the safety injection mode of operation.
2. The pump motor coolers and mechanical seal heat exchanger of each pump receive cooling flow.
3. The pump motor coolers of each pump receive cooling flow.
4. The pump motor coolers and oil cooler(s) of each pump receive cooling flow.
5. The Reactor Coolant Drain Tank HX will continue to receive cooling flow until the containment high pressure signal is received, when cooling flow is automatically secured.
6. If the Excess Letdown HX is receiving cooling flow when the safety injection signal is received, it will continue to receive cooling flow until the containment high pressure signal is received, when flow is automatically secured.
7. The Reactor Vessel Support Coolers have been abandoned in place per CD100872 (Unit 1) and CD200950 (Unit 2).
8. The Reactor Coolant Pumps receive cooling flow until the containment high-high pressure signal is received, when flow is automatically secured. The thermal barrier, upper and lower bearing oil coolers of each pump receive cooling flow.
9. The PALS Panel is normally in operation only during Engineered Safeguards; however, the panel may be tested at any time. Following train separation, the PALS panel receives cooling flow from one (but not both) KC Essential Headers.
10. ASPSU cooling water supplied by RN on ASP event.
11. Reciprocating Charging Pump No. 1 has been abandoned in place per NSM CN-11392/00. Reciprocating Charging Pump No. 2 has been abandoned in place per NSM CN-21392/00.

Engineered Safeguard (Recirculation)					
Residual Heat Removal HXs	2	2	95.03	10000	

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
Residual Heat Removal Pumps	2	2	.886	50	1
Component Cooling Pumps	4	4	.216	120	2
Auxiliary Feedwater Pumps	2	2	.136	60	2
Containment Spray Pumps	2	2	.772	60	2
Safety Injection Pumps	2	2	1.132	80	3
Centrifugal Charging Pumps	2	2	1.154	140	3
Letdown HX	0	0	-	-	
Sealwater HX	0	0	-	-	
Reciprocating Charging Pump Brg. Oil Cooler	0	0	-	-	10
Fuel Pool Cooling Pumps	0	0	-	-	
Fuel Pool Cooling HXs	0	0	-	-	
Recycle Evaporator Package	0	0	-	-	
Waste Evaporator Package	0	0	-	-	
Waste Gas Compressor Packages	0	0	-	-	
Waste Gas Hyd. Recombiner Pack.	0	0	-	-	
Reactor Coolant Drain Tank HX	0	0	-	0	4
Excess Letdown HX	0	0	-	0	5
Reactor Vessel Support Coolers	0	0	-		6
Reactor Coolant Pumps	0	0	-	0	7
Post Accident Liquid Sample Cooler	1	1	0.331	10	8
Radiation Monitors	0	2	-	6	

Equipment Cooled by the Component Cooling System	Number With Heat Load	Number Receiving Flow	Total Heat Load (Btu/Hr 10^6)	Total Flow (GPM)	Notes
ASPSUs	2	2	0.06	20	9
TOTALS			99.717	10546	

Notes:

1. The pump motor coolers and mechanical seal heat exchanger of each pump receive cooling flow.
2. The pump motor coolers of each pump receive cooling flow.
3. The pump motor coolers and oil cooler(s) of each pump receive cooling flow.
4. The Reactor Coolant Drain Tank HX will continue to receive cooling flow until the containment high pressure signal is received, when cooling flow is automatically secured.
5. If the Excess Letdown HX is receiving cooling flow when the safety injection signal is received, it will continue to receive cooling flow until the containment high pressure signal is received, when flow is automatically secured.
6. The Reactor Vessel Support Coolers have been abandoned in place per CD100872 (Unit 1) and CD200950 (Unit 2).
7. The Reactor Coolant Pumps receive cooling flow until the containment high-high pressure signal is received, when flow is automatically secured. The thermal barrier, upper and lower bearing oil coolers of each pump receive cooling flow.
8. The PALS Panel is normally in operation only during Engineered Safeguards; however, the panel may be tested at any time. Following train separation, the PALS panel receives cooling flow from one (but not both) KC Essential Headers.
9. ASPSU cooling water supplied by RN on ASP event.
10. Reciprocating Charging Pump No. 1 has been abandoned in place per NSM CN-11392/00.
    Reciprocating Charging Pump No. 2 has been abandoned in place per NSM CN-21392/00.

Table 9-7. Component Cooling System Valve Alignment for Various Modes of Operation

Valve Number	Mode of Operation 1	2	3-1	3-2	3-3	4	5-1	5-2	Figure	Loc.
KC1A	0	0	0	0	0	0	(1,3)	(1,3)	9-35	C-6
KC3A	0	0	0	0	0	(2)	(1,3)	(1,3)	9-35	C-6
KC50A	0	0	0	0	0	0	(1,3)	(1,3)	9-35	K-7
KC230A	0	0	0	0	0	(2)	(1,3)	(1,3)	9-35	K-7
KC56A	(4)	X	0	0	(4)	0	(5,9)	(5,9)		CN-1573-2.0
KC18B	0	0	0	0	0	(2)	(1,3)	(1,3)	9-35	C-9
KC2B	0	0	0	0	0	0	(1,3)	(1,3)	9-35	C-9
KC53B	0	0	0	0	0	0	(1,3)	(1,3)	9-35	K-8
KC228B	0	0	0	0	0	(2)	(1,3)	(1,3)	9-35	K-8
KC81B	(4)	X	0	0	(4)	0	(5,9)	(5,9)		CN-1573.2.1
KC148	(4,6)	(4)	X	X	X	(4,6)	—	—	9-37	G-11
KC155	(4,6)	(4)	X	X	X	(4,6)	—	—	9-37	G-13
KC225[1]	0	0	0	0	0	0	—	—	9-41	G-8
KC252[1]	0	0	0	0	0	0	—	—	9-41	G-7
KC463[1]	0	0	0	0	0	0	—	—	9-41	B-2
KC477[1]	0	0	0	0	0	0	—	—	9-41	F-4
KC320A	0	0	0	0	0	0	(7)	(7)	9-38	B-10
KC332B	0	0	0	0	0	0	(7)	(7)	9-38	E-2
KC333A	0	0	0	0	0	0	(7)	(7)	9-38	G-2
KC305B	0	X	X	X	X	X	(8)	(8)	9-38	D-13
KC315B	0	X	X	X	X	X	(8)	(8)	9-38	L-13
KC338B	0	0	0	0	0	0	(3)	(3)	9-38	D-12
KC424B	0	0	0	0	0	0	(3)	(3)	9-38	L-5
KC425A	0	0	0	0	0	0	(3)	(3)	9-38	L-7

Note:

1. On Unit 1 only.

Nonmenclature: 0 - open

X – closed
- - downstream of a closed valve

	Mode of Operation									
Valve Number	1	2	3-1	3-2	3-3	4	5-1	5-2	Figure	Loc.

Valves listed in this table are isolation valves which are regularly manipulated align the system for its various modes of operation. All other isolation valves should remain in the position indicated on the flow diagrams except for changes required for maintenance, or emergency situations.

1. Closes on low-low FWST level following a S-signal (Safety Injection Signal).
2. Normally open, but closed when both fuel pool cooling HXs are used in refueling.
3. Closes on P-signal (High-High Containment Pressure Signal).
4. Valve may be open or closed, depending on which train (or heat exchanger) is in operation and which is serving as backup.
5. Opens on low-low FWST level following a S-signal (Safety Injection Signal).
6. Both fuel pool cooling HXs may be in operation. See Note 2.
7. Normally open, closes on T-signal (High Containment Pressure Signal).
8. Normally closed, closes on T-signal (High Containment Pressure Signal) if open.
9. Opens on P-Signal (High High Containment Pressure Signal).

This table contains nominal valve alignments based on projected component operation and selected worst case assumptions (such as maximum lake temperature). Actual valve alignments may differ based on actual plant conditions.

Table 9-8. Component Cooling System Component Design Data

COMPONENT COOLING PUMPS	
Number per unit	4
Type	Centrifugal
Design Pressure, psig	150
Design Temperature, F	200
Design Flow, gpm	3760
Design Head, ft.	200
OEM Max. Tested Flow Rate, gpm	5700
Deleted Per 2006 Update	
Minimum Flow Rate (continuous), gpm	1100
NPSH Required At Design Flow, Ft.	13.7
Material of Construction	Carbon Steel
COMPONENT COOLING HEAT EXCHANGERS	
Number per Unit	2
Design Pressure, psig	150
Design Temperature, F	200
Estimated UA, BTU/HR F (inhibited Admiralty)	6.82×10^6
Estimated UA, BTU/HR F (316SS)	6.38×10^6
Design Flow (Shell Side), LB/HR	3.242×10^6
Design Flow (Tube Side), LB/HR	5.000×10^6
Shell Side Inlet Temp., F	172
Shell Side Outlet Temp., F	110
Tube Side Inlet Temp., F	90
Tube Side Outlet Temp., F	130.4
Max. Pressure Loss, psi	15
Shell Side Fouling Factor	.0005
Tube Side Fouling Factor	.002
Shell Side Material	Carbon Steel
Tube Side Material (HXs 1B, 2A)	Inhibited Admiralty
Tube Side Material (HXs 1A, 2B)	316SS
COMPONENT COOLING SURGE TANK	
Number per Unit	2

Total Volume per tank, gal	3925
Normal Water Volume per tank, gal	2500
Normal Pressure, psig	0
Design Pressure, psig	15
Design Temperature, F	200
Material of Construction	304 Stainless Steel
COMPONENT COOLING DRAIN SUMP	
Number per Unit	1
Total Volume per sump, gal.	500
Design Temperature, F	200
Height of curbing, inches	6
COMPONENT COOLING DRAIN SUMP PUMPS	
Number per Unit	2
Type	Vertical wet pit centrifugal
Design Flow, gpm	50
Design Head, ft	115
Shutoff, ft	138

Table 9-9. Component Cooling System. Failure Analysis (Assuming Receipt of Safety Injection Signal)

Component	Malfunction	Comments & Consequences
1. Component cooling water pump	Rupture of pump casing	By definition, the backup train of pumps start on signal. They provide 100% redundancy and are able to supply minimum engineered safety requirements.
2. Component cooling water pump	Pump fails to start	Same as #1.
3. Component cooling water pump	Manual valve on a pump suction line closed	This is prevented by prestartup and operational checks. Further, during normal operation each pump is checked on a periodic basis which should show that a valve was closed.
4. Component cooling water pump	Stop valve on discharge line closed or check valve sticks closed	Stop valves are locked open and check valves are checked open by prestartup and operational checks.
5. Component cooling water pump	Loss of normal electric power	Normal power sources automatically switch to emergency diesel power. There are two emergency diesel- generators per unit, either of which are capable of supplying power for the operation of the necessary safeguard features & protection systems.
6. Component cooling heat exchanger	Tube or shell rupture	Backup train of pumps/heat exchanger function as required. Each heat exchanger is capable of supplying minimum engineered safety features heat transfer requirements. A tube rupture will cause a release of chromated water to the environment well within allowable limits. A shell rupture will cause the spillage of one train of the system. Pressure, flow, and surge tank level alarms would indicate this failure.
7. Component cooling heat exchanger vent or drain valve	Left Open	This is prevented by prestartup and operational checks.

Component	Malfunction	Comments & Consequences
8. Valves and piping	Through-wall crack	Isolate equipment supplied and start redundant equipment or isolate entire header and start equipment on redundant header. Any pipe crack will cause spillage of pot entially radioactive water within Auxiliary Building.
9. Component Cooling Surge Tank	Through-wall crack	Backup train of component cooling system functions as required. Surge tank failure would drain down only the channel affected, and even then, pump operation is assured with surge tank empty. However, this channel is disabled as far as outleakage is concerned. Level alarm indicates such a failure.
10. Isolation Valve Train A	Fails to Actuate on Safety Signal	Train B gives 100% redundancy.
11. Isolation Valve Train B	Fails to Actuate on Safety Signal	Train A gives 100% redundancy.

Table 9-10. Makeup Demineralized Water System Component Design Parameters

MAKEUP DEMINERALIZER SUPPLY PUMPS	
Manufacturer	Ingersoll-Rand
Quantity	2 per Station
Type	Vertical In-Line
Model	4 x 3 x 8 VOC
Number of Stages	One
Design Flow	475 GPM
Design TDH	215 FT
Speed	3600 RPM
Design Brake Horsepower	40 HP
Minimum Continuous Flow	100 GPM
Deleted per 2015 update	
MAKEUP DEMINERALIZERS	
Manufacturer	IWT
Quantity	2 per Station
Type	Mixed Bed
Model	NA
Design Flow	475 GPM each
Design Pressure	100 PSIG
Design Temperature	150°F
Pressure Drop @ Design Flow	21 PSI
Anion Resin Volume	339 CU. FT.
Cation Resin Volume	154 CU. FT.
Deleted per 2015 update	
DEMINERALIZED WATER STORAGE TANK	
Manufacturer	FESCO
Quantity	1 per Station
Design Capacity	9,970 GAL.
Design Temperature	110°F
Design Internal Pressure	60 PSIG
Design External Pressure	0 PSIG
Deleted per 2015 update	

DEMINERALIZED WATER STORAGE TANK SUPPLY PUMPS	
Manufacturer	Ingersoll - Rand
Quantity	2 per Station
Type	Vertical In - Line
Model	2 x 1 1/2 x 8 VOC
Number of Stages	One
Design Flow	100 GPM
Design TDH	130 FT
Speed	3550 RPM
Design Brake Horsepower	7.8 HP
Minimum Continuous Flow	25 GPM
Deleted per 2015 update	
MAKEUP DEMINERALIZER AIR COMPRESSOR	
Manufacturer	Nash
Quantity	One per Station
Type	Liquid Ring
Model	CL - 701
Number of Stages	One
Design Capacity	620 SCFM
Design Discharge Pressure	15 PSIG
Motor Horsepower	50 HP
Deleted per 2015 update	

Table 9-11. Filtered Water System and Drinking Water System Component Design Parameters

Deleted per 2015 update	
FILTERED WATER BOOSTER PUMP	
Manufacturer	Ingersoll-Rand
Quantity	Two per Station
Type	Centrifugal
Model	3 x 2 x 8 VOC
Number of Stages	One
Design Flow	210 GPM
Design TDH	120 FT
Speed	3550 RPM
Design Brake Horsepower	15 HP
Deleted per 2015 update	

Table 9-12. Deleted Per 1994 Update

Table 9-13. Deleted Per 1994 Update

Table 9-14. Condensate Storage System Design Parameters

UPPER SURGE TANK DOME	
Quantity	1 per Unit
Design Capacity	7570 Gal.
Design Temperature	212°F
Design External Pressure	15 PSIG
Design Internal Pressure	0 PSIG
UPPER SURGE TANK	
Quantity	2 per Unit
Design Capacity	42,500 Gal.
Design Temperature	212°F
Design External Pressure	15 PSIG
Design Internal Pressure	0 PSIG
CONDENSATE STORAGE TANK	
Quantity	1 per Unit
Design Capacity	30,000 Gal.
Design Temperature	212°F
Design External Pressure	4 PSIG
Design Internal Pressure	4 PSIG
AUXILIARY FEEDWATER CONDENSATE STORAGE TANKS	
Quantity	1 per Unit
Design Capacity	42,500 Gal.
Design Temperature	135°F
Design External Pressure	0 PSIG
Design Internal Pressure	0 PSIG
CONDENSATE STORAGE TANK PUMPS	
Manufacturer	Ingersoll - Rand
Quantity	2 per Unit
Type	Vertical In-Line
Model	3 x 7 W
Number of Stages	One
Design Flow	300 GPM
Design Head	125 FT

