Appendix 9A. Tables

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

1. Fuel Pool Cooling Pumps		
Number per unit	2	
Type	Centrifugal	
Design pressure, psig	155	
Design temperature, °F	200	
Material of construction	Stainless Steel	
Shutoff head, ft	345	
Design flow range, gpm	2310-2900	
2. Fuel Pool Cooling Heat Exchanger		
Number per unit	2	
Type	Straight tube, 2 passes	
Heat transfer rate at normal conditions, Btu/hr	15×10^6	
Estimated UA, Btu/hr F	1.25×10^6	
Shell Side Data:		
Design pressure, psig	150	
Design temperature, °F	200	
Pressure drop (Allow/calc), psi	12/9	
Nozzle size inches	10	
Material of construction	Carbon Steel	
Fluid circulated	Component cooling water	
Tube Side Data:		
Design pressure, psig	150	
Design temperature, °F	200	
Pressure drop (Allow/calc), psi	12/7	
Nozzle size inches	8	
Material of construction	Stainless Steel	
Fluid circulated	Fuel pool water	
Design Parameters:		
	Shell	Tube
Flow, gpm	2500	2900
Inlet temperature, °F	95	125
Outlet temperature, °F	107	110

3. Fuel Pool Cooling Pre-Filter	
Number per unit	1
Type	Disposable cartridge
Design pressure, psig	200
Design temperature, °F	215
Design flow, gpm (operating condition)	310
Pressure loss of design flow, psid	5 (Unfouled), 50(Fouled)
Material of construction	100 percent Stainless Steel
4. Fuel Pool Cooling Demineralizer	
Number per unit	1
Type	Flushable
Resin type	Nuclear Grade mixed bed (Contact Chemistry)
Design pressure, internal, psig	200
Design temperature, vessel, °F	200
Resin volume, ft^3	15-40
Vessel volume, ft^3	80
Bed depth, ft	1.0-2.5
Bed diameter, ft	4.5
Design flow, gpm	310
Resin bed and vessel pressure drop for 310 gpm flow, 40 cft (fouled condition) psid	35
Upper retention screen U.S., mesh	50
Material of construction	Stainless Steel
5. Fuel Pool Cooling Post-Filter	
Number per unit	1
Type	Disposable cartridge
Design pressure, psig	200
Design temperature, °F	215
Design flow, gpm (operating condition)	310
Pressure loss at design flow, psid	5 (Unfouled), 50(Fouled)
Material of construction	100 percent Stainless Steel
6. Fuel Pool Skimmer Strainer	
Number per unit	1

Type	Basket
Design temperature, °F	200
Design pressure, psig	20
Design flow, gpm	100
Pressure loss at design flow	negligible
Strainer perforations dia.	7/64"
Material of construction	Stainless Steel
7. Fuel Pool Skimmer Pump	
Number per unit	1
Type	Centrifugal
Design pressure, psig	45
Design temperature, °F	200
Material of construction	Stainless Steel
Design flow, gpm	100
Design head, ft	55
8. Fuel Pool Skimmer Filter	
Number per unit	1
Type	Disposable cartridge
Design pressure, psig	150
Design temperature, °F	215
Design flow, gpm	100
Pressure loss at design flow, psid	5 (Unfouled), 20(Fouled)
Material of construction	100 percent Stainless Steel

Table 9-2. Spent Fuel Cooling System Failure Analysis

Component	Failure	Comments and Consequences
1. Fuel pool cooling pump	Rupture of a pump casing	The casing and shell are designed for 155 psig and 200°F which equals or exceeds the maximum operating conditions. Pump can be isolated. Only one of the two pumps is required under normal conditions. The pump is located in the Auxiliary Building and protected against credible accidents. Rupture is considered unlikely.
2. Fuel pool cooling pump	Pump stops running and cannot be restarted	Under normal operating conditions only one pump is required and the backup pump is started. With maximum spent fuel stored in the fuel pool, the heat generated does not increase the fuel pool temperature beyond 200°F during the time required for maintenance or temporary arrangement to provide adequate cooling. Assured pool makeup water is provided by the Nuclear Service Water System.
3. Fuel pool cooling pump	Suction strainer plugs	Under normal conditions, standby pump and suction line are brought into operation. Strainer service or replacement is accomplished within an adequate period of time.
4. Fuel pool cooling heat exchanger	Tube or shell rupture	Rupture is considered unlikely. Heat exchanger can be isolated for maintenance. Only one of the two heat exchangers is required under normal conditions.
5. Fuel pool skimmer loop	Component failure	Spent fuel continues to be cooled by fuel pool cooling pumps and heat exchangers. Optical clarity of pool water may be decreased. Adequate time is available for restoration before unacceptable clarity is reached. Pool water can be clarified by passing it through the fuel pool cooling filter and demineralizer.
6. Fuel pool cooling purification loop	Component failure	Loop can be isolated from fuel pool cooling loop. Spent fuel continues to be cooled by the fuel pool cooling pumps and heat exchangers. Purity of pool water may be decreased until loop is restored. Adequate time is available for restoration before unacceptable impurity level is reached.
7. Fuel pool cooling loop	Pipe rupture	Fuel pool cannot be drained below level providing adequate shielding. Sufficient time is available for restoration of cooling. Assured pool makeup water is provided by the Nuclear Service Water System.

Table 9-3. Deleted Per 2008 Update

Table 9-4. Deleted Per 2008 Update

Table 9-5. Peak Heat Loads and Pool Temperatures for the McGuire Units 1 & 2 Spent Fuel Pools

Operating Condition			Pool Temperatures (F°)	
Case	**Heat Load (10^6 BTU/HR)**	**Cooling Trains Operating**	**Design Basis[1]**	**Calculated**
Normal Heat Load	20.8	2	120	116
	20.8	1	140	136
Maximum Heat Load	42.2	2	140	137
	42.2	1	<212	180

Note:

1. Thermal Hydraulic Analysis assumes a more conservative maximum of 150°F when the cooling system is operational. Structural calculations use a 140°F maximum.

Table 9-6. Time to Boiling Following Loss of Forced Cooling Under Design Basis Conditions for McGuire Units 1 & 2 Spent Fuel Pools

Heat Load (10^6 BTU/HR)	Initial Pool Temperature (°F)	Heat Up Time (HRS)
20.8	120	11.9
20.8	140	9.4
42.2	140	4.6

Table 9-7. Recirculated Cooling Water System-Component Design Parameters

Recirculated Cooling Water Pumps	
Manufacturer	Worthington
Type	Centrifugal
Number	3 per station
Design Flow Rate	2000 gpm
Design Head	160 Feet
Recirculated Cooling Water Heat Exchangers	
Manufacturer	American Standard
Type	Shell and Tube
Number	4 per station
Flow, shell/tube	1333 gpm/1667 gpm
Design Pressure, shell/tube	150 psig/50 psig
Design Temperature, shell/tube	125°F/80°F
Pressure drop, shell/tube	7.0 psi/2.0 psi
Recirculated Cooling Water Storage Tank	
Manufacturer	Midland Steel Corp.
Volume	15,000 gal.
Design Pressure	9.6 psig
Design Temperature	110°F

Table 9-8. Nuclear Service Water Flow Requirements (gpm per channel per Unit)

Component or Service	Normal	LOCA S Signal	LOCA P Signal	20 Hour Cooldown
1. Component Cooling Surge Tank Assured Makeup	0	50[1]	50[1]	0
2. Nuclear Service Water Pump Motor Cooler	40	40	40	40
3. Nuclear Service Water (RN) Strainer Supply Flow	400[.5]	400[5]	400[5]	400[5.]
4. Nuclear Service Water (RN) Strainer Backwash Discharge Flow	300	200	200	300
5. Diesel Generator Cooling (KD) Heat Exchanger	0	600	600	0
6. Component Cooling (KC) Pump Motor Cooler	40[7]	40[7]	40[7]	40[8]
7. Component Cooling (KC) Heat Exchanger	3800	3700	3700	4500[6]
8. Control, Cable and Equipment Room A/C (YC) Condenser	620[4]	640[3,4]	640[3,4]	620[4]
9. Fuel Pool (KF) Assured Makeup	0	86[1]	86[1]	0
10. E. S. Fan Coil Unit - Fuel Pool Cooling (KF) Pump/Motor	16	16	16	16
11. Containment Spray (NS) Heat Exchanger	0	0	3300	0
12. Centrifugal Charging (NV) Pump Bearing Oil Cooler	3	3	3	3
13. Centrifugal Charging (NV) Pump Speed Increaser Oil Cooler	7	7	7	7
14. Centrifugal Charging (NV) Pump Motor Cooler	30	30	30	30
15. E. S. Fan Coil Unit - Containment Spray (NS) Pump/Motor	0	0	26	0
16. E. S. Fan Coil Unit - Residual Heat Removal (ND) Pump/Motor	0	26	26	26
17. Safety Injection (NI) Pump Motor Cooler	0	20	20	0
18. Safety Injection (NI) Pump Bearing Oil Cooler	0	15	15	0

Component or Service	Normal	LOCA S Signal	LOCA P Signal	20 Hour Cooldown
19. Auxiliary Feedwater (CA) Pump Motor Cooler	0	30	30	30
20. Auxiliary Feedwater (CA) Assured Supply	0	1350[2]	560[2]	0
21. Reciprocating Charging Pump Bearing Oil Cooler	0	0	0	0
22. Reciprocating Charging Pump Fluid Drive Oil Cooler	0	0	0	0
23. Reactor Coolant (NC) Pump Motor Air Coolers	800	800	0	800
24. Diesel Generator Cooling Water (KD) Surge Tank Assured Makeup	0	30[1.]	30[1.]	0
25. Diesel Generator Starting Air Compressor After Coolers	25	25	25	25
Continuous Total Supply Required	5681	7542	9278	10977
Intermittent Total Supply Required	6081	8108	9844	11377
The following can be supplied by the RN System pump or RV System pumps, but always discharge into the NSW discharge lines, hence they are considered on Figure 9-31.				
1. Lower Containment Ventilation Units	2000	0	0	2000
2. Upper Containment Ventilation Units	540	0	0	540
3. Auxiliary and Fuel Building Ventilation Units	600	0	0	600
Continuous Total Discharge	8821	7542	9278	14117

Component or Service	Normal	LOCA S Signal	LOCA P Signal	20 Hour Cooldown

Notes:

1. Not normally used, so these numbers are not included in total.
2. 1350 gpm is a nominal value based on the nominal capacities of one Motor-Driven (450 gpm) Auxiliary Feedwater pump and the Turbine-Driven (900 gpm) Auxiliary Feedwater Pump, with the assumption that only one train of Nuclear Service Water is available to supply the pumps. 560 gpm is a nominal value based on the minimum flow for one Motor-Driven (200 gpm) Auxiliary Feedwater pump and the Turbine-Driven (360 gpm) Auxiliary Feedwater Pump.
3. This flow is supplied by either of the two units, but not both.
4. Flow through condenser modulated by self regulating refrigerant operated control valve. This valve does not receive an Ss or Sp signal and is always throttled.
5. Intermittent nominal value based on strainer operation.
6. Total flow of 9000 gpm is made up of 4500 gpm per train with two trains required.
7. Total flow of 40 gpm is made up of two KC pumps running per unit.
8. Total flow of 80 gpm is made up of two KC pumps running per unit with two units in service, i.e., four pump operations.