Speed	3500 RPM
Design Brake Horsepower	14.8 HP

Table 9-15. Refueling Water System Component Design Data

Refueling Water Storage Tank	
Number per unit	1
Internal Volume, gallons	395,000
Technical Specification minimum contained Volume, gallons	377,537
Design pressure, internal	ATM
Normal Operating pressure, internal	ATM
Design pressure, external, psig	0.20
Vent size(s) in	(1)-6 (1)-12
Design temperature, F	120
Operating temperature F (Water-min)	70
Type	Vertical, field constructed
Material of construction	Stainless steel
Outside diameter, ft-in	40'-0 7/16"
Straight side height, ft-in	42' - 6 1/4"
Number of heaters	4
Capacity of each heater, Kw	10-20-30 (staged)
Insulation	sides only
Boron concentration ppm B	2000 to 4000
Refueling Water Pumps	
Number per unit	1
Type	Centrifugal
Design pressure, psig	205
Design Temperature, F	140
Material of construction	Stainless Steel
Design flow, gpm	Condition 1: 310 Condition 2: 200
Design head, ft	Condition 1: 220 Condition 2: 305
Refueling Water Pump Strainer	
Number per unit	1
Type	Basket

Design pressure, psig	70
Design temperature, F	140
Design flow, gpm	310
Pressure loss at design flow	Negligible
Strainer openings, inches	1/4
Refueling Water Recirculation Pumps	
Number per unit	2
Type	Centrifugal
Design pressure, psig	75
Design temperature, F	120
Material of construction	Stainless Steel
Design flow, gpm	50
Design head, ft	35

Table 9-16. Conventional Low Pressure Service Water System Component Design Parameters

CONVENTIONAL LOW PRESSURE SERVICE WATER PUMPS	
Manufacturer	Johnston
Quantity	3
Type	Vertical
Model	48 CMC
Number of Stages	1
Design Flow	38,000 GPM
Design Head	160 Ft. (min.)
Speed	710 RPM
Design Brake Horsepower	1,900 HP
Minimum Continuous Flow	19,000 GPM
CONVENTIONAL LOW PRESSURE SERVICE WATER STRAINERS	
Manufacturer	R. P. Adams
Quantity	2 per station
Type	Self-cleaning Simplex
Model	42" VDWS-146
Design Flow	33,000 GPM
Design Pressure	125 PSIG
Design Temperature	88°F
Strainer Medium	1/8" mesh
Maximum Pressure Drop	1.8 PSI

Table 9-17. Compressed Air Systems Component Design Parameters

INSTRUMENT AIR COMPRESSORS (INCLUDES AFTERCOOLERS)	
Manufacturer	Ingersoll-Rand
Quantity	3 per station
Type	Centrifugal
Model	1ACII15M2
Number of Stages	2
Design Capacity	1455 ICFM
Design Discharge Pressure	105 psig
Design Brake Horsepower	350 HP
INSTRUMENT AIR DESICCANT DRYER	
Manufacturer	Pneumatic Products Corp. (PPC)
Quantity	2 per Station
Type	Heatless, desiccant, air-purge
Model	2500 CHA
Design Capacity	2000 ICFM
Design Dew Point	-40°F @ Design Conditions
Design Pressure	150 PSIG
Design Inlet Temperature	110°F
Design Ambient Temperature	110°F
INSTRUMENT AIR RECEIVERS	
Manufacturers	IPC
Quantity	3 per Station
Volume	60 " x 16 '
Design Pressure	15 PSIG
Design Temperature	110°F
MAINSTREAM ISOLATION VALVE AIR TANKS	
Manufacturer	RECO
Quantity	4 per Unit
Volume	8 ft. ^{3}
Design Pressure	115 PSIG
Design Temperature	200°F
INSTRUMENT AIR PREFILTERS AND AFTER-FILTERS	

Manufacturer	Pneumatic Products Corp. (PPC)
Quantity	5 per Station
Type	Particulate Filter
Model	PCC124004G65 (2 Prefilters, 2 Afterfilters) PCS124004G65 (1 Prefilter)
Design Flow	2400 SCFM
Design Pressure	115 PSIG
Design Temperature	110°F
Filter Medium	1 Micron
Pressure Drop @ Design Flow	2 PSI Clean
PORTABLE DIESEL COMPRESSOR DRYER	
Manfacturer	Pure-Aire
Quantity	1 per Station
Type	Regenerative
Model	PAR 1200
Design Capacity	1200 CFM
Design Dewpoint	-40°F
Design Pressure	100 PSIG
Design Ambient Temperature	100°F
PORTABLE DIESEL COMPRESSOR AFTERFILTER	
Manufacturer	Pure-Aire
Quantity	1 per Station
Type	Coalescing
Model	PF-510
Design Flow	1600 CFM
Design Pressure	100 PSIG
Design Temperature	250°F
Filter Medium	0.3 micron
STATION AIR COMPRESSORS	
Manufacturer	Sullair
Quantity	2 per Station
Type	Screw
Model	20-150L

Number of Stages	One
Design Capacity	750 CFM
Design Discharge Pressure	100 PSIG
Design Brake Horsepower	150 HP
STATION AIR COMPRESSOR AFTERCOOLERS AND MOISTURE SEPARATORS	
Manufacturer	R. P. Adams
Quantity	2 per Station
Type	Shell and Tube
Model	SAF-SL-53 & 6" CYC
Design Capacity	750 CFM
Design Shell Side Pressuree	115 PSIG
Design Shell Side Pressure	125 PSIG
Design Temperature	240°F
STATION TO INSTRUMENT AIR OIL FILTERS	
Manufacturer	Zurn
Quantity	2 per Station
Type	Coalescing Oil Filter
Model	77107
Design Flow	750 CFM
Design Pressure	115 PSIG
Design Temperature	110°F
Filter Medium	0.3 Micron
Pressure Drop @ Design Flow	2 PSI Clean
STATION AIR RECEIVERS	
Manufacturer	IPC
Quantity	2 per Station
Volume	60" x 16'
Design Pressure	115 PSIG
Design Temperature	110°F
BREATHING AIR COMPRESSORS	
Manufacturer	Sullair
Quantity	2 per Station
Type	Rotary Screw

Model	RAS-75
Number of Stages	One
Design Capacity	330 CFM
Design Discharge Pressure	115 PSIG
Design Brake Horsepower	75 HP
BREATHING AIR RECEIVERS	
Manufacturer	NASH
Quantity	2 per Station
Volume	49.5 ft^3
Design Pressure	115 PSIG
Design Temperature	120°F
AUXILIARY FEEDWATER FLOW CONTROL VALVES AIR TANKS	
Manufacturer	Tioga (Unit 1) Ward (Unit 2)
Quantity	8 per Unit
Volume	15 $ft.^3$
Design Pressure	115 psig
Design Temperature	110°F

Table 9-18. Nuclear Sampling System Sample Locations and Data

Sampled System	Sample Location	Design Pressure, PSIA	Design Temperature°F
Reactor Coolant System	Pressurizer Liquid	2500	680
Reactor Coolant System	Pressurizer Steam	2500	680
Reactor Coolant System	Reactor Coolant Hotleg Loop A	2500	650
Reactor Coolant System	Reactor Coolant Hotleg Loop C	2500	650
Residual Heat Removal System	RHR Pump A Discharge	615	400
Residual Heat Removal System	RHR Pump B Discharge	615	400
Chemical Volume Control System	Volume Control Tank Gas Space	90	200
Safety Injection System	Accumulator A	715	300
Safety Injection System	Accumulator B	715	300
Safety Injection System	Accumulator C	715	300
Safety Injection System	Accumulator D	715	300
Chemical Volume Control System	Letdown Hx. Outlet	315	175
Chemical Volume Control System	Mixed Bed Demin. Outlet	315	175
Chemical Volume Contol System	Cation Bed Demin. Outlet	315	175
Chemical Volume Control System	Volume Control Tank Outlet	90	175
Chemical Volume Control System	Boric Acid Blender Outlet	165	250
Boron Thermal Regeneration System	Boron Thermal Reg. Demin. Outlet	315	175
Boron Recycle System[1]	Recycle Evap. Feed Demin. A Outlet	165	200
Boron Recycle System[1]	Recycle Evap. Feed Demin. B Outlet	165	200
Boron Recycle System[1]	Recycle Evap. Feed Pump Outlet	165	200
Boron Recycle System[1]	Recycle Evap. Cond. Demin. Outlet	165	200
Boron Recycle System[1]	Recycle Evap. Feed Demin. Inlet	165	200
Boron Recycle System	Reactor Makeup Water Storage	50	120

Sampled System	Sample Location	Design Pressure, PSIA	Design Temperature°F
Liquid Radwaste System[1]	Waste Evap. Feed Tank Pump Outlet	165	200
Liquid Radwaste System[1]	Waste Drain Tank Pump Outlet	165	200
Liquid Radwaste System[1]	Waste Evap. Dist. Cooler Outlet	165	200
Liquid Radwaste System[1]	Waste Monitor Tank Pump Outlet	165	200
Spent Fuel Cooling System	Spent Fuel Pool	165	200
Spent Fuel Cooling	Fuel Pool Cooling Post Filter	215	200
Refueling Water System	Refueling Water Storage Tank Recirculation	65	114
Solid Radwaste System[1]	Spent Resin Sluice Filter	165	200
Steam Generator Blowdown System	Steam Generator Blowdown A	1200	600
Steam Generator Blowdown System	Steam Generator Blowdown B	1200	600
Steam Generator Blowdown System	Steam Generator Blowdown C	1200	600
Steam Generator Blowdown System	Steam Generator Blowdown D	1200	600
Steam Generator Blowdown System	Steam Generator A Upper Shell	1200	600
Steam Generator Blowdown System	Steam Generator BUpper Shell	1200	600
Steam Generator Blowdown System	Steam Generator C Upper Shell	1200	600
Steam Generator Blowdown System	Steam Generator D Upper Shell	2300	600

Note:

1. Shared system, receives from both units

Table 9-19. Temperature and Pressure Reduction for Samples in the Conventional Systems Sample Panel

Sample	Rough Cooling	Pressure Regulated	Final Cooling
S. G. "A" Blowdown Sample		X	X
S. G. "B" Blowdown Sample		X	X
S. G. "C" Blowdown Sample		X	X
S. G. "D" Blowdown Sample		X	X
Final Feedwater Sample	X	X	X
Hotwell Pump Discharge		X	X
Polish Demineralizer Main Effluent Sample		X	X
Heater Drain C1 H. P. Sample	X	X	X
Heater Drain C2 H. P. Sample	X	X	X
Upper Surge Tank Sample	X		
Main Steam Sample A	X	X	X
Main Steam Sample B	X	X	X
Main Steam Sample C	X	X	X
Main Steam Sample D	X	X	X
Moisture Separator Reheater Drain Tank (A, B, C, & D)	X	X	X
First Stage Reheater Drain (A, B, C, & D)	X	X	X
Second Stage Reheater Drain (A, B, C, & D)	X	X	X
Low Pressure Reheater Drain (A/B, C/D)	X	X	X
Steam Generator Blowdown Demineralizer Influent	X	X	X
Steam Generator Blowdown Demineralizer Effluent	X	X	X

Table 9-20. Types of Analyses Provided in the Conventional Sampling Lab

Samples	Grab Sample	Specific Conductivity	Cation Conductivity	Sodium	PH	Sulfate, Amine, Chloride	Oxygen	Hydrazine	Patch Panel
S.G. "A" Blowdown Sample	X		X	X	X	X			X
S.G. "B" Blowdown Sample	X		X	X	X	X			X
S.G. "C" Blowdown Sample	X		X	X	X	X			X
S.G. "D" Blowdown Sample	X		X	X	X	X			X
Final Feedwater Sample	X	X	X	X	X	X	X	X	X
Hotwell Pump Discharge Sample	X	X		X	X		X		X
Polish Demineralizer Main Influent Sample	X		X						X
Polish Demineralizer Main Effluent Sample	X		X	X					X
Heater Drain C1 H. P. Sample	X								X
Heater Drain C2 H. P. Sample	X								X
Upper Surge Tank Sample	X								
Main Steam Sample A	X		X	X					X
Main Steam Sample	X		X	X					X

Samples	Grab Sample	Specific Conductivity	Cation Conductivity	Sodium	PH	Sulfate, Amine, Chloride	Oxygen	Hydrazine	Patch Panel
B									
Main Steam Sample C	X		X	X					X
Main Steam Sample D	X		X	X					X
Moisture Separator Reheater Drain Tank (A, B, C, & D)	X								X
First Stage Reheater Drain Tank (A, B, C, & D)	X								X
Second Stage Reheater Drain Tank (A, B, C, & D)	X								X
Low Pressure Turbine Crossover (A/B, C/D)	X								X
Steam Generator Blowdown Demineralizer Effluent	X	X	X	X		X			X
Steam Generator Blowdown Demineralizer Influent	X	X	X	X					X
Polish Demineralizer Vessel (A, B, C, D, E) Effluent Sample	X		X						

Samples	Grab Sample	Specific Conductivity	Cation Conductivity	Sodium	PH	Sulfate, Amine, Chloride	Oxygen	Hydrazine	Patch Panel

Table 9-21. Chemical and Volume Control System Design Parameters

General	
Seal water supply flow rate, for four reactor coolant pumps, nominal, gpm	32
Seal water return flow rate, for four reactor coolant pumps, nominal, gpm	12
Letdown flow:	
Normal, gpm	75
Maximum, gpm[1]	120
Charging flow (excludes seal water):	
Normal, gpm	55
Maximum, gpm[2]	100
Temperature of letdown reactor coolant entering system, °F	557
Temperature of charging flow directed to Reactor Coolant System, °F	516
Temperature of effluent directed to Boron Recycle System, °F	115
Centrifugal charging pump bypass flow (each), gpm	60
Amount of 4% boric acid solution required to meet cold shutdown requirements shortly after full power operation	Controlled by COLR
Unuseable volume at bottom of Boric Acid Tank (21" above bottom of tank), gallons	10,846
Maximum pressurization required for hydrostatic testing of Reactor Coolant System, psig	3,107

Notes:

1. 185 gpm is the maximum allowable flow when RHR letdown is in service and the reactor coolant system temperature is <200°F.
2. 180 gpm is the maximum allowable flow when RHR letdown is in service and the reactor coolant system temperature is <200°F.

Table 9-22. CVCS Principal Component Data Summary

Centrifugal Charging Pumps	
Number	2
Design pressure, psig	2800
Design temperature, °F	300
Design flow, gpm	150
Design head, ft	5800
Material	Austenitic Stainless Steel
180-gpm reactor coolant charging flow is permissible from the centrifugal charging pumps when residual heat removal system letdown is in service and the reactor coolant system temperature is <200°F.	
Boric Acid Transfer Pump	
Number	2
Design pressure, psig	150
Design temperature, °F	250
Design flow, gpm	75
Design head, ft	235
Material	Austenitic Stainless Steel
Boric Acid Batching Tank Pump	
Number	1
Design Pressure, psig	150
Design Temperature °F	200
Design flow, gpm	75
Design head, ft	12
Material	Austenitic Stainless Steel
Boric Acid Recirculation Pump	
Number	1
Design Pressure, psig	150
Design Temperature, °F	200
Design Flow, gpm	120
Design Head, ft	198
Material	Austenitic Stainless Steel

Regenerative Heat Exchanger	
Number	1
Heat transfer rate at design conditions, BTU/hr	11.0×10^6
Shell Side	
Design Pressure, psig	2485
Design temperature, °F	650
Fluid	Borated Reactor Coolant
Material	Austenitic Stainless Steel
Tube Side	
Design pressure, psig	2735
Design temperature, °F	650
Fluid	Borated Reactor Coolant
Material	Austenitic Stainless Steel
Shell Side (Letdown)	
Flow, lb/hr	37,200
Inlet temperature, °F	560
Outlet temperature, °F	290
Tube Side (Charging)	
Flow, lb/hr	27,300
Inlet temperature, °F	130
Outlet temperature, °F	516
180-gpm reactor coolant charging flow is permissible through the regenerative heat exchanger (tube side) when residual heat removal system letdown is in service and the reactor coolant system temperature is <200°F.	