Table 9-9. Main Supply and Discharge Valve Position for Nuclear Service Water System

The following table lists valve positions as if both units were operating, and flow were required in both an A channel and a B channel. Only butterfly valves are listed, check valves can be assumed to be open in the direction of flow. The B channel of CCW supply has had all automatic isolation features removed. It is no longer an allowed configuration. See Figure 9-31.

All of the following valves are shared between units.

O = Open, C = Closed

Conditions	CCW Supply CCW Return	Lo-Level Supply CCW Return	Pond Supply Pond Return
Valve Nos.			
1RN1	O	O	O
0RN2 B	O	C	C
0RN3 A	O	C	C
0RN4 A,C	O	O	O
0RN5 B	C	C	C
0RN7 A	C	C	O
0RN9 B	C	C	O
0RN10 A,C	C	O	C
0RN11 B	C	O	C[1]
0RN12 A,C	C	O	C
0RN13 A	C	O	C[1]
0RN14 A Crossover	C	C	C
0RN15 B Crossover	C	C	C
0RN147 A,C	O	O	C
0RN148 A,C	O	O	C[1]
0RN149 A	C	C	O
0RN150 A Crossover	C	C	C
0RN151 B Crossover	C	C	C
0RN152 B	C	C	O
0RN283 A,C	O	O	C
0RN284 B	O	O	C
0RN301 A,C	O	O	O
0RN302 B	O	O	O

Note: These valves provide redundant isolation. During normal operation these valves are open, however, during abnormal or emergency operation these valves are closed.

Table 9-10. Nuclear Service Water System Component Design Data

	NUCLEAR SERVICE WATER PUMPS		
Quantity:	Unit 1:2 Unit 2:2 Total: 4		
Temperature:	Maximum	102°F	
	Operating	45°F - 70°F	
	Minimum	40°F	
	At NPSH available	90°F	
Capacity and Head	Design: Maximum: Minimum: Shutoff Head:	17,500 gpm at 130 ft. 17,500 Minimum flow = 2700 gpm continuous 230 ft.	
Required NPSH		27 ft at 17,500	
Maximum Pump Spd:		1185 RPM	
Type of Pump		Horizontal Centrifugal	
Applicable Code:		ASME Boiler and Pressure Vessel Code Section III, Class 3	
	NUCLEAR SERVICE WATER STRAINER		
Quantity:		Unit 1:2 Unit 2:2 Total: 4	
Type:		Kinney AP-1 Continuous/Automatic Backflush	
Nozzle Size		30"	
Temperature:		Maximum	125°F
		Operating	45°F - 70°F
		Minimum	40°F
Flow:		17,500 gpm	
Perforations:		3/16" diameter	
	NUCLEAR SERVICE WATER STRAINER BACKWASH PUMPS		
Quantity:		Unit 1:2 Unit 2:2 Total: 4	
Temperature:		Maximum	102°F
		Operating	45°F - 70°F
Capacity:		Design:	200 gpm
Head:		Design:	64 ft (1A/2A), 60 ft (1B/2B)
Maximum Pump Spd:			1750 RPM
Type of Pump			Centrifugal

Applicable Code	ASME Boiler and Pressure Vessel Code Section III, Class 3

Table 9-11. Nuclear Service Water System Failure Analysis

Component	Malfunction	Comment and Consequences
1. Lake Norman	Loss of Dam	a. During normal station operation: Isolate supply and return lines to Lake Norman and use Standby Nuclear Water Pond for station cooling.
		b. During postulated LOCA: Channel B of the Nuclear Service Water System will already have been automatically aligned with supply and return to the SNSWP, and the redundant trains of equipment isolated from each other. Channel A will have been automatically aligned to low level intake, and would lose supply upon loss of lake. Channel A could then be manually aligned to have redundant train of supply and discharge lines and heat exchangers to back up the Channel B.
2. Operating Train NSW supply line to NSW pumps from CCW crossover	Rupture or plug or seismic event disabling CCW piping	a. If opposite train NSW supply line from CCW crossover is available, change over to opposite train NSW Pump and HX train operation, using opposite train CCW supply and return lines, or
		b. Isolate channel A and B CCW supplies with corresponding HX trains and discharge to Lake Norman, or
		c. Isolate supply and return to Lake Norman and use Standby Nuclear Service Water Pond for plant cooling.
3. Either Operating NSW pump	Any failure that would curtail normal operation of the pump including failure of motor cooler.	Start opposite train pump and supply opposite train heat exchangers until repairs are made.
4. Any Operating train safety related heat exchanger	Tube rupture or plug or shell rupture	a. Shut down the Operating NSW pump, use redundant train NSW Pump and heat exchangers, or
		b. If opposite train NSW pump unavailable, open crossovers and supply opposite train heat exchangers with operating pump.
5. Operating NSW pump discharge header	Rupture or plug	Use opposite train pump and heat exchangers until repairs can be made.

Component	Malfunction	Comment and Consequences
6. Either Operating NSW pump strainer	Plug (includes strainer drum and backwash)	Isolate strainer and associated Operating NSW pump, use opposite train pump to satisfy unit cooling water requirements.
7. Any non-safety related component	Any failure which will curtail normal operation of the component	Isolate component and perform required maintenance.
8. NSW return header to CCW crossover	Rupture or plug or seismic event disabling CCW piping	Isolate and use Standby Nuclear Service Water Pond supply and return.

Table 9-12. Nuclear Service Water System Instrumentation and Control

1. Indicators				
	a.	Temperature	Local	Control Room
		1) Essential Header 1A and 1B	X	X
		2) Safety Related Pump Motor High Temperature Alarms		X
		3) Standby Nuclear Service Water Pond		X
	b.	Pressure		
		1) Essential Headers 1A and 1B	X	X
		2) Pond Supply A	X	
		3) Strainer Differential Pressure A and B	X	X
	c.	Level		
		1) Lake Norman		X
		2) Standby Nuclear Service Water Pond		X
	d.	Status		
		1) Nuclear Service Water Pumps		X
		2) All Class 3 Motor Operated Valves 3) NSW Strainer Backwash Pumps	 X	X
	e.	Radioactivity		
		1) Return from Containment Spray Heat Exchanger		X
	f.	Flow		
		1) NSW Pump Discharge		X
		2) Component Cooling HX Outlet	X	X
		3) Diesel Generator Cooling Water HX Outlet		X
		4) Containment Spray HX Outlet		X
2. Regulators	Pressure			
	a. Control, Cable and Equipment Rm A/C Condenser head pressure self regulating control valves (YC condenser pressure)			X
3. Test Points	a. Temperature			
		1) On outlets of each heater exchanger where practical for performance testing.		
		2) Non-essential header		

	b. Pressure
	3) Non-essential header
	4) Differential pressure across heat exchangers provided for testing purposes.

Table 9-13. Chemistry Specifications Nuclear Service Water

	Range
pH	5.5-8.5
Turbidity, JTU	3-80
Total Dissolved solids, ppm	30-70
Suspended solids, ppm	5-225
Total Hardness, ppm as $CaCO_3$	12-22
Silica, ppm SiO_2	4-12
Conductivity, micromhos	30-100
Total iron, ppm Fe	0.03-5
Manganese, ppm Mn	0-1
Color, APHA	1-5

Table 9-14. Worst 1, 4 and 30-Day Cooling Periods

Day	Dry Bulb (°F)	Dew Point (F)	Wind Speed (mph)	Solar Radiation (Langleys/day)
		Worst 1-Day Period		
6/27/52	91	71	3.6	679
		Worst 4-Day Period		
6/24/52	85	71	2.9	636
6/25/52	89	70	2.9	611
6/26/52	89	72	3.0	659
6/27/52	91	71	3.6	679
		Worst 30-Day Period		
6/5/52	80	67	4.9	482
6/6//52	78	65	5.0	716
6/7/52	83	66	4.3	687
6/8/52	85	68	4.8	632
6/9/52	82	67	6.5	628
6/10/52	78	68	7.2	521
6/11/52	82	61	6.5	735
6/12/52	71	58	4.5	336
6/13/52	75	65	2.6	696
6/14/52	76	70	5.5	441
6/15/52	80	72	3.7	572
6/16/52	81	72	4.9	564
6/17/52	79	72	8.1	408
6/18/52	79	72	3.0	726
6/19/52	83	67	4.2	704
6/20/52	82	67	5.1	725
6/21/52	78	69	6.2	597
6/22/52	81	71	6.3	544
6/23/52	81	72	3.4	619

Day	Dry Bulb (°F)	Dew Point (F)	Wind Speed (mph)	Solar Radiation (Langleys/day)
6/24/52	85	71	2.9	636
6/25/52	89	70	2.9	611
6/26/52	89	72	3.0	659
6/27/52	91	71	3.6	679
6/28/52	83	72	7.3	653
6/29/52	79	71	4.4	379
6/30/52	83	71	4.2	392
7/1/52	72	61	8.1	733
7/2/52	73	58	5.2	805
7/3/52	75	60	3.9	800
7/4/52	77	62	6.0	733

Table 9-15. Worst 1,4 and 30-Day Evaporation Periods

Day	Dry Bulb (°F)	Dew Point (F)	Wind Speed (mph)	Solar Radiation (Langleys/day)
		Worst 1-Day Period		
11/6/52	56	21	6.6	300
		Worst 4-Day Period		
3/3/68	43	18	11.2	492
3/4/68	42	8	9.3	450
3/5/68	45	13	6.5	439
3/6/68	49	24	9.6	297
		Worst 30-Day Period		
2/6/68	44	18	6.5	359
2/7/68	43	20	6.6	352
2/8/68	43	23	11.5	287
2/9/68	40	21	9.1	306
2/10/68	36	10	9.0	372
2/11/68	31	12	7.3	392
2/12/68	29	5	8.6	395
2/13/68	34	9	9.1	403
2/14/68	35	11	7.0	392
2/15/68	41	21	7.9	215
2/16/68	39	21	5.3	395
2/17/68	42	20	8.5	393
2/18/68	34	5	4.3	230
2/19/68	35	3	6.6	413
2/20/68	44	21	12.5	279
2/21/68	38	16	12.0	363
2/22/68	31	6	9.6	411
2/23/68	34	9	6.2	235
2/24/68	39	13	6.5	348

Day	Dry Bulb (°F)	Dew Point (F)	Wind Speed (mph)	Solar Radiation (Langleys/day)
2/25/68	37	12	8.5	426
2/26/68	36	7	4.9	438
2/27/68	41	16	4.5	398
2/28/68	40	24	8.9	327
2/29//68	34	29	7.8	79
3/1/68	33	13	11.4	459
3/2/68	45	26	10.8	455
3/3/68	43	18	11.2	492
3/4/68	42	8	9.3	450
3/5/68	45	13	6.5	439
3/6/68	49	24	9.6	297

Table 9-16. Heat Transfer Rates to Standby Nuclear Service Water Pond. From LOCA Unit Loads and Controlled Shutdown Unit Loads Along with Associated Station Auxiliary Loads Over Thirty Days. This represents a sample of data only. See Ref #15.