Letdown Heat Exchanger	
Number	1
Heat transfer rate at design conditions, BTU/hr	$16.0 \text{ X } 10^6$
Shell Side	
Design pressure, psig	150
Design temperature, °F	250
Fluid	Component Cooling Water

Material		Carbon Steel	
Tube Side			
Design pressure, psig		600	
Design temperature, °F		400	
Fluid		Borated Reactor Coolant	
Material		Austenitic Stainless Steel	
Shell Side	Design	Normal	
Flow, lb/hr	498,000	200,000	
Inlet temperature, °F	105	105	
Outlet temperature, °F	137	149	
Tube Side (Letdown)			
Flow, lb/hr	59,500	37,200	
Inlet temperature, °F	380	290	
Outlet temperature, °F	115	115	
185-gpm reactor coolant letdown flow from the residual heat removal system is permissible through the letdown heat exchanger when the reactor coolant system temperature is <200°F.			
Seal Water Heat Exchanger			
Number		1	
Heat transfer rate at design conditions, BTU/hr		1.98×10^6 (Alt.1)[1] 1.604×10^6	
	Shell Side	Tube Side	
Design pressure, psig	150	150	
Design temperature, °F	250	250	
Design flow, lb/hr	125,000	48,400	66,000[1]
Inlet temperature, °F	105	155.9	139[1]
Outlet temperature, °F	121	115	
Fluid	Component Cooling Water	Borated Reactor Coolant	
Material	Carbon Steel	Austenitic Stainless Steel	
Excess Letdown Heat Exchanger			
Number		1	
Heat Transfer rate at design conditions, BTU/hr		5.18×10^6	
	Shell Side	Tube Side	
Design Pressure, psig	150	2485	

Design Temperature, °F	250	650
Design Flow, lb/hr	125,000	12,500
Inlet temperature, °F	105	560
Outlet temperature, °F	147	165
Fluid	Component Cooling Water	Borated Reactor Coolant
Material	Carbon Steel	Austenitic Stainless Steel
Volume Control Tank		
Number		1
Volume, ft^3		400
Design pressure, psig		75
Design temperature, °F		250
Material		Austenitic Stainless Steel
Boric Acid Tanks		
Number		1
Volume, gal.		46,000
Design Pressure, psig		Atmospheric
Design Temperature		200°
Material		Austenitic Stainless Steel
Batching Tank		
Number		1
Capacity, gal.		800
Design pressure		Atmospheric
Design temperature, °F		300
Material		Austenitic Stainless Steel
Chemical Mixing Tank		
Number		1
Capacity, gal.		5
Design pressure, psig		150
Design temperature, °F		200
Material		Austenitic Stainless Steel

Mixed Bed Demineralizers	
Number	2
Design pressure, psig	300
Design temperature, °F	250
Design flow, gpm	120
Resin volume, each, ft^3	30
Material	Austenitic Stainless Steel
150-gpm reactor coolant letdown flow from the residual heat removal system is permissible through the mixed bed demineralizer when the reactor coolant system temperature is <200°F.	
Cation Bed Demineralizers	
Number	1
Design pressure, psig	300
Design temperature, °F	250
Design flow, gpm	75
Resin volume, ft^3	20
Material	Austenitic Stainless Steel
Resin Fill Tank	
Number	1
Volume, ft^3	8
Design pressure	Atmospheric
Design temperature, °F	200
Normal operating temperature	Ambient
Material of construction	Austenitic SS
Chemical Mixing Tank Orifice	
Number	1
Design temperature, °F	200
Design pressure, psig	150
Operating temperature, °F	Ambient
Design flow, gpm	2
Design differential pressure, psi	50
Material of Construction	Austenitic SS
Boric Acid Pump Orifice	

Number		1
Design temperature, °F		200
Design pressure, psig		150
Operating temperature, °F		75
Design flow, gpm		10
Reactor Coolant Filters		
Number		2
Design pressure, psig		300
Design temperature, °F		250
Design flow, gpm		150
Particle retention		98% of 25 micron size
Material, (vessel)		Austenitic Stainless Steel
185 gpm reactor coolant letdown flow from the residual heat removal system is permissible through the Reactor Coolant Filters when the reactor coolant system temperature is <200°F.		
Reciprocating Charging Pump Accumulators **Note:** Reciprocating Charging Pump No. 1 was abandoned in place per NSM CN-11392/00 Reciprocating Charging Pump No. 2 was abandoned in place per NSM CN-21392/00		
	Suction	Discharge
Number	1	1
Design temperature, °F	175	250
Normal operating temperature	115	115
Design pressure, psig	220	2735
Capacity, gallons	1.0	2.0
Boric Acid Blender		
Number		1
Design pressure, psig		150
Design temperature, °F		200
Material of Construction		Austenitic SS
Deleted row(s) Per 2003 Update		
Cation Bed Demineralizer Resin Strainer		

Number	1
Design pressure, psig	300
Design temperature, °F	175
Design flow rate, gpm	75
Pressure drop at design flow, psig	1
Retention screen size, inches	0.012
Material of Construction	SS
Seal Water Injection Filters	
Number	2
Design pressure, psig	2735
Design temperature, °F	250
Design flow, gpm	80
Particle retention	98% of 5 micron size
Material, (vessel)	Austenitic Stainless Steel
Seal Water Return Filter	
Number	1
Design pressure, psig	300
Design temperature, °F	250
Design flow, gpm	150
Particle retention	98% of 25 micron size
Material, (vessel)	Austenitic Stainless Steel
Batching Tank Agitator	
Number	1
Service	Continuous
Agitator mounting	Enter at angle (8° - 10°) through top head of tank
Material of construction	Austenitic SS
Fluid data (Design Basis) Fluid handled	12 wt. percent boric acid in water (Normal: 4 wt. percent)
Specific gravity (165°F)	1.025

Viscosity (165°F), cp		1.0
Temperature, °F		90-165
Boric Acid Filter		
Number		1
Design pressure, psig		300
Design temperature, °F		250
Design flow, gpm		150
Particle retention		98% of 25 micron size
Material, (vessel)		Austenitic Stainless Steel
Letdown Orifice	45 gpm	75 gpm
Number	1	1
Design flow, lb/hr	22,230	37,050
Differential pressure at design flow, psid	1700	1700
Design pressure, psig	2,485	2,485
Design temperature, °F	650	650
Material	Austenitic Stainless Steel	Austenitic Stainless Steel
No. 1 Seal Bypass Orifices		
Number		1/Loop (Total 4)
Design flow, gpm		1
Differential pressure at design flow, psig		300
Design pressure, psig		2485
Design temperature, °F		250
Material		Austenitic Stainless Steel

Note:

1. Includes max. NC Pump #1 seal leakage of 48 gpm.

Table 9-23. Failure Mode and Effects Analysis Chemical and Volume Control System. Active Components - Normal Plant Operation and Load Follow

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
1. Air operated gate valve NV2A (NV1A analogous)	a. Fails open.	a. Charging and Volume Control - letdown flow.	a. Failure reduces redundancy of providing letdown flow isolation to protect PZR heaters from uncovering at low water level in PZR. No effect on system operation. Alternate isolation valve (NV-1A) provides backup letdown flow isolation. Heaters automatically deenergize on low level.	a. Valve position indication (open to closed position change) at CB.	a. Valve is designed to fail "closed" and wired so that electrical solenoid of the operator is energized to open the valve. Solenoid is de-energized to close the valve upon the generation of a low level PZR control signal. The valve is electrically interlocked with the level letdown orifice isolation valves and may not be opened manually from the CB if any of these valves are at an open position.
	b. Fails closed	b. Charging and Volume Control - letdown flow.	b. Failure blocks normal letdown flow to VCT. Minimum letdown flow requirements for borations of RCS to hot standby concentration level may be met by establishing letdown flow through alternate excess letdown flow path.	b. Valve position indication (closed to open position change) at CB; letdown flow temperature indications (NVP5110 and NVP5590) at CB; letdown flow-pressure indication (NVP5570) at CB; letdown flow indication (NVP5530) at CB; and VCT level indication (NVP5761) and low level alarm at CB.	

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
			If the alternate excess letdown flow path to VCT is not available due to common mode failure (loss of instrument air supply) affecting the opening operation of isolation valves in each flow path, the plant operator can borate the RCS to a hot standby concentration level without letdown flow by taking advantage of the steam space available in the PZR.		
2. Air diaphragm operated gate valve NV10A (NV13A and NV11A analogous)	a. Fails open	a. Charging and Volume Control - letdown flow.	a. Failure prevents isolation of normal letdown flow through regenerative heat exchanger when bringing the reactor to a cold shutdown condition after the RHRS is placed into operation. No effect on hot standby operation. Containment isolation valve (NV15B) may be remotely closed from the CB to isolate letdown flow through the heat exchanger.	a. Valve position indication (open to closed position change) at CB.	a. Valve is of the similar design as that stated for item #1. Solenoid is de-energized to close the valve upon the generation of an ESF "T" signal, the generation of letdown isolation valves (NV2A and NV1A) upstream of the regenerative heat exchanger.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
	b. Fails closed.	b. Charging and Volume Control - letdown flow.	b. Failure blocks normal letdown flow to VCT. Normal letdown flow to VCT may be maintained by opening alternate letdown orifice isolation valve NV11A. Minimum letdown flow requirements for boration of RCS to hot standby concentration level may be met by opening letdown orifice isolation valves NV13A or NV11A. If common mode failure (loss of instrument air) prevents opening of these valves and also prevents establishing alternate flow through excess letdown flow path, plant operator can borate the RCS to a hot standby concentration level without letdown flow by taking advantage of steam space available in PZR.	b. Same methods of detection as those stated for item #1, failure mode “Fails closed”.	
3. Motor operated globe valve NV15B	a. Fails closed.	a. Charging and Volume Control letdown flow.	a. Same effect on system operation as that stated for item #1, failure mode “Fails closed”.	a. Same methods of detection as those stated for item #1, failure mode “Fails closed”. In addition, close position group monitoring light at CB.	a. Motor operator is energized to close the valve upon the generation of an ESF "T" signal.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
	b. Fails open.	b. Charging and Volume Control - letdown flow.	b. Failure has no effect on CVCS operation during normal plant operation and load follow. However, under accidents conditions requiring containment isolation, failure reduces the redundancy of providing isolation of normal letdown line.	b. Valve position indication (open to closed position change) at CB.	
4. Deleted per 1994 update.					
5. Air diaphragm operated globe valve NV148	a. Fails open	a. Charging and Volume Control - letdown flow.	a. Failure prevents control of pressure to prevent flashing of letdown flow in letdown heat exchanger and also allows high pressure fluid to mixed bed demineralizers. Relief valve (NV151) opens in demineralizer line to release pressure to VCT and valve (NV153A) changes position to divert flow to VCT. Boration of RCS to hot standby concentration level is possible with valve failing open.	a. Letdown heat exchanger tube discharge flow indication (NVP5530) and high flow alarm at CB; temperature indication (NVP5590) and high temperature alarm at CB; and pressure indication (NVP5570) at CB.	1. Valve is designed fail "open" and is electrically wired so the electrical solenoid of the air diaphragm operator is energized to close valve.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
	b. Fails closed	b. Charging and Volume Control - letdown flow.	b. Same effect on system operation as that for item #1, failure mode “Fail closed”.	b. Letdown heat exchanger discharge flow indication (NVP5530), and pressure indication (NVP5570) and high pressure alarm at CB.	2. As a design transient the letdown heat exchanger is designed for complete loss of letdown flow.
6. Air diaphragm operated threeway valve NV153 A.	a. Fails open for flow only to VCT.	a. Charging and Volume Control - letdown flow.	a. Letdown flow bypassed from flowing to mixed bed demineralizers. Boration of RCS to hot standby concentration level is possible with valve failing open for flow only to VCT.	a. Valve position indication (VC Tank) at CB and RCS activity level when sampling letdown flow.	1. Electrical solenoid of air diaphragm operatore is electrically wired so that solenoid is energized to open valve flow to the mixed bed demineralizers. Valve opens for flow to VCT on “High Letdown Temp.”
	b. Fails open for flow only to mixed bed demineralizer.	b. Charging and Volume Control - letdown flow.	b. Continuous letdown to mixed bed demineralizers. Failure prevents automatic isolation of mixed bed demineralizers under fault condition of high letdown flow temperatures. These systems may be manually isolated using local valves (NV353 and NV368) at mixed bed demineralizers. Boration of RCS to hot standby concentration level is possible with valve failing open for flow only to demineralizer.	b. Valve position indication (Demin.) at CB.	2. Technical specifications provide a limit on RCS activity.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
7. Deleted per 1997 update.					
8. Deleted per 2000 update.					
9. Deleted per 2000 update.					
10. Relief valve NV14	a. Fails open.	a. Charging and Volume Control - letdown flow.	a. Letdown flow is relieved to pressurizer relief tank. Failure inhibits use of demineralizers for reactor coolant purification. Normal letdown line can be isolated and minimum letdown flow requirements for hot standby may be met by establishing letdown flow through alternate excess letdown flow path.	a. High temperature relief line indication and alarm at CB and VCT level indication (NVP5761) and low level alarm at CB.	1. Radioactive fluid contained.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
11. Relief valve NV151	a. Fails open.	a. Charging and Volume Control - letdown flow.	a. Letdown flow is relieved to VCT. Failure inhibits use of demineralizers for reactor coolant purification. Normal letdown line can be isolated and minimum letdown flow requirement for hot standby may be met by establishing flow through alternate excess letdown flow path.	a. RCS activity level when sampling letdown flow.	1. Radioactive fluid contained.
12. Deleted per 1997 update.					
13. Deleted per 2000 update.					
14. Deleted per 2000 update.					
15. Deleted per 2000 update.					
16. Deleted per 2000 update.					

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
17. Deleted per 2000 update.					
18. Deleted per 2000 update.					
19. Deleted per 2000 update.					
20. Deleted per 2000 update.					
21. Deleted per 2000 update.					
22. Deleted per 2000 update.					

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
23. Air diaphragm operated globe valve NV123B (NV122B analogous)	a. Fails closed.	a. Charging and Volume Control - letdown flow.	a. Failure inhibits use of the excess letdown fluid system of the CVCS as an alternate system that may be used for letdown flow control during normal plant operation and inhibits use of the excess letdown system to control water level in the pressurizer of the RCS during final stage of plant startup due to flow blockage.	a. Valve position indication (closed to open position change) at CB and excess letdown heat exchanger outlet pressure indication (NVP5280) and temperature indication (NVP5090) at CB.	1. Valve is designed fail "closed" and is electrically wired so that the electrical solenoid of the air diaphragm operator is energized to open valve.
	b. Fails open.	b. Charging and Volume Control - letdown flow.	b. Failure reduces redundancy of providing excess letdown flow isolation during normal plant operation and for plant startup. No effect on system operation. Alternate isolation valve (NV122B) closes to provide backup flow isolation of excess letdown line.	b. Valve position indication (open to closed position change) at CB.	2. If normal letdown and excess letdown flow is not available for hot standby operations, plant operator can borate RCS to hot standby concentration using steam space available in PZR.
24. Air diaphragm operated globe valve NV124B	a. Fails closed.	a. Charging and Volume Control - letdown flow.	a. Same effect on system operation as stated for item #23, failure mode “Fails closed”.	a. Same methods of detection as those stated for item #23, failure mode “Fails closed” except for valve position indication at CB.	1. Same remarks as those stated above for item #23.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
	b. Fails open.	b. Charging and Volume Control - letdown flow.	b. Failure prevents manual adjustment at CB of RCS system pressure downstream of excess letdown heat exchanger to a low pressure consistent with No. 1 seal leakoff backpressure requirements. When using excess letdown system failure leads to a decrease in seal water pump shaft flow for cooling pump bearings.	b. Excess letdown heat exchanger outlet pressure indication (NVP5280) at CB, and seal water return flow recordings (NVCR5140) and low flow alarm at CB.	
25. Air diaphragm operated plug valve NV102A (NV107B, NV112A, and NV117B analogous)	a. Fails closed.	a. Charging and Volume Control - seal water flow.	a. No automatic makeup of seal water to seal standpipe that services No. 3 seal of RC pump 1A. No effect on operation to bring the plant to hot standby condition.	a. Valve position indication (closed to open position change) and low standpipe level alarm at CB.	1. Valve is designed fail "closed" and is electrically wired so that the electrical solenoid of the air diaphragm operator is energized to open valve.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
	b. Fails open.	b. Charging and Volume Control - seal water flow.	b. Overfill of seal water standpipe and dumping of reactor makeup water to containment sump during automatic makeup of water for No. 3 seal of RC pump 1A. No effect on operations to bring reactor hot standby condition.	b. Valve position indication (open to closed position change) and high standpipe level alarm at CB.	2. Low level standpipe alarm conservatively set to allow RC pump operation without a complete loss of seal water from being injected to No. 3 seal after sounding of alarm.
26. Relief valve NV87	e. Fails open.	a. Charging and Volume Control - seal water flow.	a. RC pump seal water return flow and excess letdown flow bypassed to PZR relief tank of RCS. Failure inhibits use of the excess letdown fluid system of the CVCS as an alternate system that may be used for letdown flow control during normal plant operation and inhibits use of excess letdown system to control water level in the PZR of the RCS during final stage of a plant startup.	a. Decrease in VCT level causing RMCS of CVCS to operate.	1. The capacity of the relief valve equals maximum flow from four RC pump seals flow.
					1. Radioactive fluid contained.
					2. Same as remark #2 noted for item #23.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
27. Motor operated gate valve NV89A (NV91B analogous)	a. Fails open.	a. Charging and Volume Control - seal water flow and excess letdown flow.	a. Failure has no effect on CVCS operation during normal plant operation and load follow. However, under accident conditions requiring containment isolation failure reduces redundancy of providing isolation of seal water flow and excess letdown flow.	a. Valve position indication (open to closed position change) at CB.	1. Valve in normally at a full open position and motor operator is energized to close the valve upon the generation of an ESF “T” signal.
	b. Fails closed.	b. Charging and Volume Control - seal water flow and excess letdown flow.	a. RC pump seal water return flow and excess letdown flow blocked. Failure inhibits use of the excess letdown fluid system of the CVCS as an alternate system that may be used for letdown flow control during normal plant operation and degrades cooling capability of seal water in cooling RC pump bearings.	b. Valve position indication (closed to open position change) at CB; group monitoring light and alarm at CB; and seal water return flow recordings (NVCR5140) and low seal water return flow alarm at CB.	2. If normal letdown and excess letdown flow is not available for hot standby operation, plant operator can borate RCS to hot standby concentration using steam space available in PZR.
28. Motor operated gate valve NV314B (NV312A analogous)	a. Fails open.	a. Charging and Volume Control - charging flow.	a. Failure has no effect on CVCS operation during normal plant operation and load follow. However, under accident condition requiring isolation of charging line, failure reduces redundancy of providing isolation of normal charging flow.	a. Valve position indication (open to closed position change) at CB.	1. Valve is normally at a full open position and motor operator is energized to close the valve upon the generation of a Safety Injection “S” signal.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
	b. Fails closed.	b. Charging and Volume Control M charging flow.	b. Failure inhibits use of normal charging line to RCS for boration, dilution, and coolant makeup operations. Seal water injection path remains available for boration of RCS to a hot standby concentration level and makeup of coolant during operations to bring the reactor to hot standby condition.	b. Valve position indication (closed to open position change) and group monitoring light (valve closed) at CB; letdown temperature indication (NVP5110) and high temperature alarm at CB; charging flow temperature indication (NVP5100) at CB; seal water flow pressure indication (NVP5620) at CB; VCT level indication (NVP5761) and high level alarm at CB.	

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
29. Air diaphragm operated globe valve NV309	a. Fails open.	a. Charging and Volume Control - charging flow and seal water flow.	a. Failure prevents manual adjustment at CB of seal water flow through the control of back pressure in charging header resulting in a reduction of flow to RC pump seals leading to a reduction in flow to RCS via labyrinth seals and pump shaft flow for cooling pump bearings. Boration of RCS to a hot standby concentration level and makeup of coolant during operations to bring reactor to hot standby condition is still possible through normal charging flow path.	a. Seal water flow pressure indication (NVP5620) at CB; seal water return recordings (NVCR5140); and low seal water return flow alarm at CB.	1. Valve is designed fail "open" and is electrically wired so the electrical solenoid of the air diaphragm operator is energized to close valve.
	b. Fails closed.	b. Charging and Volume Control - charging flow.	b. Same effect on system operation as that stated for item #28, failure mode "Fails closed".	b. Same method of detection as those stated above for item #28, failure mode "Fails closed".	

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
30. Motor operated globe valve NV203A (NV202B analogous)	a. Fails open.	a. Charging and Volume Control - charging flow and seal water flow.	a. Failure has no effect on CVCS operation during normal plant operation and load follow. However, under accident condition requiring isolation of centrifugal charging pump miniflow line, failure reduces redundancy of providing isolation of miniflow to suction of pumps via seal water heat exchanger.	a. Valve position indication (open to closed position change) at CB.	
	b. Fails closed.	b. Charging and Volume Control - charging flow and seal water flow.	b. Failure blocks miniflow to VCT via seal water heat exchanger. Normal charging flow and seal water flow prevents deadheading of pumps when used. Boration of RCS to a hot standby concentration level and makeup of coolant during operations to bring reactor to hot standby condition is still possible.	b. Valve position indication (closed to open position change) at CB; group monitoring light (valve closed) and alarm at CB; and charging and seal water flow indication (NVP5630) and high flow alarm at CB.	

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
31. Air diaphragm operated gate valve NV32B	a. Fails open.	a. Charging and Volume Control - charging flow	a. Failure has no effect on CVCS operation during normal plant operation, load follow and hot standby operation. Valve is used during cold shutdown operation to isolate normal charging line when using the auxiliary spray during the cooldown of the pressurizer. Cold shutdown of reactor is still possible, however, time for cooling down PZR will be extended.	a. Valve position indication (open to closed position change) at CB.	1. Valve is designed fail "open" and is electrically wired so the electrical solenoid of the air diaphragm operator is energized to close valve.
	b. Fails closed.	b. Charging and Volume Control - charging flow.	b. Failure blocks normal charging flow to the RCS. No effect on CVCS operations during normal plant operation, load follow or hot standby operation. Plant operator can maintain charging flow by establishing flow through alternate charging path by opening of isolation valve (NV39A).	b. Valve position indication (closed to open position change) at CB; charging flow indication (NVP5100) at CB; regenerative heat exchanger shell side exit temperature indication (NVP5110) and high temperature alarm at CB; and charging and seal water flow indication (NVP5630) and low flow alarm at CB.	

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
32. Air diaphragm operated gate valve NV39A	a. Fails closed.	a. Charging and Volume Control - charging flow.	a. Failure reduces redundancy of charging flow paths to RCS. No effect on CVCS operations during normal plant operation, load follow, or hot standby operation. Normal charging flow path remains available for charging flow.	a. Valve position indication (closed to open position change) at CB.	1. Valve is designed fail "open" and is electrically wired so the electrical solenoid of the air diaphragm operator is energized to close valve.
	b. Fails open.	b. Charging and Volume Control - charging flow.	b. Same effect on system operation and shutdown as that stated above for item #31, failure mode "Fails open" if alternate charging line is in use.	b. Valve position indication (open to closed position change) at CB.	
33. Motor operated globe valve NV37A	a. Fails open.	a. Charging and Volume Control - charging flow.	a. Failure results in inadvertent operation of auxiliary spray that results in a reduction of PZR pressure during normal plant operation and load follow. PZR heaters operate to maintain required PZR pressure. Boration of RCS to a hot standby concentration level and makeup of coolant during operation to bring reactor to hot standby condition is still possible.	a. Valve position indication (open to closed position change) at CB and PZR pressure recording (NCCR5160) and low pressure alarm at CB.	

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
	b. Fails closed.	b. Charging and Volume Control - charging flow.	b. Failure has no effect on CVCS operation during normal plant operation, load follow and hot standby operation. Valve may be used during cold shutdown operation to activate auxiliary spray for cooling down the pressurizer after operation of RHRS.	b. Valve position indication (closed to open position change) at CB.	
34. Relief Valve NV205	a. Fails open.	a. Charging and Volume Control - charging flow.	a. Failure results in a portion of seal water return flow and centrifugal charging pump miniflow being bypassed to VCT. Boration of RCS to a hot standby concentration level and maekup of coolant during operations to bring reactor to hot standby condition is still possible.	a. Local pressure indication (NVPG5550 and NVPG5560) in discharge line of centrifugal charging pumps.	1. Radioactive fluid contained.
35. Relief Valve NV305	a. Fails open.	a. Charging and Volume Control - charging flow and seal water flow.	a. No effect on normal plant operation, load follow or bringing reactor to hot standby condition.	a. Local pressure indication (NVPG5540) in discharge line of constant displacement pump.	

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
					2. Radioactive fluid contained. 3. Valve 1NV305 has been gagged closed and 1NVPG5540 has been abandoned in place per NSM CN-11392/00. Valve 2NV305 has been gagged closed and 2NVPG5540 has been abandoned in place per NSM CN-21392/00.
36. Air diaphragm operated globe valve NV294	a. Fails open.	a. Charging and Volume Control - charging flow and seal water flow.	a. Failure reduces redundancy of providing charging and seal water flow to RCS. No effect on normal plant operation, load follow, or bringing reactor to hot standby condition.	a. Charging and seal water flow indication (NVP5630) and high flow alarm at CB, and PZR level recording (NCCR5161) and high level alarm at CB.	1. Valve is designed fail "open" and is electrically wired so the electrical solenoid of the air diaphragm operator is energized to close valve.
					2. Methods of detection apply when a centrifugal charging pump is in operation.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
	b. Fails closed.	b. Charging and Volume Control - charging flow and seal water flow.	b. Failure reduces redundancy of providing charging and seal water flow to RCS. No effect on system operation during normal plant operation, load follow, or bringing reactor to hot standby condition. Valve failing closed under an accident condition requiring flow delivery by centrifugal charging inhibits flow from the pumps.	b. Charging and seal water flow indication (NVP5630) and low flow alarm at CB, and PZR level recording (NCCR5161) and low level alarm at CB.	
37. Check valve NV306	a. Fails open.	a. Charging and Volume Control - charging flow and seal water flow.	a. Failure reduces redundancy of providing charging and seal water to RCS. No effect on normal plant operation, load follow, or bringing reactor to hot standby condition.	a. Charging and seal water flow indication (NVP5630) and low flow alarm at CB, and PZR level recording (NCCR5161) and low level alarm at CB.	
					2. Methods of detection apply when centrifugal charging pump 1A is in operation. 3. Positive displacement pump No. 1 has been abandoned in place per NSM CN-11392/00. Positive displacement pump No. 2 has been abandoned in place per NSM CN-21392/00.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
38. Check valve NV270 (NV290 analogous)	a. Fails open.	a. Charging and Volume Control - charging flow and seal water flow.	a. Failure reduces redundancy of providing charging and seal water flow to RCS. Discharge of centrifugal charging pump 1A is open to "backflow" when centrifugal charging pump 1B is placed into operation after failure of centrifugal charging pump 1A to deliver charging and seal water flow. No effect on normal plant operation, load follow, or bringing reactor to hot standby condition.	a. Same methods for detection as those stated above for item #37.	1. Centrifugal charging pump 1A may be isolated by the closing of manual valves in pump's suction and discharge lines.
39. Deleted per 2000 update.					
40. Centrifugal charging pump 1A APCH (Pump 1B analogous)	a. Fails to deliver working fluid.	a. Charging and Volume Control - charging flow and seal water flow.	a. Failure reduces redundancy of providing charging and seal water flow to RCS. Alternate delivery of charging and seal water flow by a centrifugal charging pump not available. No effect on normal plant operation, load follow, or bringing reactor to hot standby condition.	a. Same methods of detection as those stated above for item #39 when centrifugal charging pump 1A is in operation. In addition, monitor light and alarm for group monitoring of components at CB.	1. Flow rate for a centrifugal charging pump is controlled by a modulating valve (NV294) in discharge header for the centrifugal charging pumps.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
41. Air diaphragm operated globe valve NV224	a. Fails closed.	a. Chemical Control, Purification and Makeup - oxygen control.	a. Failure blocks hydrogen flow to VCT and loads to loss of venting of VCT (vent valve 1WG3 closes on low VCT pressure) resulting in loss of gas stripping of fission products from RCS coolant. No effect on operation to bring the reactor to hot standby condition.	a. VCT pressure indication (NVP5500) and low pressure alarm at CB. Periodic sampling of gas mixture in VCT.	1. Plant's technical specification sets limits on RCS activity level.
42. Relief valve NV223	a. Fails open.	a. Charging and Volume Control - charging flow and seal water flow.	a. Failure allows VCT liquid to be relieved to BRS recycle holdup tank resulting in a loss of VCT liquid and makeup coolant available for charging and seal water flow during normal plant operation, load follow, and bringing the reactor to a hot standby condition. VCT isolation valves (NV188A and NV189B) close on low water level tank level signal causing the suction of charging pumps to be transferred to the RWST for an alternate supply of borated (Controlled by COLR) coolant.	a. Decrease in VCT level causing RMCS to operate; VCT level indications (NVP5761) and low level alarm at CB; and BRS recycle holdup tank level increase.	1. Radioactive fluid contained.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
43. Motor operated gate valve NV188A (NV189B) analogous	a. Fails open.	a. Charging and Volume Control - charging flow and seal water flow.	a. Failure has no effect on CVCS operation during normal plant operation, load follow, and bringing reactor to a hot standby condition. However, under accident conditions requiring isolation of VCT, failure reduces redundancy of providing isolation for discharge line of VCT.	a. Valve position indication (open to closed position change) at CB.	1. During normal plant operation and load follow valve is at a full open position and the motor operator is energized to close the valve upon the generation of a VCT low water level signal or upon the generation of a Safety Injection "S" signal.
	a. Fails closed.	a. Charging and Volume Control - charging flow and seal water flow.	a. Failure blocks fluid flow from VCT during normal plant operation, load follow and when bringing the reactor to a hot standby condition. Alternate supply of borated (Controlled by COLR) coolant from the RWST to suction of charging pumps can be established from the CB by the operator through the opening of RWST isolation valves (NV252A and NV253B).	a. Valve position indication (closed to open position change) at CB; group monitoring light and alarm (valve closed) at CB; charging and seal water flow indication (NVP5630) and low flow alarm at CB; and PZR level recording (NCCR5161) and low level alarm at CB.	

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
44. Air diaphragm operated globe valve NV467	a. Fails closed.	a. Chemical Control, Purification and Makeup - oxygen control.	a. Failure reduces the redundancy of flow paths provided for the venting of VCT gas mixture to gas waste processing system for stripping of fission products from RCS coolant during normal plant operation and load follow. No effect on operations to bring the reactor to standby condition.	a. VCT pressure indication (NVP5500) and high pressure alarm at CB. Periodic sampling of gas mixture in VCT.	1. Valve is designed fail "closed" and is electrically wired so that the electrical solenoid of the air diaphragm operator is energized to open valve. 2. Same remark as that stated for item #41 in regards to RCS activity. 3. Methods of detection apply when alternate flow path is being used for venting.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
45. Air diaphragm operated globe valve NV186 A	a. Fails closed	a. Boron Concentration Control - reactor makeup control - boration, auto makeup, and alternate dilution.	a. Failure blocks fluid flow from reactor makeup control system for automatic boric acid addition and reactor water makeup during normal plant operation and load follow. Failure also reduces redundancy of fluid flow paths for dilution of RC coolant by reactor makeup water and blocks fluid flow for boration of the RC coolant when bringing the reactor to a hot standby condition. Boration (at BA tank boron concentration level) of RCS coolant to bring the reactor to hot standby condition is possible by opening of alternate BA tank isolation valve (NV236B) at CB.	a. Valve position indication (closed to open position change) at CB; total makeup flow deviation alarm at CB; and VCT level indication (NVP5761) and low level alarm at CB.	1. Valve is designed fail "closed" and is electrically wired so that the electrical solenoid of the air diaphragm operator is energized to open valve.
	b. Fails open.	b. Boron Concentration Control - reactor makeup control - boration, auto makeup, and alternate dilution.	b. Failure allows for alternate dilute mode type operation for system operation of normal dilution of RCS coolant. No effect on CVCS operation during normal plant operation and load follow, and when bringing the reactor to a hot standby condition.	b. Valve position indication (open to closed change) at CB.	