Hours After LOCA and C.S. Event	LOCA Unit Heat Load 10^6 BTU/Hr. Note 1	Cont.Shut.Unit Heat Load 10^6 BTU/Hr.	Total Heat Loads 10^6 BTU/Hr.
0	0	0	0
1	215	0	215
2	316	0	316
3	291	0	291
4	278	0	278
5	201	134	334
6	197	127	325
7	180	122	302
8	177	117	295
9	174	113	287
10	170	110	281
11	167	108	275
12	164	105	270
13	161	103	265
14	159	101	260
15	157	100	256
16	154	98	252
17	153	96	249
18	151	95	246
19	149	94	243
20	147	93	240
21	146	77	223
25	141	73	215
30	137	70	207
40	131	65	196
50	126	61	186
60	121	57	179
80	115	52	166

Hours After LOCA and C.S. Event	LOCA Unit Heat Load 10∧6 BTU/Hr. Note 1	Cont.Shut.Unit Heat Load 10∧6 BTU/Hr.	Total Heat Loads 10∧6 BTU/Hr.
100	110	47	157
168	99	39	138
175	99	38	137
180	98	38	136
185	98	37	135
200	97	36	133
300	92	32	124
400	89	29	118
500	87	27	114
600	86	25	111
700	84	24	108
720	84	24	108

Note 1: Auxiliary Loads are included from both units.

Table 9-17. Computer Program for McGuire Nuclear Station SNSWP Thermal Analysis

```
'McGuire SNSWP Thermal Analysis

OPEN "E:\03291301.TXT" FOR OUTPUT AS #1

PRINT #1, "MCC-1150.01-00-0008 SNSWP THERMAL ANALYSIS MODEL FOR"
PRINT #1, "ONE-UNIT LOCA, ONE-UNIT COOLDOWN, WITH COINCIDENT DUAL-"
PRINT #1, "UNIT LOOP, BOTH UNITS ALIGNED TO THE SNSWP, MAXIMUM"
PRINT #1, "SAFEGUARDS PLANT RESPONSE"
PRINT #1, ""
PRINT #1, "COMPUTER MODEL IS THE ORIGINAL SNSWP ANALYSIS MODEL USED"
PRINT #1, "IN MCC-1150.01-00-0001 UP TO AND INCLUDING REVISION 3"
PRINT #1, "MODEL HAS BEEN MODIFIED AS FOLLOWS:"
PRINT #1, "(1) FLOW RATE FROM HOUR 5 TO HOUR 720 IS 56,000 GPM"
PRINT #1, "(2) INITIAL INITIAL TEMPERATURE PROFILE IS FROM ATT.2"
PRINT #1, "(3) HEAT INPUTS ARE FROM MCC-1223.24-00-0130 ATT.1"

PRINT #1, ""
PRINT #1, ""


PRINT #1, "TIME              REAL        PLANT       T-LOST      SURFACE
MIXED         MIXED      PLANT"
PRINT #1, "INCREMENT         TIME        DISCHARGE   TO-ATMOS    TEMP
DEPTH         TEMP       INTAKE"

DIM S(50, 2)'S STORES INTEGER VOL (TCF) AND TEMP AT EACH FOOT
DIM T(720, 5)'T STORES E,K,Q,H, AND DELTA-T FOR EACH HOUR
DIM L(100, 2)'L STORES FLOOR DEPTH AND TEMP OF EACH UNIT

READ S1, T1, L1, K2
DATA 46,720,20,20

READ E1, K1
DATA 88,150

FOR I = 1 TO S1
    READ S10
    S(I, 1) = S10 * 43.56
NEXT I
    DATA 1,2,3,4,5,6,9,10,11,12,15,18
    DATA 20,24,28,31,35,40,47,52,60,67,75,82,91,100,111
    DATA 122,133,146,160,172,188,205,222,240,260,280,306
    DATA 330,355,383,410,440,470,500

'Input Stage Temps in DegF

FOR I = 1 TO S1
    READ S(I, 2)
NEXT I
    DATA 82,82,82,82,82,82,82,82,82,82
    DATA 82,82,82,82,82,82,82,82,82,82
    DATA 82,82,82,82,82,82,82,82,82,82
    DATA 82,82,82.49,83.71,84.93,86.15,87.37,88.59,90,90
    DATA 90,90,90,90,90,90
```

Page 1

```
'Input Equil Temps DegF

FOR I = 1 TO T1
    T(I, 1) = E1
NEXT I

'Input Exch Coeff in BTU/SQFT/HR/DEGF

FOR I = 1 TO T1
    T(I, 2) = K1 / 24
NEXT I

'Input flows (TGPM to TCF/hr)

FOR I = 1 TO 4
    T(I, 3) = 56
NEXT I
FOR I = 5 TO T1
    T(I, 3) = 56
NEXT I
FOR I = 1 TO T1
    T(I, 3) = T(I, 3) * 60 / 7.4805
NEXT I

'Input Heat (MBTU/Hr)

FOR I = 1 TO T1
    READ T(I, 4)
NEXT I
DATA 215 , 316 , 291 , 278 , 334 , 325 , 302 , 295 , 287 , 281
DATA 275 , 270 , 265 , 260 , 256 , 252 , 249 , 246 , 243 , 240
DATA 223 , 220 , 218 , 216 , 215 , 213 , 211 , 210 , 209 , 207
DATA 206 , 205 , 204 , 202 , 201 , 200 , 199 , 198 , 197 , 196
DATA 195 , 194 , 193 , 192 , 191 , 190 , 189 , 188 , 187 , 186
DATA 186 , 185 , 184 , 183 , 182 , 182 , 181 , 180 , 179 , 179
DATA 178 , 177 , 177 , 176 , 175 , 174 , 174 , 173 , 172 , 172
DATA 171 , 171 , 170 , 170 , 169 , 169 , 168 , 167 , 167 , 166
DATA 166 , 165 , 165 , 164 , 164 , 163 , 163 , 162 , 162 , 161
DATA 161 , 161 , 160 , 160 , 159 , 159 , 158 , 158 , 157 , 157
DATA 157 , 156 , 156 , 156 , 155 , 155 , 154 , 154 , 154 , 153
DATA 153 , 153 , 152 , 152 , 152 , 151 , 151 , 150 , 150 , 150
DATA 149 , 149 , 149 , 149 , 148 , 148 , 148 , 148 , 147 , 147
DATA 147 , 146 , 146 , 146 , 146 , 145 , 145 , 145 , 145 , 144
DATA 144 , 144 , 144 , 143 , 143 , 143 , 143 , 142 , 142 , 142
DATA 142 , 141 , 141 , 141 , 141 , 141 , 140 , 140 , 140 , 140
DATA 139 , 139 , 139 , 139 , 139 , 139 , 138 , 138 , 138 , 138
DATA 138 , 137 , 137 , 137 , 137 , 137 , 137 , 136 , 136 , 136
DATA 136 , 136 , 136 , 135 , 135 , 135 , 135 , 135 , 135 , 135
DATA 134 , 134 , 134 , 134 , 134 , 134 , 134 , 133 , 133 , 133
DATA 133 , 133 , 133 , 133 , 133 , 132 , 132 , 132 , 132 , 132
DATA 132 , 132 , 132 , 132 , 131 , 131 , 131 , 131 , 131 , 131
DATA 131 , 131 , 131 , 130 , 130 , 130 , 130 , 130 , 130 , 130
DATA 130 , 130 , 130 , 129 , 129 , 129 , 129 , 129 , 129 , 129
DATA 129 , 129 , 129 , 129 , 128 , 128 , 128 , 128 , 128 , 128
DATA 128 , 128 , 128 , 128 , 128 , 128 , 127 , 127 , 127 , 127
DATA 127 , 127 , 127 , 127 , 127 , 127 , 127 , 127 , 126 , 126
DATA 126 , 126 , 126 , 126 , 126 , 126 , 126 , 126 , 126 , 126
DATA 126 , 126 , 125 , 125 , 125 , 125 , 125 , 125 , 125 , 125
DATA 125 , 125 , 125 , 125 , 125 , 125 , 125 , 124 , 124 , 124
DATA 124 , 124 , 124 , 124 , 124 , 124 , 124 , 124 , 124 , 124
DATA 124 , 124 , 123 , 123 , 123 , 123 , 123 , 123 , 123 , 123
DATA 123 , 123 , 123 , 123 , 123 , 123 , 123 , 123 , 122 , 122
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DATA 122 , 122 , 122 , 122 , 122 , 122 , 122 , 122 , 122 , 122
DATA 122 , 122 , 122 , 122 , 121 , 121 , 121 , 121 , 121 , 121
DATA 121 , 121 , 121 , 121 , 121 , 121 , 121 , 121 , 121 , 121
DATA 121 , 121 , 120 , 120 , 120 , 120 , 120 , 120 , 120 , 120
DATA 120 , 120 , 120 , 120 , 120 , 120 , 120 , 120 , 120 , 120
DATA 119 , 119 , 119 , 119 , 119 , 119 , 119 , 119 , 119 , 119
DATA 119 , 119 , 119 , 119 , 119 , 119 , 119 , 119 , 119 , 118
DATA 118 , 118 , 118 , 118 , 118 , 118 , 118 , 118 , 118 , 118
DATA 118 , 118 , 118 , 118 , 118 , 118 , 118 , 118 , 118 , 118
DATA 117 , 117 , 117 , 117 , 117 , 117 , 117 , 117 , 117 , 117
DATA 117 , 117 , 117 , 117 , 117 , 117 , 117 , 117 , 117 , 117
DATA 117 , 117 , 116 , 116 , 116 , 116 , 116 , 116 , 116 , 116
DATA 116 , 116 , 116 , 116 , 116 , 116 , 116 , 116 , 116 , 116
DATA 116 , 116 , 116 , 116 , 116 , 116 , 115 , 115 , 115 , 115
DATA 115 , 115 , 115 , 115 , 115 , 115 , 115 , 115 , 115 , 115
DATA 115 , 115 , 115 , 115 , 115 , 115 , 115 , 115 , 115 , 115
DATA 115 , 115 , 115 , 114 , 114 , 114 , 114 , 114 , 114 , 114
DATA 114 , 114 , 114 , 114 , 114 , 114 , 114 , 114 , 114 , 114
DATA 114 , 114 , 114 , 114 , 114 , 114 , 114 , 114 , 114 , 114
DATA 114 , 114 , 113 , 113 , 113 , 113 , 113 , 113 , 113 , 113
DATA 113 , 113 , 113 , 113 , 113 , 113 , 113 , 113 , 113 , 113
DATA 113 , 113 , 113 , 113 , 113 , 113 , 113 , 113 , 113 , 113
DATA 113 , 113 , 113 , 112 , 112 , 112 , 112 , 112 , 112 , 112
DATA 112 , 112 , 112 , 112 , 112 , 112 , 112 , 112 , 112 , 112
DATA 112 , 112 , 112 , 112 , 112 , 112 , 112 , 112 , 112 , 112
DATA 112 , 112 , 112 , 112 , 111 , 111 , 111 , 111 , 111 , 111
DATA 111 , 111 , 111 , 111 , 111 , 111 , 111 , 111 , 111 , 111
DATA 111 , 111 , 111 , 111 , 111 , 111 , 111 , 111 , 111 , 111
DATA 111 , 111 , 111 , 111 , 111 , 110 , 110 , 110 , 110 , 110
DATA 110 , 110 , 110 , 110 , 110 , 110 , 110 , 110 , 110 , 110
DATA 110 , 110 , 110 , 110 , 110 , 110 , 110 , 110 , 110 , 110
DATA 110 , 110 , 110 , 110 , 110 , 109 , 109 , 109 , 109 , 109
DATA 109 , 109 , 109 , 109 , 109 , 109 , 109 , 109 , 109 , 109
DATA 109 , 109 , 109 , 109 , 109 , 109 , 109 , 109 , 109 , 109
DATA 109 , 109 , 109 , 109 , 109 , 109 , 108 , 108 , 108 , 108
DATA 108 , 108 , 108 , 108 , 108 , 108 , 108 , 108 , 108 , 108
DATA 108 , 108 , 108 , 108 , 108 , 108 , 108 , 108 , 108 , 108
DATA 108 , 108 , 108 , 108 , 108 , 108 , 108 , 108 , 108 , 108
DATA 108 , 108 , 108 , 108 , 108 , 108 , 108 , 108 , 108 , 108

'Deduce Delta-T (Deg F)

K = 0
FOR I = 1 TO T1
    K = K + 1
    T(I, 5) = (1000 / 62.4) * T(I, 4) / T(I, 3)
    IF K < K2 THEN 856
    K = 0
856 NEXT I

'Form Unit volume layers

V1 = S(S1, 1) / L1
L(1, 1) = 0
V2 = 0
S2 = 0
J1 = 1
K = 1
FOR I = 2 TO L1
K = K + 1
V2 = V2 + V1
FOR J = J1 TO S1
    IF V2 < S(J, 1) THEN GOTO 990
```

```
NEXT J

990 J1 = J
IF J = 1 THEN 1020
S2 = S(J - 1, 1)

1020 L(I, 1) = J - 1 + (V2 - S2) / (S(J, 1) - S2)

IF K < K2 THEN 1050
K = 0

1050 NEXT I

'DEDUCE UNIT LAYER TEMPS

K = 0
J1 = 1
FOR I = 1 TO L1
K = K + 1
FOR J = J1 TO S1
IF L(I, 1) < J THEN 1140
NEXT J

1140 L(I, 2) = S(J, 2)

J1 = J
IF K < K2 THEN 1180
K = 0

1180 NEXT I

'BEGIN FLOW ITERATION

H1 = S1 - L(L1, 1)
T5 = 0

'T5 IS TOTAL TIME

K4 = 1
K = 0
FOR I = 1 TO T1
IF T5 > (I - .5) THEN 2110
K = K + 1
1280 T2 = V1 / T(I, 3)

'T2 IS TIME INCREMENT (HRS)

T5 = T5 + T2
T3 = L(1, 2) + T(I, 5)

'T3 IS DISCH TEMP

L2 = L1 - 1
FOR J = 1 TO L2
L(J, 2) = L((J + 1), 2)
NEXT J

'ACCOUNT FOR SURF COOL

K1 = T(I, 2)
E1 = T(I, 1)
T9 = (T3 - E1) * EXP(-K1 * T2 / (62.4 * H1))
T4 = T3 - (E1 + T9)
```

```
L(L1, 2) = T3 - T4

'AVERAGE OVER UPPER INSTABILITY

IF L(L1, 2) > L(L1 - 1, 2) THEN 2000
FOR J = L1 TO 1 STEP -1
    IF J = 1 THEN 2000
    IF L(L1, 2) > L(J - 1, 2) THEN 2000
NEXT J

2000 A = 0
FOR M = J TO L1
    A = A + L(M, 2) / (L1 - J + 1)
NEXT M

FOR M = J TO L1
    L(M, 2) = A
NEXT M

IF K < K4 THEN 2100


PRINT #1, I, T5, T3, T4, L(L1, 2), J, L(J, 2), L(1, 2)
K = 0
2100 IF T5 < (I - .5) THEN 1280
2110 NEXT I

'ADD PRINT SPACING

PRINT #1, ""
PRINT #1, ""


END
```

Table 9-18. McGuire Nuclear Station SNSWP Thermal Analysis Computer Model Parameters

Variable	Value	Description
S1	46	Number of horizontal layers. Each layer is 1 ft. deep.
T1	720	Total number of hours of input and output for the computer model, i.e. 30 days as required by RG 1.27.
L1	20	Number of unit volumes. This number is arbitrary, and the selected number represents the point beyond which a further increase has no impact on results.
K2	20	Output check spacing, an internal counter used within the program.
E1	88	Equilibrium temperature, °F. The equilibrium temperature is calculated based on the worst 30-day meteorological period identified from the meteorological record.
K1	150	Exchange coefficient, BTU/ft²/°F/day. The exchange coefficient is calculated based on the worst 30-day meteorological period identified from the meteorological record.
I	Variable	The number of iterations.
J	Variable	An iteration counter used in multiple applications during the program.
S(I,1)	Variable	Stage volumes (acre-ft). This is based on the area/volume curve in UFSAR Figure 9-42. S(I,1) is converted to thousand cubic feet (TCF) for use in calculation.
S(I,2)	Variable	Stage temperatures (°F). The assigned temperatures correspond to an initial vertical temperature profile that envelopes the periodic profiles that have been measured during the life of the plant.
T(I,1)	88	Equilibrium temperature. The constant value E1 is required for each hour of the simulation, therefore T(I,1) = E1 for a total number of T1 matrix values.
T(I,2)	150	Exchange coefficient. The constant value K1 is required for each hour of simulation, therefore T(I,2) = K1/24s for a total number of T1 matrix values.
T(I,3)	56,000	Input flows (gallons per minute) used in the calculation of time that a unit volume remains at the pond surface, T2.
T(I,4)	Variable	Heat inputs (MBTU/Hr), as developed in calculations.
T(I,5)	Variable, calculated	Delta-T (°F), the incremental increase in temperature applied to the bottom layer as it is drawn into the plant for each hour of the simulation.
V1	Calculated	Unit layer volume.
V2	Calculated	V2 is the cumulative volume of all unit layers below the layer of interest (acre-ft).
S2	Calculated	S2 is the cumulative volume calculated by stage rather than by unit

Variable	Value	Description
		volume.
L(I,1)	Calculated	Vertical position of unit layers above the bottom of the pond (ft).
L(I,2)	Calculated	Temperature of unit volume (°F), equal to the temperature of the stage (S(I,2)) at the bottom of the unit volume.
H1	Calculated	Depth of the unit volume at the pond surface (ft.).
T2	Calculated	Time that a unit volume remains at the surface of the pond (hr).
T5	Calculated	Total simulation time elapsed (hr).
T3	Calculated	Discharge temperature (°F).
T9	Calculated	Heat transfer to the environment (°F).
T4	Calculated	Reduction in the discharge temperature T3 (°F) due to surface cooling T9.
A	Calculated	The average temperature calculated in the event that the temperature of one of the unit volumes below the pond surface exceeds the temperature of the surface layer after cooling (°F).

Table 9-19. Sample Run of McGuire Nuclear Station SNSWP Thermal Analysis

Time Increment	Real Time	Plant Discharge	T-Lost TO-Atmos	Surface Temp	Mixed Depth	Mixed Temp	Plant Intake
1	2.424484	89.67088	.4223756	89.9165	12	89.9165	82
3	4.848967	92.38245	1.10782	91.27463	20	91.27463	82
6	7.273451	93.59552	1.414468	92.18105	20	92.18105	82
8	9.697934	92.52516	1.143897	91.78116	19	91.78116	82
11	12.12242	91.81159	.9635162	91.42126	17	91.42126	82
13	14.5469	91.4548	.8733251	91.2533	16	91.2533	82
16	16.97138	90.99098	.7560778	91.08357	15	91.08357	82.49
18	19.39587	91.26691	.8258295	90.99179	14	90.99179	83.71
20	21.82035	92.27284	1.080114	91.19273	20	91.19273	86.15
23	24.24484	93.92792	1.498493	92.42943	20	92.42943	87.37
25	26.66932	95.04089	1.779836	93.26105	20	93.26105	88.59
28	29.09381	96.08248	2.043137	94.03934	20	94.03934	89.9165
30	31.51829	97.30196	2.351402	94.95055	20	94.95055	89.9165
33	33.94277	97.19492	2.324346	94.91057	19	94.91057	89.9165
35	36.36726	97.08788	2.297287	94.87057	18	94.87057	89.9165
37	38.79174	97.01653	2.27925	94.83725	17	94.83725	89.9165
40	41.21622	96.90949	2.252193	94.80125	16	94.80125	89.9165
42	43.64071	96.83813	2.234155	94.76837	15	94.76837	89.9165
45	46.06519	96.7311	2.207098	94.73346	14	94.73346	89.9165
47	48.48968	96.65974	2.18906	94.70061	13	94.70061	89.9165