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
46. Air diaphragm operated globe valve NV181A	a. Fails closed.	a. Boron Concentration Control - reactor makeup control - dilution and alternate dilution.	a. Failure blocks fluid flow from RMCS for dilution of RCS coolant during normal plant operation and load follow. No effect on CVCS operation. Operator can dilute RCS coolant by establishing "alternate dilute" mode of system operation. Dilution of RCS coolant not required when bringing the reactor to a hot standby condition.	a. Same methods for detection as those stated above for item #45, failure mode "Fails closed".	1. Valve is designed fail "closed" and is electrically wired so that the electrical solenoid of the air diaphragm operator is energized to open valve.
	b. Fails open.	b. Boron Concentration Control - reactor makeup control - dilution and alternate dilution.	b. Failure allows for alternate dilute mode type operation for system operation of boration and auto makeup of RCS coolant. No effect on CVCS operation during normal plant operation and load follow and when bringing the reactor to a hot standby operation.	b. Valve position indication (open to closed position change) at CB.	

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
47. Relief Valve NV273	a. Fails open.	a. Charging and Volume Control - charging and seal water flow.	a. Failure allows for a portion of flow to suction header of charging pumps to be relieved to BRS recycle holdup tank. Boration of RCS coolant to bring reactor to hot standby condition is still possible.	b. Decrease in VCT level causing RMCS to operate; VCT level indications (NVP5761) and low water level alarm at CB; and BRS recycle holdup tank level increase.	2. Radioactive fluid contained.
48. Air diaphragm operated globe valve NV238 A	a. Fails open.	a. Boron Concentration Control - reactor makeup control - boration and auto makeup.	a. Failure prevents the addition of a pre-selected quantity of concentrated boric acid solution at a pre-selected flow rate to the RCS coolant during normal plant operation, load follow and when bringing the reactor to a hot standby condition. Boration to bring the reactor to a hot standby condition is possible, however, flow rate of solution from BA tanks cannot be automatically controlled.	a. Valve position indication (open to closed position change) at CB; and boric acid flow recording (NVCR5450) and flow deviation alarm at CB.	1. Valve is designed fail "open" and is electrically wired so the electrical solenoid of the air diaphragm operator is energized to close valve.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
	b. Fails closed.	b. Boron Concentration Control - reactor makeup control - boration, and auto makeup.	b. Failure blocks fluid flow of boric acid solution from BA tanks during normal plant operation, load follow, and when bringing the reactor to a hot standby condition. Boration (at BA tank boron concentration level) of RCS coolant to bring the reactor to hot standby condition is possible by opening of alternate BA tank isolation valve (NV236B) at CB.	b. Valve position indication (closed to open position change) at CB; and boric acid flow recording (NVCR5450) and flow deviation alarm at CB.	
49. Air diaphragm operated globe valve NV242A	a. Fails closed.	a. Boron Concentration Control - reactor makeup control - dilute, alternate dilute and auto makeup.	a. Failure blocks fluid flow of water from reactor makeup control system during normal plant operation and load follow. No effect on system operation when bringing the reactor to a hot standby condition.	a. Valve position indication (closed to open position change) at CB; VCT level indications (NVP5761) and low level alarm at CB; and makeup water flow recording (NVCR5450) and flow deviation alarm at CB.	1. Valve is designed fail "closed" and is electrically wired so that the electrical solenoid of the air diaphragm operator is energized to open valve.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
	b. Fails open.	b. Boron Concentration Control - reactor makeup control - dilute, alternate dilute and auto makeup.	b. Failure prevents the addition of a preselected quantity of water makeup at a pre-selected flow rate to the RCS coolant during normal plant operation and load follow. No effect on system operation when bringing the reactor to a hot standby condition.	b. Valve position indication (open to closed position change) at CB and makeup water flow recording (NVCR5450) and flow deviation alarm at CB.	
50. Motor operated globe valve NV236B	a. Fails closed.	a. Boron Concentration Control - reactor makeup control - boration and auto makeup.	a. Failure reduces redundancy of flow paths for supplying boric acid solution from BA tanks to RCS via charging pumps. No effect on CVCS operation during normal plant operation, load follow, or hot standby operation. Normal flow path via RMCS remains available for boration of RCS coolant.	a. Valve position indication (closed to open position change) at CB and flow indication (NVP5440) at CB.	1. Valve is at a closed position during normal RMCS operation. 2. If both flow paths from BA tanks are blocked due to failure of isolation valves (NV238A and NV236B), borated water (Controlled by COLR) from RWST is available by opening isolation valve NV252A or NV253B.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
	b. Fails open.	b. Boron Concentration Control - reactor makeup control - boration and auto makeup.	b. Failure prevents the addition of a pre-selected quantity of concentrated boric acid solution at a pre-selected flow rate to the RCS coolant during normal plant operation, load follow and when bringing the reactor to a hot standby condition. Boration to bring the reactor to a hot standby condition is possible, however, flow rate of solution from BA tanks can not be automatically controlled.	b. Valve position indication (open to closed position change) at CB and flow indication (NVP5440) at CB.	
51. Boric acid transfer pump 1A APBA (BA transfer pump 1B analogeous)	a. Fails to deliver working fluid.	a. Boron Concentration Control - reactor makeup control - boration and auto makeup.	a. No effect on CVCS system operation during normal plant operation, load follow or bringing reactor to hot standby condition. Redundant BA transfer pump 1B provides necessary delivery of working fluid for CVCS system operation.	a. Pump motor start relay position indication (open) at CB and local pump discharge pressure indication (NVP5700).	1. Both BA transfer pumps operate simultaneously for RMCS boration operation. 2. Redundant BA transfer pumps provided for each unit.

Component	Failure Mode	CVCS Operation Function	Effect on System Operation and Shutdown[1]	Failure Detection Method[2]	Remarks
52. Air diaphragm operated three way valve NV172A	a. Fails open for flow only to BRS recycle holdup tank.	a. Charging and Volume Control - letdown flow.	a. Failure bypasses normal letdown flow to BRS recylce holdup tank resulting in excessive use of RMCS. No effect on operation to bring reactor to hot standby condition.	a. Valve position indication (Holdup Tank) at CB; VCT water level indication (NVP5761) and low level alarm at CB; and increase water level in BRS recycle holdup tank.	1. Valve is designed to fail open for flow to VCT and is electrically wired so that electrical control solenoids for valve are energized for flow to BRS recycle holdup Tank. Valve opens to flow to BRS recycle holdup tank on high VCT water level signal.

Notes:

1. See list at end of table for definition of acronyms and abbreviations used.
2. As part of plant operation, periodic tests, surveillance inspection and instrument calibrations are made to monitor equipment and performance. Failures may be detected during such monitoring of equipment in addition to detection methods noted.

<u>List of Acronyms and Abbreviations</u>

BA - Boric Acid

BRS - Boron Recycle System

BTR - Boron Thermal Regeneration

BTRS - Boron Thermal Regeneration System

CB - Control Board

CVCS - Chemical and Valume Control System

Demin. - Demineralizer

HX - Heat Exchange

PZR - Pressurizer

RC - Reactor Coolant

RCS - Reactor Coolant System

RHRS - Residual Heat Removal System

RWST - Refueling Water Storage Tank

RMCSn. - Reactor Makeup Control System

VCT	- Volume Control Tank

Table 9-24. Boron Recycle System Component Data Summary

Recycle Evaporator Feed Pumps	
Number	2
Design pressure, psig	150
Design temperature, ^{0}F	200
Design flow, gpm	30
Design head, ft	302
Material	Austenitic SS
Recycle Holdup Tanks	
Number	2
Capacity, gal	112,000
Design pressure	Atmospheric
Design temperature, ^{0}F	200
Material	Austenitic SS
Recycle Evaporator Reagent Tank	
Number	1
Capacity, gal	5
Design pressure	150
Design temperature, ^{0}F	200
Material	Austenitic SS
Recycle Evaporator Feed Demineralizers	
Number	2
Design pressure, psig	300
Design temperature, ^{0}F	250
Design flow, gpm	120
Resin volume, ft^3	30
Material	Austenitic SS
Recycle Evaporator Condensate Demineralizer	
Number	1
Design pressure, psig	300
Design temperature, ^{0}F	250
Design flow, gpm	75
Resin volume, ft^3	20

Material	Austenitic SS
Recycle Evaporator Feed Filters	
Number	2
Design pressure, psig	300
Design temperature, ^{0}F	250
Design flow, gpm	150
Particle retention	98% of 5 micron size
Material, (vessel)	Austenitic SS
Recycle Evaporator Condensate Filter (as originally supplied)	
Number	1
Design pressure, psig	200
Design temperature, ^{0}F	250
Design flow, gpm	35
Particle retention	98% of 25 micron size
Material, (vessel)	Austenitic SS
Recycle Evaporator Concentrates Filter	
Number	1
Design pressure, psig	200
Design temperature, ^{0}F	250
Design flow, gpm	35
Particle retention	98% of 25 micron size
Material, (vessel)	Austenitic SS
Recycle Evaporator Package	
Number	1
Design flow, gpm	15
Concentration of Concentrate (boric acid), wt percent	4
Concentration of Condensate	10 ppm boron as H^3BO^3
Material	Stainless steel
Recycle Holdup Tank Vent Eductor	
Number	1
Design pressure, psig	5
Design temperature, ^{0}F	200

Typical flow, SCFM	1.4
Material	Stainless steel
Reactor Makeup Water Storage Tanks	
Number for Both Units	2 (1 per unit)
Usable Volume, Gallons	112,000
Total Volume, Gallons	125,000
Tank Design Pressure[1]	Atmospheric
Tank Design Temperature, ^{0}F	200
Tank Operating Temperature, ^{0}F	115
Material of Construction	Austenitic SS lined
Reactor Makeup Water Pumps	
Number for Both Units	4 (2 per unit)
Design pressure, psig	150
Design temperature, ^{0}F	200
Design flow, GPM	150
Design Head, ft	250
Material	Austenitic SS
Recycle Evaporator Condensate Return Unit	
Number for Both Units	1
Receiver Volume, Gallons	100
Design pressure, psig	200
Design temperature, ^{0}F	350
Number of Pumps	2
Design Flow, GPM	25
Design Head, ft.	65
Reactor Makeup Water Filter	
Number	1
Design pressure, psig	150
Design temperature, °F	120
Design flow, gpm	300
Particle retention	99.98% of 0.1 micron size

Material, (vessel)	Stainless steel

Note:

1. Not including hydrostatic head.

Table 9-25. Boron Thermal Regeneration System Component Data

HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED

Chiller Pumps		
Number	*3 (one per unit plus one shared)*	
Design pressure, psig	*150*	
Design temperature, °F	*200*	
Design flow, gpm	*400*	
Design head, feet	*150*	
Material	*Carbon Steel*	
Moderating Heat Exchanger		
Number	*1 (per unit)*	
Design heat transfer, BTU/hr	*2.53×10^6*	
	Shell	*Tube*
Design pressure, psig	*300*	*300*
Design temperature, °F	*200*	*200*
Design flow, lb/hr	*59,600*	*59,600*
Design inlet temperature (boron storage mode), °F	*50*	*115*
Design outlet temperature (boron storage mode), °F	*92.4*	*72.6*
Inlet temperature (boron release mode), °F	*140*	*115*
Outlet temperature (boron release mode), °F	*123.7*	*131.3*
Fluid circulated	*Reactor Coolant*	*Reactor Coolant*
Material	*Stainless Steel*	*Stainless Steel*
Letdown Chiller Heat Exchanger		
Number	*1 (per unit)*	
Design heat transfer, BTU/hr	*1.65×10^6*	
	Shell	*Tube*
Design pressure, psig	*150*	*300*
Design temperature, °F	*200*	*200*
Design flow, lb/hr	*175,000*	*59,640*

Design inlet temperature (boron storage mode), °F	*39*	*72.6*
Design outlet temperature (boron storage mode), °F	*48.4*	*45*
Inlet temperature (boron release mode), °F	*90*	*123.7*
Outlet temperature (boron release mode), °F	*99.4*	*96.1*
Fluid circulated	*Chromated Water*	*Reactor Coolant*
Material	*Carbon Steel*	*Stainless Steel*
Letdown Reheat Heat Exchanger		
Number	*1 (per unit)*	
Design heat transfer, BTU/hr	*$1.49 X 10^6$*	
	Shell	*Tube*
Design pressure, psig	*300*	*600*
Design temperature, °F	*200*	*400*
Design flow, lb/hr	*59,640*	*44,730*
Inlet temperature, °F	*115*	*280*
Outlet temperature, °F	*140*	*246.7*
Fluid circulated	*Reactor Coolant*	*Reactor Coolant*
Material	*Stainless Steel*	*Stainless Steel*
Chiller Surge Tank		
Number	*1 (per unit)*	
Volume, gal	*500*	
Design pressure, psig	*Atmospheric*	
Design temperature, °F	*200*	
Material	*Carbon Steel*	
Thermal Regeneration Demineralizers		
Number	*5 (per unit)*	
Design pressure, psig	*300*	
Design temperature, °F	*250*	
Design flow, gpm	*120*	
Resin volume, ft^3	*74.3*	
Material of construction	*Stainless Steel*	

Chillers	
Number	*3 (one per unit plus one shared)*
Capacity, BTU/hr	*$1.66 X 10^6$*
Design flow, gpm	*352*
Inlet temperature, °F	*48.4*
Outlet temperature, °F	*39*

Table 9-26. Control Room Area Ventilation System Failure Analysis

Component	Failure	Comments and Consequences
Control Room, Control Room Area, or Switchgear Room Vent Fan	Fail	Redundant Fan Available
Control Room, Control Room Area, or Switchgear Room Heating and Cooling Coil Units	Fail	Redundant Unit Available
Pressurizing Fan	Fail	Redundant Fan Available
Pressurizing Filter Train	Fail	Redundant Unit Available
Chilled Water System Component	Fail	Redundant System Available
Damper (Control or Isolation)	Fail	Redundant Damper System Available
Outside air intake isolation valve	Fail	Redundant Valve Available

Table 9-27. Fuel Handling Area Exhaust System Failure Analysis

Component	Failure	Comments and Consequences
Fuel Handling Area Exhaust Fan	Fail	Redundant Exhaust System Available
Fuel Handling Area Filter Train	Fail	Redundant Exhaust System Available
Damper (Control or Isolation)	Closes and fails to reopen	Redundant Exhaust System Available
Damper (Bypass)	Opens and fails to close	Failure is indicated. Redundant Exhaust System Available.

Table 9-28. Auxiliary Building Ventilation System Failure Analysis

Components	Failure	Comments and Consequences
Auxiliary Building Filtered Exhaust Fan	Fail	Redundant fan available during accident condition operating mode.
Auxiliary Building Filtered Exhaust Filter Train	Fail	Redundant filter train available during accident condition operating mode.
Auxiliary Building Filtered Exhaust Preheater/Demister Section	Fail	Redundant Preheater/Demister Section available during accident condition operating mode.
Auxiliary Shutdown Panel Room Air Conditioning Unit	Fail	Redundant Shutdown Panel with air conditioning unit available.
Damper (Bypass or Isolation)	Fails to close	Redundant damper and duct path available during accident condition operating mode.
Inlet Vane Damper	Fails to reduce Filtered Exhaust System flow rate	Redundant damper and filter system available during accident condition operating mode.

Table 9-29. Purge System Isolation Valve Design and Test Criteria

Design:	Pressure	15 psig
	Differential Pressure	15 psi
	Temperature	250^{0}F
	Radiation	$2x10^{8}$ rads
	Closure Time[1]	5 seconds
Tests:	Hydrotest to 150% of design pressure	
	Leak-test across valve for zero leakage	
	Valve minimum wall measurement	

Note:

1. Testing of the Containment Purge (VP) System closure times is not performed because the isolation valves are sealed or locked closed during Modes 1, 2, 3, and 4.