Time Increment	Real Time	Plant Discharge	T-Lost TO-Atmos	Surface Temp	Mixed Depth	Mixed Temp	Plant Intake
49	50.91416	96.58839	2.171022	94.66914	12	94.66914	90.99179
52	53.33865	97.59232	2.424801	95.16751	20	95.16751	90.99179
54	55.76313	97.52096	2.406763	95.14085	19	95.14085	90.99179
57	58.18761	97.4496	2.388725	95.1142	18	95.1142	90.99179
59	60.6121	97.37824	2.370687	95.08754	17	95.08754	90.99179
62	63.03658	97.30688	2.352648	95.06087	16	95.06087	90.99179
64	65.46107	97.27121	2.34363	95.03866	15	95.03866	90.99179
66	67.88555	97.19985	2.325592	95.01517	14	95.01517	91.19273
69	70.31004	97.32943	2.358347	95.00967	13	95.00967	92.42943
71	72.73452	98.53046	2.66195	95.86851	20	95.86851	93.26105
74	75.159	99.32639	2.863152	96.46324	20	96.46324	94.03934
76	77.58349	100.069	3.050876	97.01814	20	97.01814	94.66914
79	80.00797	100.6275	3.192041	97.43542	20	97.43542	94.66914
81	82.43246	100.5918	3.183022	97.42209	19	97.42209	94.66914
83	84.85694	100.5561	3.174004	97.40876	18	97.40876	94.66914
86	87.28143	100.4847	3.155965	97.38876	17	97.38876	94.66914
88	89.70591	100.4491	3.146947	97.37144	16	97.37144	94.66914
91	92.13039	100.4134	3.137927	97.35545	15	97.35545	94.66914
93	94.55488	100.3777	3.128909	97.34021	14	97.34021	94.66914
96	96.97936	100.342	3.119888	97.32545	13	97.32545	94.66914
98	99.40385	100.3064	3.11087	97.31102	12	97.31102	95.00967
100	101.8238	100.6112	3.18793	97.42326	20	97.42326	95.00967

Time Increment	Real Time	Plant Discharge	T-Lost TO-Atmos	Surface Temp	Mixed Depth	Mixed Temp	Plant Intake
103	104.2528	100.5755	3.178912	97.40993	19	97.40993	95.00967
105	106.6773	100.5398	3.169891	97.39661	18	97.39661	95.00967
108	109.1018	100.5042	3.160873	97.38328	17	97.38328	95.00967
110	111.5263	100.4685	3.151854	97.36995	16	97.36995	95.00967
113	113.9508	100.4328	3.142836	97.32927	6	97.32927	95.00967
115	116.3752	100.4328	3.142836	97.32681	5	97.32681	95.00967
117	118.7997	100.3971	3.133817	97.32307	4	97.32307	95.86851
120	121.2242	101.2203	3.3419	97.87839	20	97.87839	96.46324
122	123.6487	101.7793	3.483222	98.29612	20	98.29612	97.01814
125	126.0732	102.2986	3.614473	98.68409	20	98.68409	97.32307
127	128.4977	102.6035	3.691553	98.91193	20	98.91193	97.32307
129	130.9221	102.5678	3.682535	98.89861	19	98.89861	97.32307
132	133.3466	102.5321	3.673515	98.88528	18	98.88528	97.32307
134	135.7711	102.5321	3.673515	98.87861	17	98.87861	97.32307
137	138.1956	102.4965	3.664497	98.86928	16	98.86928	97.32307
139	140.6201	102.4965	3.664497	98.86305	15	98.86305	97.32307
142	143.0446	102.4608	3.655478	98.8548	14	98.8548	97.32307
144	145.469	102.4251	3.646459	98.84528	13	98.84528	97.32307
146	147.8935	102.4251	3.646459	98.83788	12	98.83788	97.32307
149	150.318	102.3894	3.637441	98.82929	11	98.82929	97.32307
151	152.7425	102.3894	3.637441	98.82227	10	98.82227	97.32307
154	155.167	102.3537	3.628421	98.81419	9	98.81419	97.32307

Time Increment	Real Time	Plant Discharge	T-Lost TO-Atmos	Surface Temp	Mixed Depth	Mixed Temp	Plant Intake
156	157.5915	102.3537	3.628421	98.80735	8	98.80735	97.32307
159	160.0159	102.3181	3.619403	98.79959	7	98.79959	97.32307
161	162.4404	102.2824	3.610382	98.78438	5	98.78438	97.32307
163	164.8649	102.2824	3.610382	98.77776	4	98.77776	97.32307
166	167.2894	102.2824	3.610382	98.77189	3	98.77189	97.87839
168	169.7139	102.802	3.741741	99.06029	20	99.06029	98.29612
171	172.1384	103.2198	3.847339	99.37242	20	99.37242	98.77189
173	174.5629	103.6598	3.958586	99.70126	20	99.70126	98.77189
176	176.9873	103.6598	3.958586	99.70126	19	99.70126	98.77189
178	179.4118	103.6242	3.949568	99.69238	18	99.69238	98.77189
180	181.8363	103.6242	3.949568	99.68793	17	99.68793	98.77189
183	184.2608	103.6242	3.949568	99.68526	16	99.68526	98.77189
185	186.6853	103.5885	3.940548	99.67904	15	99.67904	98.77189
188	189.1098	103.5885	3.940548	99.6746	14	99.6746	98.77189
190	191.5342	103.5885	3.940548	99.67127	13	99.67127	98.77189
193	193.9587	103.5528	3.93153	99.66572	12	99.66572	98.77189
195	196.3832	103.5528	3.93153	99.66127	11	99.66127	98.77189
197	198.8077	103.5528	3.93153	99.65763	10	99.65763	98.77189
200	201.2322	103.5171	3.922509	99.65238	9	99.65238	98.77189
202	203.6567	103.5171	3.922509	99.64793	8	99.64793	98.77189
205	206.0811	103.5171	3.922509	99.64411	7	99.64411	98.77189
207	208.5056	103.4815	3.913491	99.63905	6	99.63905	98.77189

Time Increment	Real Time	Plant Discharge	T-Lost TO-Atmos	Surface Temp	Mixed Depth	Mixed Temp	Plant Intake
210	210.9301	103.4815	3.913491	99.63461	5	99.63461	98.77189
212	213.3546	103.4815	3.913491	99.63071	4	99.63071	98.77189
214	215.7791	103.4815	3.913491	99.62723	3	99.62723	99.06029
217	218.2036	103.7342	3.977376	99.7568	20	99.7568	99.37242
219	220.6281	104.0463	4.056279	99.99003	20	99.99003	99.62723
222	223.0525	104.3011	4.12069	100.1804	20	100.1804	99.62723
224	225.477	104.2654	4.11167	100.1671	19	100.1671	99.62723
226	227.9015	104.2654	4.11167	100.1627	18	100.1627	99.62723
229	230.326	104.2654	4.11167	100.1604	17	100.1604	99.62723
231	232.7505	104.2654	4.11167	100.1591	16	100.1591	99.62723
234	235.175	104.2298	4.102653	100.1538	15	100.1538	99.62723
236	237.5994	104.2298	4.102653	100.15	14	100.15	99.62723
239	240.0239	104.2298	4.102653	100.1471	13	100.1471	99.62723
241	242.4484	104.2298	4.102653	100.1449	12	100.1449	99.62723
243	244.8729	104.2298	4.102653	100.1431	11	100.1431	99.62723
246	247.2974	104.1941	4.093633	100.1392	10	100.1392	99.62723
248	249.7219	104.1941	4.093633	100.136	9	100.136	99.62723
251	252.1463	104.1941	4.093633	100.1332	8	100.1332	99.62723
253	254.5708	104.1941	4.093633	100.1309	7	100.1309	99.62723
256	256.9953	104.1941	4.093633	100.1289	6	100.1289	99.62723
258	259.4198	104.1584	4.084615	100.1254	5	100.1254	99.62723
260	261.8442	104.1584	4.084615	100.1224	4	100.1224	99.62723

Time Increment	Real Time	Plant Discharge	T-Lost TO-Atmos	Surface Temp	Mixed Depth	Mixed Temp	Plant Intake
263	264.2687	104.1584	4.084615	100.1197	3	100.1197	99.7568
265	266.6932	104.288	4.117368	100.1706	20	100.1706	99.99003
268	269.1176	104.5212	4.176325	100.3449	20	100.3449	100.1197
270	271.5421	104.6152	4.200084	100.4151	20	100.4151	100.1197
273	273.9666	104.6152	4.200084	100.4151	19	100.4151	100.1197
275	276.3911	104.6152	4.200084	100.4151	18	100.4151	100.1197
277	278.8155	104.6152	4.200084	100.4151	17	100.4151	100.1197
280	281.24	104.6152	4.200084	100.4151	16	100.4151	100.1197
282	283.6645	104.6152	4.200084	100.4151	15	100.4151	100.1197
285	286.0889	104.5795	4.191066	100.4113	14	100.4113	100.1197
287	288.5134	104.5795	4.191066	100.4084	13	100.4084	100.1197
290	290.9379	104.5795	4.191066	100.4062	12	100.4062	100.1197
292	293.3623	104.5795	4.191066	100.4044	11	100.4044	100.1197
294	295.7868	104.5795	4.191066	100.403	10	100.403	100.1197
297	298.2113	104.5795	4.191066	100.4018	9	100.4018	100.1197
299	300.6357	104.5438	4.182045	100.3987	8	100.3987	100.1197
302	303.0602	104.5438	4.182045	100.3961	7	100.3961	100.1197
304	305.4847	104.5438	4.182045	100.3938	6	100.3938	100.1197
306	307.9091	104.5438	4.182045	100.3918	5	100.3918	100.1197
309	310.3336	104.5438	4.182045	100.39	4	100.39	100.1197
311	312.7581	104.5438	4.182045	100.3884	3	100.3884	100.1706
314	315.1826	104.5591	4.185895	100.3876	2	100.3876	100.3449

Time Increment	Real Time	Plant Discharge	T-Lost TO-Atmos	Surface Temp	Mixed Depth	Mixed Temp	Plant Intake
316	317.607	104.7333	4.22995	100.5034	20	100.5034	100.3876
319	320.0315	104.7761	4.240758	100.5353	20	100.5353	100.3876
321	322.456	104.7761	4.240758	100.5353	19	100.5353	100.3876
323	324.8804	104.7761	4.240758	100.5353	18	100.5353	100.3876
326	327.3049	104.7761	4.240758	100.5353	17	100.5353	100.3876
328	329.7294	104.7761	4.240758	100.5353	16	100.5353	100.3876
331	332.1538	104.7404	4.231738	100.5309	15	100.5353	100.3876
333	334.5783	104.7404	4.231738	100.5277	14	100.5277	100.3876
336	337.0028	104.7404	4.231738	100.5253	13	100.5253	100.3876
338	339.4272	104.7404	4.231738	100.5235	12	100.5235	100.3876
340	341.8517	104.7404	4.231738	100.522	11	100.522	100.3876
343	344.2762	104.7404	4.231738	100.5208	10	100.5208	100.3876
345	346.7007	104.7047	4.222719	100.5165	8	100.5165	100.3876
348	349.1251	104.7047	4.222719	100.514	7	100.514	100.3876
350	351.5496	104.7047	4.222719	100.5119	6	100.5119	100.3876
353	353.9741	104.7047	4.222719	100.51	5	100.51	100.3876
355	356.3985	104.7047	4.222719	100.5084	4	100.5084	100.3876
357	358.823	104.7047	4.222719	100.5069	3	100.5069	100.3876
360	361.2475	104.7047	4.222719	100.5056	2	100.5056	100.3876
362	363.6719	104.7047	4.222719	100.5045	1	100.5045	100.5045
365	366.0964	104.7859	4.24323	100.5426	20	100.5426	100.5045
367	368.5209	104.7859	4.24323	100.5426	19	100.5426	100.5045

Time Increment	Real Time	Plant Discharge	T-Lost TO-Atmos	Surface Temp	Mixed Depth	Mixed Temp	Plant Intake
370	370.9453	104.7859	4.24323	100.5426	18	100.5426	100.5045
372	373.3698	104.7859	4.24323	100.5426	17	100.5426	100.5045
374	375.7943	104.7859	4.24323	100.5426	16	100.5426	100.5045
377	378.2188	104.7859	4.24323	100.5426	15	100.5426	100.5045
379	380.6432	104.7859	4.24323	100.5426	14	100.5426	100.5045
382	383.0677	104.7502	4.234212	100.5393	13	100.5393	100.5045
384	385.4922	104.7502	4.234212	100.5367	12	100.5367	100.5045
386	387.9166	104.7502	4.234212	100.5347	11	100.5347	100.5045
389	390.3411	104.7502	4.234212	100.533	10	100.533	100.5045
391	392.7656	104.7502	4.234212	100.5315	9	100.5315	100.5045
394	395.19	104.7502	4.234212	100.5303	8	100.5303	100.5045
396	397.6145	104.7502	4.234212	100.5293	7	100.5293	100.5045
399	400.039	104.7502	4.234212	100.5284	6	100.5284	100.5045
401	402.4634	104.7145	4.225194	100.5217	1	100.5217	100.5217
403	404.8879	104.7317	4.229547	100.5207	1	100.5207	100.5207
406	407.3124	104.7308	4.229304	100.5198	1	100.5198	100.5198
408	409.7368	104.7298	4.229067	100.5188	1	100.5188	100.5188
411	412.1613	104.7289	4.228824	100.5179	1	100.5179	100.5179
413	414.5858	104.7279	4.228584	100.517	1	100.517	100.517
416	417.0103	104.727	4.228354	100.516	1	100.516	100.516
418	419.4347	104.7261	4.228124	100.5151	1	100.5151	100.5151
420	421.8592	104.7252	4.227896	100.5143	1	100.5143	100.5143

Time Increment	Real Time	Plant Discharge	T-Lost TO-Atmos	Surface Temp	Mixed Depth	Mixed Temp	Plant Intake
423	424.2837	104.6886	4.21865	100.512	1	100.512	100.512
425	426.7081	104.6864	4.218087	100.5098	1	100.5098	100.5098
428	429.1326	104.6842	4.217538	100.5077	1	100.5077	100.5077
430	431.5571	104.6821	4.21699	100.5055	1	100.5055	100.5055
433	433.9815	104.6799	4.216448	100.5034	1	100.5034	100.5034
435	436.406	104.6778	4.215914	100.5013	1	100.5013	100.5013
437	438.8305	104.6757	4.215384	100.4993	1	100.4993	100.4993
440	441.2549	104.6737	4.214872	100.4973	1	100.4973	100.4973
442	443.6794	104.6716	4.214355	100.4953	1	100.4953	100.4953
445	446.1039	104.634	4.204836	100.492	1	100.492	100.492
447	448.5284	104.6307	4.204004	100.4887	1	100.4887	100.4887
450	450.9528	104.6274	4.203177	100.4855	1	100.4855	100.4855
452	453.3773	104.6242	4.202365	100.4823	1	100.4823	100.4823
454	455.8018	104.621	4.201565	100.4792	1	100.4792	100.4792
457	458.2262	104.6179	4.20077	100.4761	1	100.4761	100.4761
459	460.6507	104.6148	4.199982	100.473	1	100.473	100.473
462	463.0752	104.6117	4.199206	100.47	1	100.47	100.47
464	465.4996	104.6087	4.198442	100.467	1	100.467	100.467
466	467.9241	104.6057	4.197686	100.464	1	100.464	100.464
469	470.3486	104.567	4.187914	100.4598	1	100.4598	100.4598
471	472.773	104.5628	4.186842	100.4556	1	100.4556	100.4556
474	475.1975	1040.5586	4.18578	100.4514	1	100.4514	100.4514

Time Increment	Real Time	Plant Discharge	T-Lost TO-Atmos	Surface Temp	Mixed Depth	Mixed Temp	Plant Intake
476	477.622	104.5545	4.184735	100.4474	1	100.4474	100.4474
479	480.0464	104.5504	4.183706	100.4433	1	100.4433	100.4433
481	482.4709	104.5464	4.182688	100.4394	1	100.4394	100.4394
483	484.8954	104.5424	4.181686	100.4355	1	100.4355	100.4355
486	487.3199	104.5385	4.180697	100.4316	1	100.4316	100.4316
488	489.7443	104.5346	4.179717	100.4277	1	100.4277	100.4277
491	492.1688	104.5308	4.178741	100.4239	1	100.4239	100.4239
493	494.5933	104.527	4.177781	100.4202	1	100.4202	100.4202
496	497.0177	104.4875	4.167816	100.4152	1	100.4152	100.4152
498	499.4422	104.4825	4.166551	100.4102	1	100.4102	100.4102
500	501.8667	104.4776	4.165298	100.4053	1	100.4053	100.4053
503	504.2911	104.4727	4.164056	100.4005	1	100.4005	100.4005
505	506.7156	104.4678	4.162827	100.3957	1	100.3957	100.3957
508	509.1401	104.463	4.161617	100.391	1	100.391	100.391
510	511.5645	104.4583	4.160426	100.3863	1	100.3863	100.3863
513	513.989	104.4536	4.159245	100.3817	1	100.3817	100.3817
515	516.4135	104.4491	4.158089	100.3772	1	100.3772	100.3772
517	518.838	104.4445	4.156946	100.3727	1	100.3727	100.3727
520	521.2625	104.4401	4.155814	100.3683	1	100.3683	100.3683
522	523.687	104.4357	4.154699	100.3639	1	100.3639	100.3639
525	526.1115	104.3956	4.144576	100.3583	1	100.3583	100.3583
527	528.536	104.39	4.143147	100.3527	1	100.3527	100.3537

Time Increment	Real Time	Plant Discharge	T-Lost TO-Atmos	Surface Temp	Mixed Depth	Mixed Temp	Plant Intake
530	530.9605	104.3844	4.141738	100.3472	1	100.3472	100.3472
532	533.385	104.3789	4.140353	100.3418	1	100.3418	100.3418
534	535.8095	104.3735	4.138982	100.3364	1	100.3364	100.3364
537	538.234	104.3681	4.137626	100.3311	1	100.3311	100.3311
539	540.6585	104.3628	4.136288	100.3259	1	100.3259	100.3259
542	543.083	104.3576	4.134962	100.3208	1	100.3208	100.3208
544	545.5075	104.3524	4.13366	100.3157	1	100.3157	100.3157
547	547.932	104.3473	4.13237	100.3106	1	100.3106	100.3106
549	550.3565	104.3423	4.131102	100.3057	1	100.3057	100.3057
551	552.781	104.3373	4.129849	100.3008	1	100.3008	100.3008
554	555.2055	104.2968	4.11959	100.2946	1	100.2946	100.2946
556	557.63	104.2906	4.118026	100.2885	1	100.2885	100.2885
559	560.0545	104.2845	4.116488	100.2825	1	100.2825	100.2825
561	562.479	104.2785	4.114966	100.2765	1	100.2765	100.2765
563	564.9035	104.2725	4.113459	100.2706	1	100.2706	100.2706
566	567.328	104.2666	4.11197	100.2648	1	100.2648	100.2648
568	569.7525	104.2608	4.11051	100.2591	1	100.2591	100.2591
571	572.177	104.2551	4.109063	100.2535	1	100.2535	100.2535
573	574.6015	104.2495	4.10763	100.2479	1	100.2479	100.2479
576	577.026	104.2439	4.106218	100.2423	1	100.2423	100.2423
578	579.4505	104.2383	4.10482	100.2369	1	100.2369	100.2369
580	581.875	104.2329	4.103441	100.2315	1	100.2315	100.2315

Time Increment	Real Time	Plant Discharge	T-Lost TO-Atmos	Surface Temp	Mixed Depth	Mixed Temp	Plant Intake
583	584.2995	104.2275	4.102077	100.2262	1	100.2262	100.2262
585	586.724	104.1865	4.091716	100.2196	1	100.2196	100.2196
588	589.1485	104.1799	4.090053	100.2131	1	100.2131	100.2131
590	591.573	104.1734	4.088409	100.2067	1	100.2067	100.2067
593	593.9975	104.167	4.086794	100.2004	1	100.2004	100.2004
595	596.422	104.1607	4.085196	100.1941	1	100.1941	100.1941
597	598.8465	104.1545	4.083617	100.188	1	100.188	100.188
600	601.271	104.1483	4.082055	100.1819	1	100.1819	100.1819
602	603.6955	104.1422	4.08052	100.1759	1	100.1759	100.1759
605	606.12	104.1362	4.079	100.17	1	100.17	100.17
607	608.5445	104.1303	4.077503	100.1641	1	100.1641	100.1641
610	610.969	104.1244	4.076026	100.1583	1	100.1583	100.1583
612	613.3935	104.1187	4.074568	100.1527	1	100.1527	100.1527
614	615.818	104.113	4.07313	100.147	1	100.147	100.147
617	618.2425	104.0716	4.06268	100.1401	1	100.1401	100.1401
619	620.667	104.0647	4.060933	100.1333	1	100.1333	100.1333
622	623.0915	104.0579	4.059211	100.1265	1	100.1265	100.1265
624	625.516	104.0512	4.057506	100.1199	1	100.1199	100.1199
627	627.9405	104.0445	4.055822	100.1133	1	100.1133	100.1133
629	630.365	104.038	4.05417	100.1069	1	100.1069	100.1069
631	632.7895	104.0315	4.052534	100.1005	1	100.1005	100.1005
634	635.214	104.0251	4.050916	100.0941	1	100.0941	100.0941