Table 9-30. Annulus Ventilation System. Malfunction Analysis

	Components	Failure	Comments and Consequences
1.	Annulus ventilation fan	Fan fails to start or stops running and cannot be restarted.	Two 100 percent capacity fans are provided.
2.	Annulus ventilation filter train	Filter failure	Two 100 percent capacity trains are provided.
3.	Annulus ventilation moisture eliminator	Eliminator failure	Two 100 percent capacity eliminators are provided.
4.	Cross-connect Valve	Fails to close	Valves provide two 100 percent flow paths in the suction header.
5.	Discharge Isolation Valve	Fails to open	Each fan train, including discharge isolation valve, is a redundant flow path.
6.	Control Damper	Fails to modulate	Two 100 percent capacity subsystems are provided.
7.	Carbon Filter	Carbon ignition due to excessive localized radioiodine deposition.	Dispersion of the radioiodine throughout the filter influent and uniform filter flow distribution assures uniform filter loading therein precluding carbon ignition. Even though carbon ignition is not considered a probability, each filter train carbon section is provided with a fire detection and protection system in accordance with Regulatory Guide 1.52. (See Section 12.3.3).
8.	Annulus ventilation fan	LOCA coincident with loss of offsite power and with a single active failure	Power is supplied to redundant annulus ventilation subsystems from the emergency diesel generators.

Table 9-31. Deleted Per 2018 Update

Table 9-32. Communications Available for Transient and Accident Conditions

Location	Expected Noise Utilizing A Weighting db Levels[3]	PABX Telephone (95dBA)[1, 2]	Electro-Sound-Powered Telephone-Emergency Circuit (110dBA)[1]	Electro-Sound-Powered Maintenance Circuit (110dBA)[1]	PA System (95dBA)[1]	PA via PABX Telephone (95dBA)[1, 2]	Fiber Optic Dispatch Phone (76dBA)[1]
Auxiliary feedwater pump turbine	95db	X	X	X		X	
Auxiliary shutdown panel rooms	70db	X	X			X	X
Control room	62db	X	X	X	X	X	X
Technical Support Center	62db	X			X	X	X
Diesel generator rooms	105db	X	X	X		X	
Fuel pool area	76db	X	X	X		X	
HVAC equipment room control panels	70db	X	X			X	
Instrument air compressors	90db	X	X			X	
Switchgear and motor control center rooms	70db	X	X	X		X	
Valves 1ND26, 1ND27, 1ND60, & 1ND61 in the Residual Heat Removal System	95db	X	X			X	
Valves 1KC56A	96db	X	X			X	

Location	Expected Noise Utilizing A Weighting db Levels[3]	PABX Telephone (95dBA)[1, 2]	Electro-Sound-Powered Telephone-Emergency Circuit (110dBA)[1]	Electro-Sound-Powered Maintenance Circuit (110dBA)[1]	PA System (95dBA)[1]	PA via PABX Telephone (95dBA)[1, 2]	Fiber Optic Dispatch Phone (76dBA)[1]
and 1KC81B in Component Cooling Water System							
Valves 1VQ15B, 1VQ16A, & 1VQ13 in the Containment Air Release and Addition System	94db	X	X			X	
Reactor Coolant System Pressure Gage	100db	X	X				
Primary Sample Sink	75db	X	X			X	
Electrical Penetration Room	75db	X	X			X	
Control Room Annex	62db	X	X			X	
6.9 KV Switchgear Room	75db	X	X			X	
RC Temperature H&C Connection Box	70db	X	X				
Residual Heat Removal heat exchanger outlet	90db	X	X				

Location	Expected Noise Utilizing A Weighting db Levels[3]	PABX Telephone (95dBA)[1, 2]	Electro-Sound-Powered Telephone-Emergency Circuit (110dBA)[1]	Electro-Sound-Powered Maintenance Circuit (110dBA)[1]	PA System (95dBA)[1]	PA via PABX Telephone (95dBA)[1, 2]	Fiber Optic Dispatch Phone (76dBA)[1]
temperature							

Notes:

Maximum noise level capabilities of equipment.

1. Telephone equipped with transistor amplifier and noise cancelling transmitter.
2. Noise levels result of measurements taken at comparable plants.
3. After a unit is operational, plant noise levels will be measured during normal and shutdown conditions. Sound isolation booths or noise cancelling devices will then be added as necessary.
4. Hand Held Radios are available to plant personnel.

Table 9-33. Communications and Lighting Available for Safe Shutdown of Plant

Location	PABX Telephone	Electro-Sound-Powered Telephone-Emergency Circuit	Electro-Sound-Powered Maintenance Circuit	PA System	PA via PABX Telephone	Fiber Optic Dispatch Phone	Emer-gency 8-Hour Battery Lighting	Emer-gency 208 Y/120VAC Lighting	Emer-gency 250VDC Lighting
Auxiliary feedwater pump turbine panel	X	X	X		X		X	X	X
Auxiliary shutdown panel rooms	X	X			X	X	X	X	X
Control room	X	X	X	X	X	X	X	X	X
Diesel generator rooms	X	X	X		X		X	X	X
Fuel pool area	X	X	X		X		X	X	X
HVAC equipment room control panels	X	X			X		X	X	X
Instrument air compressors	X	X			X		X		X
Switchgear and motor control center rooms	X	X			X		X	X	X
Valves 1 and 2 ND26,ND27,ND60, & ND61 in the Residual Heat Removal System	X	X			X		X	X	X

Location	PABX Telephone	Electro-Sound-Powered Telephone-Emergency Circuit	Electro-Sound-Powered Maintenance Circuit	PA System	PA via PABX Telephone	Fiber Optic Dispatch Phone	Emer-gency 8-Hour Battery Lighting	Emer-gency 208 Y/120VAC Lighting	Emer-gency 250VDC Lighting
Valves 1 and 2 KC56A and KC81B in the Component Cooling Water System	X	X			X		X	X	X
Valves 1 and 2 VQ15B, VQ16A, & VQ13 in the Containment Air Release and Addition System	X	X			X		X	X	X
Reactor Coolant System Pressure Gage	X	X					X	X	X
RC Temp, H&C Connection Box	X	X					X	X	X
Residual Heat Removal heat exchanger outlet termperature	X	X					X	X	X
Technical Support Center	X			X	X	X			X

Location	PABX Telephone	Electro-Sound-Powered Telephone-Emergency Circuit	Electro-Sound-Powered Maintenance Circuit	PA System	PA via PABX Telephone	Fiber Optic Dispatch Phone	Emer-gency 8-Hour Battery Lighting	Emer-gency 208 Y/120VAC Lighting	Emer-gency 250VDC Lighting

Note:

1. The Emergency 8 hour battery lights list given in this table is not intended to be a list of NRC committed Post Fire Safe Shutdown Emergency Lighting. See Table 9-36 for a complete list of NRC committed Post Fire Safe Shutdown Emergency Lights.

Table 9-34. Single Failure Analysis of the Emergency Lighting Systems. (Assume Emergency Lighting Systems are Energized)

	Component	Malfunction	Comments & Consequences
1.	Emerg. AC Lighting Fixture	Incandescent lamp or Fixture Failure - due to Damage or Other Incident	No Consequences, only failed lamp will be out of service, all other lamps will continue to operate and provide adequate illuminations. Emergency 250VDC Lighting System will also illuminate the area along with appropriate Emergency 8 Hour Battery Lighting for access and egress and vital locations.
2.	Emerg. AC Lighting Cable, Panelboard to Fixture	Failure – due to Damage	Lighting circuit affected will be out of service with protection by the panelboard circuit breaker. Will lose (AC) illumination in a localized area. Emergency 250VDC Lighting System will adequately illuminate affected area. Emergency 8 Hour Battery Lighting will illuminate area for access and egress and vital locations.
3.	Emerg. AC Lighting Panelboard	Failure or Loss of Voltage	Lighting circuits affected will be out of service. Will lose (AC) illumination in localized areas. Emerg. 250VDC Lighting System will adequately illuminate affected areas. Emergency 8 Hour Battery Lighting will provide lighting for access and egress and vital locations.
4.	Emerg. AC Lighting Transformer	Failure or Loss of 600 VAC Power Supply	Same Comment as 3.
5.	Emerg. DC Lighting Fixture	Incandescent Lamp or Fixture Failure – due to Damage or Other Incident	No consequences, only failed lamp will be out of service. All other lamps will continue to operate and provide adequate illumination. Emergency AC Lighting System will also illuminate the area along with appropriate Emergency 8 Hour Battery Lighting.
6.	Emerg. DC Lighting Cable, Panelboard to Fixture	Failure - due to Damage	Lighting circuit affected will be out of service with protection by relay protective fuse. Will lose (DC) illumination in localized area. Emerg. AC Lighting System will adequately illuminate affected area. Emergency 8 Hour Battery Lighting will also illuminate area for access and egress and vital locations.
7.	Emerg. DC Lighting Panelboard	Failure or Loss of Voltage	Lighting circuits affected will be out of service. Will lose (DC) illumination in localized areas. Emerg. AC Lighting Systems will adequately illuminate affected areas. Emergency 8 Hour Battery Lighting will also illuminate area for access and egress and vital locations.

Table 9-35. Lighting Systems Available to Illuminate Safety Related Equipment[1,2,5]

SYSTEM	EQUIPMENT	EMERG. LIGHTING AT EQUIP[3]			EMERG. LIGHTING FOR ACCESS TO EQUIP[4]		
		8-HR BATTERY	EMERG. AC	EMERG. DC	8-HR BATTERY	EMERG . AC	EMERG . DC
CA	MOTOR DRIVEN AUX. FEEDWATER PUMPS 1A, 1B, 2A, 2B					X	X
	STEAM TURB. DRIVEN AUX. FEEDWATER PUMP	X			X	X	X
	AUX. FEEDWATER CONTROL PANELS ASP1A, ASP1B	X	X	X	X	X	X
EIA	AUX. RELAY RACKS 1ARR1, 1ARR2		X	X	X	X	X
	PROTECTION SET I, II, III, IV Cabinets 1, 2, 3, 4		X	X	X	X	X
EME	RCP VOLTAGE AND FREQ SYS. PANEL 1RCPM					X	X
EOA	MAIN CONTROL BOARDS 1MC1-1MC13, 2MC1-2MC13, MC14	X	X	X	X	X	X
	CONTROL BOARD INPUT CABINETS 1IC1-1IC18, 1IC20, 2IC1-2IC18, 2IC20		X	X		X	X
	CONTROL BOARD INPUT CABINETS 1IC21, 1IC22, 1IC26-1IC33, 2IC21, 2IC22, 2IC26-2IC33		X	X			
EPB	PT'S FEEDING RCP POWER MONITOR					X	X

SYSTEM	EQUIPMENT	EMERG. LIGHTING AT EQUIP[3]			EMERG. LIGHTING FOR ACCESS TO EQUIP[4]		
		8-HR BATTERY	EMERG. AC	EMERG. DC	8-HR BATTERY	EMERG . AC	EMERG . DC
EPC	4160 SWITCHGEAR GROUP 1ETA, 1ETB	X	X	X	X	X	X
	4160 SWITCHGEAR GROUP 2ETA, 2ETB	X	X	X	X	X	X
EPE	600V LOAD CENTER 1ELXA, 2ELXA	X	X	X	X	X	X
	600V LOAD CENTER 1ELXB, 2ELXB	X	X	X	X	X	X
	600V LOAD CENTER 1ELXC, 2ELXC	X	X	X	X	X	X
	600V LOAD CENTER 1ELXD, 2ELXD	X	X	X	X	X	X
	600V MCC 1EMXA, 2EMXA	X			X	X	X
	600V MCC 1EMXB, 2EMXB	X			X	X	X
	600V MCC 1EMXC, 2EMXC	X	X	X	X	X	X
	600V MCC 1EMXD, 2EMXD	X			X	X	X
	600V MCC 1EMXE, 2EMXE	X			X	X	X
	600V MCC 1EMXF, 2EMXF	X	X	X	X	X	X
	600V MCC 1EMXG		X	X	X	X	X
	600V MCC 2EMXH						
	600V MCC 1EMXI, 2EMXI	X			X	X	X
	600V MCC 1EMXJ, 2EMXJ	X			X	X	X

SYSTEM	EQUIPMENT	EMERG. LIGHTING AT EQUIP[3]			EMERG. LIGHTING FOR ACCESS TO EQUIP[4]		
		8-HR BATTERY	EMERG. AC	EMERG. DC	8-HR BATTERY	EMERG . AC	EMERG . DC
	600V MCC 1EMXK, 2EMXK	X	X	X	X	X	X
	600V MCC 1EMXL, 2EMXL	X			X	X	X
	600V MCC 1EMXO	X			X		
	600V MCC 2EMXP				X		
	600V MCC 1EMXQ, 2EMXQ	X			X		
	600V MCC 1EMXR, 2EMXR	X			X		
EPG	STATIC INVERTER 1EIA, 2EIA		X	X		X	X
	STATIC INVERTER 1EIB, 2EIB					X	X
	STATIC INVERTER 1EIC, 2EIC		X	X		X	X
	STATIC INVERTER 1EID, 2EID		X	X		X	X
	STATIC INVERTER 1EIE, 2EIE		X	X		X	X
	STATIC INVERTER 1EIF, 2EIF		X	X		X	X
	POWER PANEL 1ERPA, 2ERPA		X	X		X	X
	POWER PANEL 1ERPB, 2ERPB					X	X
	POWER PANEL 1ERPC, 2ERPC					X	X
	POWER PANEL 1ERPD, 2ERPD		X	X		X	X
EPL	BATTERY CHARGER 1ECA, 2ECA		X	X		X	X
	BATTERY CHARGER 1ECB, 2ECB					X	X
	BATTERY CHARGER 1ECC, 2ECC					X	X
	BATTERY CHARGER 1ECD, 2ECD					X	X

SYSTEM	EQUIPMENT	EMERG. LIGHTING AT EQUIP[3]			EMERG. LIGHTING FOR ACCESS TO EQUIP[4]		
		8-HR BATTERY	EMERG. AC	EMERG. DC	8-HR BATTERY	EMERG . AC	EMERG . DC
	BATTERY 1EBA, 2EBA					X	X
	BATTERY 1EBB, 2EBB					X	X
	BATTERY 1EBC, 2EBC					X	X
	BATTERY 1EBD, 2EBD					X	X
	DC DISTR.CENTER 1EDA, 2EDA					X	X
	DC DISTR.CENTER 1EDB, 2EDB					X	X
	DC DISTR.CENTER 1EDC, 2EDC					X	X
	DC DISTR.CENTER 1EDD, 2EDD					X	X
	DC PANELS 1EPA-1EPD					X	X
	DC PANELS 2EPA-2EPD					X	X
	DC SPARE CHGR. DISTR. CTR 1EDS, 2EDS					X	X
	SPARE CHGR. 600V AC POWER PNL 1EMS, 2EMS					X	X
	AUCTIONEERING D10DES 1EADA, 2EADA	X	X	X	X	X	X
	AUCTIONEERING D10DES 1EADB, 2EADB	X	X	X	X	X	X
	DC DISTR. CENTER 1EDE, 2EDE	X	X	X	X	X	X
	DC DISTR. CENTER 1EDF, 2EDF	X	X	X	X	X	X

		EMERG. LIGHTING AT EQUIP[3]			EMERG. LIGHTING FOR ACCESS TO EQUIP[4]		
SYSTEM	**EQUIPMENT**	**8-HR BATTERY**	**EMERG. AC**	**EMERG. DC**	**8-HR BATTERY**	**EMERG . AC**	**EMERG . DC**
EPQ	DIESEL GENERATOR BATTERIES 1DGBA&B, 2DGBA&B	X	X	X	X	X	X
	BATTERY CHARGER 1DGCA&B, 2DGCA&B	X	X	X	X	X	X
	AUCT.DIODES 1VADA, 2VADA	X	X	X	X	X	X
	AUCT.DIODES 1VADB, 2VADB	X	X	X	X	X	X
	DISTR. CTR. 1DGA&B, 2DGA&B	X	X	X	X	X	X
EPY	TRANSFORMER 1EKTG		X	X	X	X	X
	TRANSFORMER 2EKTH		X	X	X	X	X
	TRANSFORMER 1EKTB,	X			X	X	X
	1EKTI, 2EKTB, 2EKTI	X			X	X	X
EQA	EMERG.DIESEL GENERATOR	X	X	X	X	X	X
EQC	DIESEL GEN.CONTROL PANELS 1A, 1B, 2A, 2B (INCLUDES EXCITATION VOLTAGE REG.)	X	X	X	X	X	X
	DIESEL ENGINE CONTROL PANELS 1A, 1B, 2A, 2B	X	X	X	X	X	X
	Deleted Per 2012 Update.						
ERN	DIESEL GEN. GROUND TRANSFORMERS	X	X	X	X	X	X
	DIESEL GEN. RESISTOR BOXES	X	X	X	X	X	X
	DIESEL GEN. SURGE PACKS	X	X	X	X	X	X