Time Increment	Real Time	Plant Discharge	T-Lost TO-Atmos	Surface Temp	Mixed Depth	Mixed Temp	Plant Intake
636	637.6385	104.0188	4.049317	100.0879	1	100.0879	100.0879
639	640.063	104.0125	4.047743	100.0817	1	100.0817	100.0817
641	642.4875	104.0064	4.046185	100.0757	1	100.0757	100.0757
643	644.912	104.0003	4.04465	100.0697	1	100.0697	100.0697
646	647.3365	103.9586	4.034116	100.0624	1	100.0624	100.0624
648	649.761	103.9514	4.032284	100.0553	1	100.0553	100.0553
651	652.1855	103.9442	4.030471	100.0482	1	100.0482	100.0482
653	654.61	103.9371	4.028681	100.0412	1	100.0412	100.0412
656	657.0345	103.9302	4.026917	100.0343	1	100.0343	100.0343
658	659.459	103.9233	4.025173	100.0275	1	100.0275	100.0275
660	661.8835	103.9165	4.023457	100.0208	1	100.0208	100.0208
663	664.308	103.9097	4.021751	100.0141	1	100.0141	100.0141
665	666.7325	103.9031	4.020074	100.0076	1	100.0076	100.0076
668	669.157	103.8965	4.018421	100.0011	1	100.0011	100.0011
670	671.5815	103.8901	4.016786	99.99472	1	99.99472	99.99472
673	674.006	103.8837	4.015169	99.9884	1	99.9884	99.9884
675	676.4305	103.8774	4.013571	99.98216	1	99.98216	99.98216
677	678.855	103.8354	4.002975	99.97467	1	99.97467	99.97467
680	681.2795	103.8279	4.001081	99.96728	1	99.96728	99.96728
682	683.704	103.8206	3.999212	99.96	1	99.96	99.96
685	686.1285	103.8133	3.997372	99.9528	1	99.9528	99.9528
687	688.553	103.8061	3.995553	99.94569	1	99.94569	99.94569

Time Increment	Real Time	Plant Discharge	T-Lost TO-Atmos	Surface Temp	Mixed Depth	Mixed Temp	Plant Intake
690	690.9775	103.799	3.993756	99.93866	1	99.93866	99.93866
692	693.402	103.7919	3.991978	99.93172	1	99.93172	99.93172
694	695.8265	103.785	3.990225	99.9249	1	99.9249	99.9249
697	698.251	103.7782	3.988499	99.91815	1	99.91815	99.91815
699	700.6755	103.7714	3.986794	99.91149	1	99.91149	99.91149
702	703.1	103.7648	3.98511	99.9049	1	99.9049	99.9049
704	705.5245	103.7582	3.983443	99.89841	1	99.89841	99.89841
707	707.949	103.7517	3.981804	99.89197	1	99.89197	99.89197
709	710.3735	103.7452	3.980175	99.88562	1	99.88562	99.88562
711	712.798	103.7389	3.97857	99.87934	1	99.87934	99.87934
714	715.2225	103.7326	3.976983	99.87314	1	99.87314	99.87314
716	717.647	103.7264	3.975415	99.86704	1	99.86704	99.86704
719	720.0715	103.7203	3.973874	99.86102	1	99.86102	99.86102

Table 9-20. Conventional Low Pressure Service Water System

COMPONENT DESIGN PARAMETERS	
CONVENTIONAL SERVICE WATER PUMPS	
Manufacturer	Ingersoll-Rand
Type	Centrifugal
Number	3 per station
Design Flow Rate	4500 gpm
Design Head	56 ft.
MAIN TURBINE LUBE OIL COOLERS	
Manufacturer	Westinghouse
Type	Shell and Tube
Number	2 per unit
Flow, Tube Side	3400 gpm
Design Pressure, Tube Side	125 psig
Design Pressure, Shell Side	50 psig
Shell Material	Steel
Tube Material	Admiralty Brass
Design Inlet Temp., Tube Side	95°F
Tube Side Pressure Drop	12 psi
CONVENTIONAL SERVICE WATER STRAINER	
Manufacturer	Zurn
Type and Size	Duplex with ¼" openings
Number	1
Design Flow	9000 gpm
Design Pressure	125 psi
Estimated Pressure Drop, Clean	1.35 psi
Estimated Pressure Drop, 35% Clogged	2.4 psi
Estimated Pressure Drop, 65% Clogged	2.95 psi

Table 9-21. Component Cooling System Component Design Data

Component Cooling Pumps	
Number per Unit	4
Type	Centrifugal
Design Pressure, psig	150
Design Temperature, °F	160
Design Flow, gpm	3500
Design Head, feet	179
Max. Flow Rate, gpm	4300
Head at Max. Flow, feet	130
Shutoff Head, feet	260
Min. Flow Rate, gpm	200
NPSH Required at Max. Flow, feet[1]	28
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	3.84×10^6 (Note 2)
Design Flow (Shell Side), gpm	6704
Design Flow (Tube Side), gpm	10000
Shell Side Inlet Temp., °F	155 (Note 2)
Shell Side Outlet Temp., °F	110 (Note 2)
Tube Side Inlet Temp., °F	78 (Note 2)
Tube Side Outlet Temp., °F	108 (Note 2)
Max. Pressure Loss, psi	15
Shell Side Fouling Factor	.0005
Tube Side Fouling Factor	.002
Shell Side Material	Carbon Steel
Tube Side Material	Inhibited Admiralty

Component Cooling Surge Tank	
Number per Unit	1
Total Volume, Gal.	7100
Normal Water Volume, Gal.	5852
Maximum Water Volume, Gal.	6600
Normal Pressure, psig	0
Design Pressure, psig	15
Design Temperature, °F	200
Material of Construction	304 Stainless Steel
Component Cooling Drain Tank	
Number	1
Total Volume, Gal.	205
Design Pressure, psig	40
Design Temperature, °F	180
Material of Construction	304 Stainless Steel
Component Cooling Drain Tank Pump	
Number	1
Design Flow, gpm	20
Design Head, feet	95
Shutoff Head, feet	100
NPSH Required at Design Flow, feet	6

Notes:

1. NPSH required at pump floor level
2. Values expected during normal operation

Table 9-22. Component Cooling System Nominal Heat Loads and Flows

Component	No. In Service	Heat Load Each (10^6 BTU/HR)	Total Heat Load (10^6 BTU/HR)	Req'd Flow Each (GPM)	Total Flow (GPM)	Note(s)
			Operating Condition - Unit Startup			
ND HX's	1	37.4	37.4	5000	5000	1
ND Pumps	1	.075	.075	5	10	3
Letdown HX	1	16.0	16.0	1000	1000	
Sealwater HX	1	1.6	1.6	250	250	
KF HX's	1	8.7	8.7	2500	2500	4
Sample HX's	7	.212	1.5	14	98	
NB Evap. Cond.	1	7.93	7.93	600	600	
NB Dist. Cooler	1	.75	.75	150	150	
NB Vent Cond.	1	.225	.225	30	30	
NB Seal Hx.	1	.03	.03	10	10	
WL Evap. Cond.	1	7.93	7.93	600	600	
WL Dist. Cooler	1	.75	.75	150	150	
WL Vent Cond.	1	.225	.225	30	30	
WL Seal Hx.	1	.03	.03	10	10	
WG Compressors	2	.135	.27	30	60	
WG Hyd. Recombiners	2	.15	.30	10	20	
RCDT HX	-	-	-	225	225	2
Excess Ltdn. HX	1	5.2	5.2	250	250	
RCP Thermal Barriers	4	.246	.984	40	160	
RCP Motor Lower Brg.	4	.031	.124	5	20	
RCP Motor Upper Brg.	4	.923	3.692	160	640	
TOTAL			93.715		11813	
2 KC Heat Exchanger(s) in service.						
4 KC Pump(s) in service.						

Component	No. In Service	Heat Load Each (10^6 BTU/HR)	Total Heat Load (10^6 BTU/HR)	Req'd Flow Each (GPM)	Total Flow (GPM)	Note(s)
Operating Condition - Normal Unit Operation						
ND HX's						
ND Pumps	-	-	-	5	5	1
Letdown HX	1	16.0	16.0	1000	1000	
Sealwater HX	1	1.6	1.6	250	250	
KF HX's	1	8.5	8.5	2500	2500	
Sample HX's	7	.212	1.5	14	98	
NB Evap. Cond.	1	7.93	7.93	600	600	
NB Dist. Cooler	1	.75	.75	150	150	
NB Vent Cond.	1	.225	.225	30	30	
NB Seal Hx.	1	.03	.03	10	10	
WL Evap. Cond.	1	7.93	7.93	600	600	
WL Dist. Cooler	1	.75	.75	150	150	
WL Vent Cond.	1	.225	.225	30	30	
WL Seal Hx.	1	.03	.03	10	10	
WG Compressors	2	.135	.27	30	60	
WG Hyd. Recombiners	2	.15	.30	10	20	
RCDT HX	1	1.0	1.0	225	225	
Excess Ltdn. HX						
RCP Thermal Barriers	4	.246	.984	40	160	

Notes:

1. Discontinued after RCP's started. The design basis cooling water flow rate for the ND Heat Exchangers is 5000 GPM. This flow rate is required for Operating Condition-Engineered Safety Features (Safety Injection) and Operating Condition-Engineered Safety Features (Recirculation) with all non-essential headers isolated. For other modes of operation, operator action can be assumed to adjust the travel stops on control valves 1/2 KC 57 and 1/2 KC 82 to get a flow rate of 5000 GPM.
2. Receives cooling flow though not in service.
3. Both pumps receive cooling although only one is in service.
4. Only one KF HX assumed in service. However, KC flow capacity is available to place both HX's in service if necessary.

Component	**No. In Service**	**Heat Load Each (10^6 BTU/HR)**	**Total Heat Load (10^6 BTU/HR)**	**Req'd Flow Each (GPM)**	**Total Flow (GPM)**	**Note(s)**
RCP Motor Lower Brg.	4	.031	.124	5	20	
RCP Motor Upper Brg.	4	.923	3.692	160	640	
TOTAL			51.84		6558	
1 KC Heat Exchanger(s) in service.						
2 KC Pump(s) in service.						
Note:						
1. One pump receives flow although neither is in service.						
Operating Condition - Fast Unit Shutdown At 4 Hours						
ND HX's	2	118.59	237.18	5000	10000	1
ND Pumps	2	.075	.15	5	10	
Letdown HX	1	1.2	1.2	300	300	
Sealwater HX	1	.75	.75	250	250	
KF HX's						3
Sample HX's	7	.212	1.5	14	98	
NB Evap. Cond.						3
NB Dist. Cooler						3
NB Vent Cond.						3
NB Seal Hx.						3
WL Evap. Cond.						3
WL Dist. Cooler						3
WL Vent Cond.						3
WL Seal Hx.						3
WG Compressors	2	.14	.28	30	60	
WG Hyd. Recombiners	2	.15	.30	10	20	
RDCT HX	1	1.6	1.6	225	225	
Excess Ltdn. HX						3
RCP Thermal Barriers	1	.246	.246	40	160	2
RCP Motor Lower Brg.	1	.031	.031	5	20	2
RCP Motor Upper Brg.	1	.923	.923	160	640	2
TOTAL			244.16		11783	

Component	No. In Service	Heat Load Each (10^6 BTU/HR)	Total Heat Load (10^6 BTU/HR)	Req'd Flow Each (GPM)	Total Flow (GPM)	Note(s)
2 KC Heat Exchanger(s) in service.						
4 KC Pump(s) in service.						