SYSTEM	EQUIPMENT	EMERG. LIGHTING AT EQUIP[3] 8-HR BATTERY	EMERG. LIGHTING AT EQUIP[3] EMERG. AC	EMERG. LIGHTING AT EQUIP[3] EMERG. DC	EMERG. LIGHTING FOR ACCESS TO EQUIP[4] 8-HR BATTERY	EMERG. LIGHTING FOR ACCESS TO EQUIP[4] EMERG . AC	EMERG. LIGHTING FOR ACCESS TO EQUIP[4] EMERG . DC
	DIESEL GEN. GROUND CT'S	X	X	X	X	X	X
	DIESEL GEN. RELAY CABINETS 1EATC14, 15, 2EATC14, 15	X	X	X	X	X	X
EWA	CABLE ROOM CABLE SUPPORT SYS					X	X
EWB	BATTERY ROOM CABLE SUPPORT SYS					X	X
EZA	ELECTRICAL PENETRATIONS					X	X
N/A	AREA TERMINAL CABINETS 1EATC1-1EATC19				X	X	X
	2EATC1-2EATC19				X	X	X
	AREA TERMINAL BOXES 1T BOX 1-27					X	X
FD	DIESEL GENERATOR FUEL OIL DAY TANKS	X	X	X	X	X	X
	DIESEL GENERATOR FUEL OIL BOOSTER PUMPS	X	X	X	X	X	X
	DIESEL GENERATOR FUEL RELIEF VALVES	X	X	X	X	X	X
IPE	REACTOR PROT. SYS. SOLID STATE PROT SYS RACKS	X			X	X	X
	AUX. SAFEGUARD CABINET AUX. SHUTDOWN PANELS 1A, 1B	X	X	X	X	X	X

SYSTEM	EQUIPMENT	EMERG. LIGHTING AT EQUIP[3]			EMERG. LIGHTING FOR ACCESS TO EQUIP[4]		
		8-HR BATTERY	EMERG. AC	EMERG. DC	8-HR BATTERY	EMERG . AC	EMERG . DC
ISE	ESF TEST CABINET				X	X	X
ITE	TURBINE TERMINAL BOX A, B, D, EESF TEST CABINET					X	
KC	COMPONENT COOLING WTR. PUMPS	X			X	X	X
	COMPONENTS COOLING HEAT EXCH.	X			X	X	X
	COMPONENT COOLING SURGE TK.					X	X
KD	DIESEL GEN. COOLING WTR. HEAT EXCH.				X	X	X
	DIESEL GEN JACKET WTR. PUMPS				X	X	X
	DIESEL GEN JACKET WTR. STANDPIPE				X	X	X
KF	SPENT FUEL COOLING PUMPS					X	X
	SPENT FUEL COOLING HEAT EXCH					X	X
	SPENT FUEL COOLING PUMP SUCTION STRAINERS					X	X
LD	DIESEL GENERATOR LUBE OIL FILTERS	X			X	X	X
	DIESEL GENERATOR LUBE OIL COOLERS	X			X	X	X

SYSTEM	EQUIPMENT	EMERG. LIGHTING AT EQUIP[3]			EMERG. LIGHTING FOR ACCESS TO EQUIP[4]		
		8-HR BATTERY	EMERG. AC	EMERG. DC	8-HR BATTERY	EMERG . AC	EMERG . DC
	DIESEL GENERATOR LUBE OIL RELIEF VLVs	X			X	X	X
	DIESEL GENERATOR LUBE OIL HEAT EXCH	X			X	X	X
	DIESEL GENERATOR LUBE OIL SUMP TK	X			X	X	X
NB	BORON RECYCLE EVAP FEED PUMPS					X	X
	BORON RECYCLE HOLDUP TANK					X	X
	BORON RECYCLE EVAP FEED FILTERS					X	X
	BORON RECYCLE STRIPPING COLUMN					X	X
ND	RESIDUAL HEAT REMOV. PUMPS	X			X	X	X
	RESIDUAL HEAT REMOV. HEAT EXCH	X			X	X	X
NI	SAFETY INJECTION PUMPS	X			X	X	X
	SAFETY INJ ACCUMULATORS					X	X
NM	NUCLEAR SAMPLING DELAY COIL [6]				X		
	NUCLEAR SAMPLING VLV. OPER. PNL				X		
NS	CONTAINMENT SPRAY PUMPS					X	X

SYSTEM	EQUIPMENT	EMERG. LIGHTING AT EQUIP[3]			EMERG. LIGHTING FOR ACCESS TO EQUIP[4]		
		8-HR BATTERY	EMERG. AC	EMERG. DC	8-HR BATTERY	EMERG . AC	EMERG . DC
	CONTAINMENT SPRAY HEAT EXCH					X	X
NV	CHEMICAL AND VOLUME CONTROL CHARGING PUMPS					X	X
	CHEMICAL AND VOLUME CONTROL BORIC ACID TRANSFER PUMPS						
	CHEMICAL AND VOLUME CONTROL LETDOWN HEAT EXCH	X			X	X	X
	CHEMICAL AND VOLUME TANK					X	X
	CHEMICAL AND VOLUME CONTROL BORIC ACID TANK					X	X
RF	FIRE PROT DIESEL ROOM CONTROL PANEL	X			X	X	X
SM	MAIN STEAM ISOLATION VLVS.					X	X
SV	MAIN STEAM ISOLATION VLVS. RELIEF VLVS.					X	X
VA	AUX. BLDG. VENT SYS. FITERS.					X	X
VC	CONTROL BLDG. VENT SYS FAN					X	X
	CONTROL BLDG. VENT SYS FILTERS					X	X
	CONTROL BLDG. VENT SYS AIR HANDLING UNITS					X	X

		EMERG. LIGHTING AT EQUIP[3]			EMERG. LIGHTING FOR ACCESS TO EQUIP[4]		
SYSTEM	**EQUIPMENT**	**8-HR BATTERY**	**EMERG. AC**	**EMERG. DC**	**8-HR BATTERY**	**EMERG . AC**	**EMERG . DC**
	CONTROL BLDG VENT SYS HVAC AUX RELAY CAB. A&B					X	X
VD	DIESEL BLDG. VENT FANS				X	X	X
	DIESEL BLDG. VENT FILTERS				X	X	X
	DIESEL BLDG. VENT DAMPERS				X	X	X
VP	CONTAINMENT PURGE VENT SYS ISOLATION VALVES					X	X
WG	WASTE GAS COMPRESSOR PKG.					X	X
	WASTE GAS TANKS					X	X
`	WASTE GAS HYDROGEN RECOMBINERS					X	X
WL	LIQUID WASTE SYS. DRAIN TK.				X	X	X
	RHR & CS ROOM SUMP						
WN	DIESEL GEN ROOM SUMPS				X	X	X
	DIESEL GEN ROOM SUMPS PUMP PANELS				X	X	X
WS	SPENT RESIN STORAGE TK						
YC	CONTROL AREA CHILLER COMPRESSOR CRA-C-1, 2 PANELS				X	X	X

		EMERG. LIGHTING AT EQUIP[3]			EMERG. LIGHTING FOR ACCESS TO EQUIP[4]		
SYSTEM	EQUIPMENT	8-HR BATTERY	EMERG. AC	EMERG. DC	8-HR BATTERY	EMERG . AC	EMERG . DC

Notes:

1. Equipment listing taken from "Nuclear Safety Related Structures, Systems, and Components".
2. Listing does not contain equipment located in reactor bldgs.
3. Listed lighting is located in close proximity to equipment listed.
4. Listed lighting is located in corridors/areas outside rooms, alcoves, etc. that equipment is located in.
5. The emergency 8 hour battery lights list given in this table isn ot intended to be a list of NRC committed Post Fire Safe Shutdown Emergency Lighting. See Table 9-36 for a complete list of NRC committed Post Fire Safe Shutdown Emergency Lights.
6. The delay coil has been abandoned in place per EC 112660 (U-1) and EC 112663 (U-2) based on ALARA dose considerations.

Table 9-36. Lighting for Post-Fire Alternate Shutdown Utilizing the Standby Shutdown System

Building	Elevation	Column	Light Unit	Coverage
AB	543	AA/51-52	210	Turbine Driven CA Pump
AB	543	AA/62-63	253	Turbine Driven CA Pump
AB	543	AA/62-63	254	Aisle
AB	543	AA-BB/51	7	Turbine Driven CA Pump
AB	543	AA-BB/63	61	Turbine Driven CA Pump
AB	543	BB/51	192	Aisle
AB	543	BB/52	48	Aisle/RC Temp Control Box
AB	543	BB/62	100	Feedwater Pump Panels
AB	543	BB/65	63	Area
AB	543	BB-CC/49-50	284	1CA36/1CA64/Area
AB	543	BB-CC/61-62	101	Aisle
AB	543	CC/52-53	191	Aisle
AB	543	CC/61-62	165	Aux. FW Pump Turb PNL
AB	543	CC/62	252	Aisle
AB	543	CC/63	287	2CA64/2CA36
AB	543	CC-DD/52	47	Stairs
AB	543	CC-DD/61-62	102	Stairs
AB	543	DD/52-53	208	Aisle/1CA52
AB	543	DD-EE/53-54	209	Aisle/1CA48
AB	543	DD-EE/60-61	251	Aisle/2CA48
AB	543	EE/52-53	207	Aisle
AB	543	EE/61-62	247	Aisle/2CA52
AB	543	FF/52-53	206	Aisle
AB	543	FF/61-62	246	Aisle
AB	543	FF-GG/59-60	250	Stairs
AB	543	FF-GG/61	248	Aisle
AB	543	GG/52-53	205	Aisle
AB	543	GG/56	218	Aisle
AB	543	GG/59-60	249	Aisle
AB	543	GG/61-62	244	Aisle

Building	Elevation	Column	Light Unit	Coverage
AB	543	GG/61-62	245	Aisle
AB	543	HH/52	204	Aisle
AB	543	HH/62	97	2VQ13/2VQ15B
AB	543	HH/62	242	Aisle
AB	543	HH/62	243	Aisle
AB	543	JJ/51	203	Aisle
AB	543	JJ/63	241	Aisle
AB	543	JJ-KK/50-51	224	Aisle
AB	543	JJ-KK/63-64	240	Aisle
AB	543	KK/50	202	Aisle
AB	543	KK-LL/50-51	68	Aisle
AB	543	KK-LL/63-64	238	Aisle
AB	543	KK-LL/63-64	239	Aisle
AB	543	MM-NN/50-51	201	Aisle
AB	543	MM-NN/63-64	237	Aisle
AB	543	PP/50-51	200	Stairs
AB	543	PP/63-64	236	Stairs
AB	554	BB/54	234	Aisle
AB	554	BB/60	278	Aisle
AB	554	CC/61	277	Aisle
AB	560	AA/49-50	16	1ETB
AB	560	AA/64	260	2ETB11/2ETB12
AB	560	AA/65	110	2ETB/2ELXB
AB	560	AA-BB/61-62	263	Aisle
AB	560	BB/46	15	Aisle/1EMXL F09A
AB	560	BB/46	230	Aisle
AB	560	BB/49	229	Aisle
AB	560	BB/51	14	Aisle/1ETB12/1ETB13
AB	560	BB/51	228	Aisle
AB	560	BB/52-53	226	Aisle
AB	560	BB/63	111	Aisle/2ETB
AB	560	BB/63	261	Aisle

Building	Elevation	Column	Light Unit	Coverage
AB	560	BB/65	259	Aisle
AB	560	BB/68	258	Aisle
AB	560	BB/69	109	Aisle
AB	560	CC-DD/52	17	Stairs
AB	560	CC-DD/52-53	227	Stairs
AB	560	CC-DD/61-62	112	Stairs
AB	560	CC-DD/61-62	262	Aisle
AB	560	FF-GG/59	257	Stairs
AB	560	GG/55	164	1EMXJ/1EMXB
AB	560	GG/59	160	2EMXJ/2EMXB
AB	560	GG/59	161	Area/Door
AB	560	HH/55	85	Comp. Cooling PMP Area
AB	560	HH/57	163	KC Pump 1B1/Door
AB	560	HH/58	162	Area
AB	560	PP/50-51	199	Stairs
AB	560	PP/63-64	256	Stairs
AB	568	FF-GG/59	159	Stairs
AB	574	BB/61	279	Aisle
AB	574	BB-CC/54	180	Aisle
AB	574	CC/61	181	Aisle
AB	577	AA/49	22	1EMXS/1ETA
AB	577	AA/50	194	Aisle/1ETA
AB	577	AA/61-62	189	Aisle
AB	577	AA/64	267	2ETA12/2ETA13
AB	577	AA/65	119	Aisle/2EMXS
AB	577	AA/67	266	Aisle
AB	577	AA-BB/45	193	Aisle
AB	577	AA-BB/52	185	Aisle
AB	577	AA-BB/62	118	Aisle/2ETA
AB	577	AA-BB/69	265	Aisle/SSS Disconnect Cubicle
AB	577	BB/46	21	Aisle/1EMXK F09A
AB	577	BB/46	184	Aisle

Building	Elevation	Column	Light Unit	Coverage
AB	577	BB/51	20	Aisle
AB	577	BB/51	183	Aisle
AB	577	BB/63	187	Aisle
AB	577	BB/65	268	Aisle
AB	577	BB/68	188	Aisle
AB	577	BB/68-69	120	2ELXC/2ETXE
AB	577	CC-DD/52	23	Stairs
AB	577	CC-DD/52-53	182	Aisle
AB	577	CC-DD/61-62	117	Stairs
AB	577	DD/62	186	Aisle
AB	577	FF/58	155	Component Cooling Pump 2A1/2A2
AB	577	FF-GG/59-60	153	Stairs
AB	577	GG/57	156	Area
AB	577	GG/60	154	Door/Area
AB	577	PP/50-51	198	Stairs
AB	577	PP/63-64	264	Stairs
AB	594	AA-BB/57	35	Aisle/Control Boards
AB	594	BB/49	27	Area
AB	594	BB/51	28	Aisle
AB	594	BB/51	29	Aisle
AB	594	BB/55	168	Aisle
AB	594	BB/59	171	Area
AB	594	BB/63	148	Aisle/AX656B Switchgear
AB	594	BB/63	149	Aisle/AX656B Switchgear
AB	594	CC/51	231	Aisle/Reactor Trip
AB	594	CC/56	167	Aisle
AB	594	CC/58	170	Aisle
AB	594	CC/62	147	Stairs
AB	594	CC/63	275	Aisle/Reactor Trip
AB	594	CC/63	276	Aisle/Reactor Trip
AB	594	CC-DD/52	31	Stairs
AB	594	CC-DD/54	169	1PCC7/1PCC8

Building	Elevation	Column	Light Unit	Coverage
AB	594	CC-DD/60	172	2PCC7/2PCC8
AB	594	DD/51-52	190	Aisle
AB	594	DD/53-54	143	Aisle
AB	594	DD/60-61	146	Aisle
AB	594	DD/62	283	Ladder/2CA54B
AB	594	DD-EE/52	225	Aisle/1CA54B
AB	594	DD-EE/55	144	Aisle
AB	594	DD-EE/58	145	Aisle
AB	594	EE/62	280	Area
AB	594	FF/53-54	211	Aisle
AB	594	FF-GG/60-61	150	Aisle
AB	594	GG/54	212	Aisle
AB	594	GG/61-62	273	Aisle
AB	594	GG-HH/60	151	Aisle
AB	594	HH/53	213	Aisle
AB	594	JJ/61	272	Aisle
AB	594	JJ-KK/53	214	Aisle
AB	594	KK-LL/62	271	Aisle
AB	594	MM/51	216	Aisle
AB	594	MM/52	215	Aisle
AB	594	MM/61	270	Aisle
AB	594	NN/63	269	Aisle
DH	594	EE/43	80	Area
DH	594	EE/43	82	Area
DH	594	EE/43	285	1CA38A/1CA66B
DH	594	EE/43-45	286	Area
DH	594	EE/71	139	Area
DH	594	EE/71	140	Area
DH	594	EE-70	288	2CA66B/2CA38A
DH	594	EE-70	289	Stairs/Aisle
DH	618	EE/52-53	232	Aisle/Ladder/1SA4
DH	618	EE/52-53	233	Aisle/Ladder/1SA4

Building	Elevation	Column	Light Unit	Coverage
DH	618	EE/61-62	281	Aisle/Ladder/2SA4
DH	618	EE/61-62	282	Aisle/Ladder/2SA4
SRV	574	V/37	178	Area
SRV	584	V/36	175	Stair
SRV	594	U/34-35	174	Aisle
SSF	601	A/2-4	SSF5	Aisle
SSF	601	A-B/4	SSF6	Aisle/Diesel Generator
SSF	601	B/6	SSF7	Aisle
SSF	601	B-C/2	SSF4	Aisle
SSF	601	B-C/4	SSF3	Aisle
SSF	601	B-C/8	SSF1	Aisle/SSS Control Console
SSF	601	C/6	SSF2	Aisle/SSS Control Console
TB	594	1C/17	56	6.9KV SWGR. RMS.
TB	594	1D/17	57	6.9KV SWGR. RMS.
TB	594	1L/17	54	6.9KV SWGR. RMS.
TB	594	1M/17	55	6.9KV SWGR. RMS.
TB	594	2C/17	124	SWITCHGEAR
TB	594	2D/17	123	SWITCHGEAR
TB	594	2L/17	126	SWITCHGEAR
TB	594	2M/17	125	SWITCHGEAR

Notes:

1. AB Auxiliary Building
2. DH Doghouse
3. SRV Service Building
4. SSF Standby Shutdown Facility
5. TB Turbine Building

Table 9-37. Diesel Generator Engine Fuel Oil System Single Failure Analysis

COMPONENT	FAILURE MODE/ CAUSE	EFFECTS	DETECTION METHOD	REMARKS
Fuel Oil Transfer Valve	Fails open/material failure or solenoid failure	No adverse effect on system performance	High level alarm in day tank	Level rises in day tank until it enters the day tank vent pipe and eventually reaches an equilibrium level well below the top of the vent.
	Fails closed/material or solenoid failure	Low level in day tank	Low level alarm in day tank	Transfer valve can be manually bypassed. One hour of fuel is available in day tank. Redundant diesel remains operable.
Fuel Oil Transfer Piping and Day Tank	Line break or tank rupture/ corrosion or mechanical damage	Loss of fuel or limited fuel	Low level alarm in day tank	Redundant diesel remains operable.
Day Tank Level Control	Fails to function/material, mechanical or electrical failure	Low level in day tank	Low level alarm in day tank	Transfer valve can be manually bypassed. One hour of fuel is available in day tank. Redundant diesel remains operable.
Fuel Oil Booster Pump Strainer	Clogged/Accumulation of dirt and debris	Low fuel oil supply pressure	High differential pressure alarm	Strainer is duplex type and flow can be manually diverted from the clogged strainer to the clean strainer.
Fuel Oil Booster Pump	Fails to start/mechanical or electrical failure or damage	No fuel to engine, engine fails to start	Low pressure alarm	Redundant diesel remains operable.
Fuel Oil Filter	Clogged/Accumulation of dirt and debris	Low fuel oil supply pressure	High differential pressure alarm	Redundant diesel remains operable.

COMPONENT	FAILURE MODE/ CAUSE	EFFECTS	DETECTION METHOD	REMARKS
Vents to Atmosphere	Failed due to tornado missiles	Eventual loss of fuel oil flow to engine	Low pressure alarm	Redundant diesel remains operable.

Table 9-38. Deleted Per 2004 Update

Table 9-39. Diesel Generator Engine Cooling Water System Single Failure Analysis

COMPONENT	FAILURE MODE/ CAUSE	EFFECTS	DETECTION METHOD	REMARKS
Engine-Driven Jacket Water Circulation Pump	Fails to function/mechnanical failure or damage	Loss of cooling water flow to engine leading to eventual shutdown	Low pressure alarm	Redundant diesel remains operable.
Temperature Control Valve	Fails open/mechanical failure	Continuous flow through jacket water cooler - low system temperature	Low temperature alarm	Diesel continues to run but with less efficiency.
	Fails closed/mechanical failure	All flow through by - pass, no flow to cooler - temperature rise leading to eventual shutdown	High temperature alarm	Redundant diesel remains operable.
Jacket Water Standpipe	Leaks/Mechanical failure due to corrosion	Low water level in standpipe	Low level alarm	Manual makeup from demineralized water system.
Jacket Water Cooler	Leaks/Mechanical failure due to corrosion or ruptures	Low level in standpipe, loss of NPSH to circulation pump, loss of flow to engine leading to eventual shutdown	Low level alarm standpipe	Redundant diesel remains operable.
Jacket Water Piping	Leaks or ruptures in piping including tube-sides of tube oil cooler, governor oil cooler, engine intercooler	Low level in standpipe, loss of flow to engine, temperature rise in Cooliing water, lube oil, and combustion air leading to eventual shutdown	Low level alarm standpipe	Redundant diesel remains operable.
Jacket Water Heater or Keep Warm Pump	Inoperable/mechanical or electrical failure	Drop in cooling water temperature below optimum starting temperature (140°F)	Low temperature alarm	Redundant diesel maintains readiness at proper temperature.

Table 9-40. Diesel Generator Engine Cooling Water System Alarm and Shutdown Setpoints

PARAMETER	ALARM SETPOINT	SHUTDOWN SETPOINT
Pressure:		
Low Jacket Water Inlet Pressure	10 PSIG	
Temperature:		
High Temp Aftercooler Inlet	165°F	
Low Temp H_2O Engine Inlet	140°F	
High Temp H_2O Engine Inlet	175°F	
Low Temp H_2O Engine Outlet	140°F	
High Temp H_2O Engine Outlet	190°F	200°F
Level:		
Low Level Jacket Water Standpipe	176 Inches Above Tank Bottom	

Table 9-41. Diesel Generator Engine Starting Air System Single Failure Analysis

COMPONENT	FAILURE MODE/ CAUSE	EFFECTS	DETECTION METHOD	REMARKS
Starting Air Compressor	Fails to function/mechanical or electrical failure or damage	Low air pressure in system	Low pressure alarm	Redundant compressor on the same diesel remains operable. Redundant diesel remains operable.
Starting air Aftercooler	Leaks/mechanical failure due to corrosion or ruptures	Low air pressure in system	Low pressure alarm	Redundant aftercooler on the same diesel remains operable. Redundant diesel remains operable.
Starting Air Dryer	Leaks due to corrosion or control system failure	Low air pressure in system	Low pressure alarm	Redundant air dryer on the same diesel remains operable. Redundant diesel remains operable.
Starting Air Tanks	Leaks/mechanical failure due to corrosion	Low air pressure in system	Low pressure alarm	Redundant air tank on the same diesel remains in service. Redundant diesel remains operable.
Starting Air Solenoid Valves	Fails open/material or electrical failure	Starting air tank bleeds down through open valve	Low pressure alarm	Redundant air tank on the same diesel remains in service. Redundant diesel remains operable.
	Fails closed/material or electrical failure	Loss of associated starting air train	None	Redundant starting air train on same diesel remains in service. Redundant diesel remains operable.

COMPONENT	FAILURE MODE/ CAUSE	EFFECTS	DETECTION METHOD	REMARKS
Starting Air Piping	Line break upstream of check valves 1VG29, 1VG30, 1VG31, and 1VG32 (Figure 9-183) and check valves 1VG73, 1VG74, 1VG75, and 1VG76 (Figure 9-184)/ Mechanical failure due to corrosion or ruptures	Loss of associated starting air train	Low pressure alarm	Redundant starting air train on same diesel remains in service. Redundant diesel remains operable.
	Line break down stream of check valves 1VG29, 1VG30, 1VG31, and 1VG32 (Figure 9-183) and check valves 1VG73, 1VG74, 1VG75, and 1VG76 (Figure 9-184) Mechanical failure due to corrosion or ruptures	Starting air tanks bleed down	Low pressure alarm	Redundant diesel remains operable.
Starting Air Governor Oil Pressure Boost Cylinder	Fails to function/mechanical or pneumatic failure	Time required to start diesel will increase	None	Diesel remains operable. Redundant diesel remains operable.
Starting Air Distributors	One air distributor fails to function/mechanical failure	None	None	Redundant air distributor on the same diesel remains operable. Redundant diesel remains operable.
	Both air distributors fail to function/mechanical failure	Engine start capability is lost	None	Redundant diesel remains operable.

Table 9-42. Diesel Generator Engine Lube Oil System Single Failure Analysis

COMPONENT	FAILURE MODE/ CAUSE	EFFECTS	DETECTION METHOD	REMARKS
Engine-Driven Lube Oil Pump	Fails to function/ mechanical failure or damage	No oil flow to engine leading to high bearing temperatures and eventual shutdown	Low pressure alarm	Redundant diesel remains operable.
Lube Oil Cooler	Leaks/Mechanical failure due to corrosion or ruptures	Reduction in oil flow to engine, increase in bearing temperature	Low pressure alarm or high bearing temperature alarm	Redundant diesel remains operable.
Lube Oil Filter (Duplex)	Clogged/Accumulation of dirt and debris	Reduction in oil flow to engine	High differential pressure alarm	Filter is duplex type and flow can be manually diverted from the clogged filter to the clean filter. Cannot be bypassed.
Lube Oil Strainer	Clogged/Accumulation of dirt and debris	Reduction in oil flow to engine	High differential pressure alarm	Strainer is duplex type and flow can be manually diverted from the clogged strainer to the clean strainer.
Lube Oil Heaters	Electrical failure	Low oil temperature; diesel may not start within acceptable time frame	Low temperature alarm	Redundant diesel maintains readiness at proper temperature.
Prelube Oil Pump	Fails to function/mechanical or electrical failure or damage	Low oil temperature; diesel may not start within acceptable time frame	Low temperature alarm	Redundant diesel maintains readiness at proper temperature.
Prelube Oil Filter or Strainer	Clogged/Accumulation of dirt and debris	Reduction in standby oil flow through engine; diesel may not start within acceptable time frame	Low temperature alarm	Redundant diesel maintains readiness at proper temperature.
Lube Oil Piping	Line break/corrosion or damage	Loss of oil flow to engine	Low pressure or low temperature alarm	Redundant diesel remains operable.

Table 9-43. Diesel Generator Engine Lube Oil System Alarm and Shutdown Setpoints

Parameter	Alarm Setpoint	Shutdown Setpoint
Pressure:		
Full Flow Lube Oil Duplex Strainer High Differential Pressure	20 PSID	
Full Flow Lube Oil Duplex Filter High Differential Pressure	20 PSID	
Low Engine Lube Oil Pressure	40 PSIG	30 PSIG[1]
Low Turbocharger (RH) Lube Oil Pressure	20 PSIG	15 PSIG
Low Turbocharger (LH) Lube Oil Pressure	20 PSIG	15 PSIG
High Crankcase Pressure		5 in - H^2O
Temperature:		
Low Temperature Lube Oil Engine Inlet	140°F	
High Temperature Lube Oil Engine Inlet	175°F	
Low Temperature Lube Oil Engine Outlet	140°F	
High Temperature Lube Oil Engine Outlet	190°F	200°F
High Temperature Engine Main Bearings		228°F

Note:

1. Low-low lube oil pressure trip will automatically shutdown diesel regardless of operating mode.

Table 9-44. Diesel Generator Engine Intake and Exhaust System Single Failure Analysis

Component	Failure Mode/ Cause	Effects	Detection Method	Remarks
Intake Filter	Blockage/Accumulation of dirt and debris	Reduction in air flow to engine	High exhaust gas temperature	Redundant diesel remains operable.
Silencer	Blockage/Accumulation of dirt and debris	Reduction in air flow to engine	High exhaust gas temperature	Redundant diesel remains operable.
	Ruptured/Mechanical Failure due to cracks or corrosion	Excessive noise, loss of outdoor intake air	Excessive noise in diesel building	Engine remains operable.
Intake Air Pipes And Flexible Hose	Blockage/Accumulation of dirt and debris	Reduction in air flow to engine	High exhaust gas temperature	Redundant diesel remains operable.
	Ruptured/Mechanical Failure due to cracks or corrosion	Excessive noise, loss of outdoor intake air	Excessive noise in diesel building	Engine remains operable.
Turbocharger	Loss of air supplied mechanical failure of compressor or turbine	Reduced or no air flow	High exhaust gas temperature or stopping of engine	Redundant diesel remains operable.
Aftercooler	Leaks/Mechanical failure due to cracks or corrosion	Loss of adequately cooled air	Loss of engine power output	Redundant diesel remains operable.
Exhaust Gas Pipe And Flexible Coupling	Blockage/Accumulation of dirt and debris	Engine slows or stops	Stopping of engine	Redundant diesel remains operable.
	Ruptured/Mechanical failure due to cracks or corrosion	Excessive noise, exhaust gas inside diesel building	Excessive noise in diesel building	Engine remains operable.
Exhaust Silencer	Blockage	Engine slows or stops	Stopping of engine	Redundant diesel remains operable.
	Ruptured	Excessive noise, exhaust gas inside diesel building	Excessive noise inside building	Engine remains operable.

Table 9-45. Comparison of VQ System to BTP CSB 6-4

BTP	Disposition
1a.	Actuators will close the containment isolation valves assuming full containment pressure differential and resultant flow.
b.	The system as shown in Figure 9-194 contains only one supply and one return line.
c.	The lines are nominal 4" pipe.
d.	The design of the containment penetrations is listed in Table 6-74 and Table 6-77.
e.	The containment isolation valves close on receipt of a "T" signal (phase A isolation). One of the parameters that can initiate a "T" signal is high containment airborne activity (see Figure 7-2, page 10).
f.	The containment isolation valves close within 5 seconds.
g.	The pipes which connect the containment isolation valves with the containment is Duke Class F (i.e., ANSI B31.1 pipe, seismically qualified). The pipes are open to upper containment atmosphere which will afford virtually complete isolation from high energy pipe break generated debris. In addition, the opening of the pipes are covered by a 40 mesh screen that is held in place between a pair of flanges.
2.	This system is designed only to control containment pressure during normal operation.
3.	This system is not designed or used to purge the containment to reduce airborne activity.
4.	Provisions for testing of containment isolation valves during reactor operations exist.
5a.	See response to position 1.e. for valve closure signals. The amount of radiation that can realistically be expected to be released through this flow path is insignificant.
b.	The VQ system utilizes schedule 40 pipe which precludes rupture due to application of containment design pressure (15 psig). The only safety related equipment in the system are the containment isolation valves.
c.	If the system is in operation at the start of an accident the amount of air lost while the valves are closing is insignificant.
d.	An allowable leak rate for these valves will be developed in the type "C" test program.

Table 9-46. Groundwater Drainage System Component Design Parameters

AUXILIARY BUILDING GROUNDWATER DRAINAGE SUMP PUMPS	
Number both units	6
Type	Vertical
Design Capacity, GPM	300
Head at Design Flow, FT	90
Minimum Available NPSH, FT	30
Normal Operating Pressure, PSIG	40
Temperature of Pumped Fluid, °F	Ambient
TURBINE BUILDING GROUNDWATER DRAINAGE SUMP PUMPS	
Number both units	4
Type	Vertical
Design Capacity, GPM	300
Head at Design Flow, FT	65
Minimum Available NPSH, FT	30
Normal Operating Pressure, PSIG	25
Temperature of Pumped Fluid, °F	Ambient