Notes:

1. Heat load determined as follows:

Core decay heat load	116.38 x 10^6 BTU/HR
Reactor Coolant System sensible heatload (2.01 x 10^6 BTU/HR/°F at 50°F/HRcooldown rate)	100.5 x 10^6 BTU/HR
1 RCP heat input	20.3 x 10^6 BTU/HR
Total	237.18 x 10^6 BTU/HR

The design basis cooling water flow rate for the ND Heat Exchangers is 5000 GPM. This flow rate is required for Operating Condition-Engineered Safety Features (Safety Injection) and Operating Condition-Engineered Safety Features (Recirculation) with all non-essential headers isolated. For other modes of operation operator action can be assumed to adjust the travel stops on control valves 1/2 KC 57 and 1/2 KC 82 to get a flow rate of 5000 GPM.

2. All pumps receive cooling flow although only one pump in service.
3. Equipment normally valved out of service to maximize cooldown rate.

Component	No. In Service	Heat Load Each (10^6 BTU/HR)	Total Heat Load (10^6 BTU/HR)	Req'd Flow Each (GPM)	Total Flow (GPM)	Note(s)
Operating Condition - Fast Unit Shutdown At 20 Hours						
ND HX's	2	36.65	73.3	5000	10000	3
ND Pumps	2	.075	.15	5	10	
Letdown HX	1	1.2	1.2	300	300	
Sealwater HX	1	.75	.75	250	250	
KF HX 's						2
Sample HX's	7	.212	1.5	14	98	
NB Evap. Cond.						2
NB Dist. Cooler						2
NB Vent Cond.						2
NB Seal Hx.						2
WL Evap. Cond.						2
WL Dist. Cooler						2
WL Vent Cond.						2
WL Seal Hx.						2

Component	No. In Service	Heat Load Each (10^6 BTU/HR)	Total Heat Load (10^6 BTU/HR)	Req'd Flow Each (GPM)	Total Flow (GPM)	Note(s)
WG Compressors	-	-	-	30	60	1
WG Hyd. Recombiners	-	-	-	10	20	1
RCDT HX	1	1.6	1.6	225	225	
Excess Ltdn. HX						2
RCP Thermal Barriers	-	-	-	40	160	1
RCP Motor Lower Brg.	-	-	-	5	20	1
RCP Motor Upper Brg.	-	-	-	160	640	1
TOTAL			78.5		11783	

2 KC Heat Exchanger(s) in service.

4 KC Pump(s) in service.

Note:

1. Receive cooling flow although not in service.
2. Equipment normally valved out of service to minimize cooldown rate.
3. The design basis cooling water flow rate for the ND Heat Exchangers is 5000 GPM. This flow rate is required for Operating Condition-Engineered Safety Features (Safety Injection) and Operating Condition-Engineered Safety Features (Recirculation) with all non-essential headers isolated. For other modes of operation operator action can be assumed to adjust the travel stops on control valves 1/2 KC 57 and 1/2 KC 82 to get a flow rate of 5000 GPM.

Operating Condition - Unit Shutdown At 4 Hours (LOCA on Other Unit)						
ND HX's	1	136.68	136.68	5000	5000	2
ND Pumps	1	.075	.075	5	5	
Letdown HX	1	1.2	1.2	300	300	
Sealwater HX	1	.75	.75	250	250	
KF HX 's						1
Sample HX's	7	.212	1.5	14	98	
NB Evap. Cond.						1
NB Dist. Cooler						1
NB Vent Cond.						1
NB Seal Hx.						1
WL Evap. Cond.						1
WL Dist. Cooler						1
WL Vent Cond.						1

Component	**No. In Service**	**Heat Load Each (10^6 BTU/HR)**	**Total Heat Load (10^6 BTU/HR)**	**Req'd Flow Each (GPM)**	**Total Flow (GPM)**	**Note(s)**
WL Seal Hx.						1
WG Compressors						1
WG Hyd. Recombiners						1
RCDT HX						1
Excess Ltdn. HX						1
RCP Thermal Barriers	1	.246	.246	40	160	3
RCP Motor Lower Brg.	1	.031	.031	5	20	3
RCP Motor Upper Brg.	1	.923	.923	160	640	3
TOTAL			141.405		6473	

1 KC Heat Exchanger(s) in service.

2 KC Pump(s) in service.

Note:

1. Equipment valved out of service to reduce heat load and flow requirements.
2. Heat load requirement is removal of core decay heat plus heat input of one RCP as follows:

Core decay heat load	116.38 x 10^6 BTU/HR
1 RCP heat input	20.3 x 10^6 BTU/HR
Total	136.68 x 10^6 BTU/HR

Unit cooldown will be accomplished slowly as decay heat load decreases.

The design basis cooling water flow rate for the ND Heat Exchangers is 5000 GPM. This flow rate is required for Operating Condition-Engineered Safety Features (Safety Injection) and Operating Condition-Engineered Safety Features (Recirculation) with all non-essential headers isolated. For other modes of operation operator action can be assumed to adjust the travel stops on control valves 1/2 KC 57 and 1/2 KC 82 to get a flow rate of 5000 GPM.

3. All pumps receive cooling flow although only one pump is in service.

			Operating Condition - Refueling			
ND HX's	2	20.95	41.9	5000	10000	1
ND Pumps	2	.075	.15	5	10	
Letdown HX	-	-	-	300	300	2
Sealwater HX	-	-	-	250	250	2
KF HX 's	1	-	-	2500	2500	3
Sample HX's	7	.212	1.5	14	98	
NB Evap. Cond.	1	7.93	7.93	600	600	

Component	No. In Service	Heat Load Each (10^6 BTU/HR)	Total Heat Load (10^6 BTU/HR)	Req'd Flow Each (GPM)	Total Flow (GPM)	Note(s)
NB Dist. Cooler	1	.75	.75	150	150	
NB Vent Cond.	1	.225	.225	30	30	
NB Seal Hx.	1	.03	.03	10	10	
WL Evap. Cond.						
WL Dist. Cooler						
WL Vent Cond.						
WL Seal Hx.						
WG Compressors	-	-	-	30	60	2
WG Hyd. Recombiners	-	-	-	10	20	2
RCDT HX	-	-	-	225	225	2
Excess Ltdn. HX						
RCP Thermal Barriers	-	-	-	40	160	2
RCP Motor Lower Brg.	-	-	-	5	20	2
RCP Motor Upper Brg.	-	-	-	160	640	2
TOTAL			52.49		15703	

2 KC Heat Exchanger(s) in service.

4 KC Pump(s) in service.

Notes:

1. Heat load is core decay heat at 4 days after zero power, at which time transfer of fuel assemblies to the fuel pool is estimated to begin.

   The design basis cooling water flow rate for the ND Heat Exchangers is 5000 GPM. This flow rate is required for Operating Condition-Engineered Safety Features (Safety Injection) and Operating Condition-Engineered Safety Features (Recirculation) with all non-essential headers isolated. For other modes of operation operator action can be assumed to adjust the travel stops on control valves 1/2 KC 57 and 1/2 KC 82 to get a flow rate of 5000 GPM.
2. Equipment receives cooling flow although not in service. Cooling flow may be blocked to reduce system flow requirements.
3. One KF HX placed in service for normal 3/8 core removal. If two KF HX's are required for 1 3/8 core removal cooling flow should be blocked to equipment not in service (see 2.).

Operating Condition - Engineered Safety Features (Safety Injection)						
ND HX's	2	-	-	5000	10000	1
ND Pumps	2	.075	.15	5	10	
Letdown HX						

Component	No. In Service	Heat Load Each (10^6 BTU/HR)	Total Heat Load (10^6 BTU/HR)	Req'd Flow Each (GPM)	Total Flow (GPM)	Note(s)
Sealwater HX						
KF HX 's						
Sample HX's						
NB Evap. Cond.						
NB Dist. Cooler						
NB Vent Cond.						
NB Seal Hx.						
WL Evap. Cond.						
WL Dist. Cooler						
WL Vent Cond.						
WL Seal Hx.						
WG Compressors						
WG Hyd. Recombiners						
RCDT HX						
Excess Ltdn. HX						
RCP Thermal Barriers						2
RCP Motor Lower Brg.						2
RCP Motor Upper Brg.						2
TOTAL			.15		10010	

2 KC Heat Exchanger(s) in service.

4 KC Pump(s) in service.

Notes:

1. Flow supplied although no cooling is required by the ND HX's during the safety injection mode of operation.
2. These components continue to receive cooling flow until containment high- high pressure signal is received at which time flow is blocked automatically.

Operating Condition - Engineered Safety Features (Recirculation)						
ND HX's	2	70.	140	5000	10000	1,2
ND Pumps	2	.075	.15	5	10	
Letdown HX						
Sealwater HX						

Component	No. In Service	Heat Load Each (10^6 BTU/HR)	Total Heat Load (10^6 BTU/HR)	Req'd Flow Each (GPM)	Total Flow (GPM)	Note(s)
KF HX 's						
Sample HX's						
NB Evap. Cond.						
NB Dist. Cooler						
NB Vent Cond.						
NB Seal Hx.						
WL Evap. Cond.						
WL Dist. Cooler						
WL Vent Cond.						
WL Seal Hx.						
WG Compressors						
WG Hyd. Recombiners						
RCDT HX						
Excess Ltdn. HX						
RCP Thermal Barriers						
RCP Motor Lower Brg.						
RCP Motor Upper Brg.						
TOTAL			140.15		10010	

2 KC Heat Exchanger(s) in service.

4 KC Pump(s) in service.

Notes:

1. Two ND HX's shown in service although only one is required operative under accident conditions.
2. Heat load is approximate initial value. Load is dependent on KC supply temperature and sump water temperature and decreases with time as decay heat generation decreases.

Table 9-23. Component Cooling System Valve Alignment for Various Modes of Operations

Valve Number[1]	Unit Startup	Normal Unit Operation	Fast Unit Shutdown At 4 hrs	Fast Unit Shutdown At 20 hrs	Unit Shutdown At 4 hrs (LOCA on Other Unit)	Refueling	ESF Safety Injection	ESF Recircu-lation	Figure
1KC1A	O	O	O	O	O	O	X	X	9-57
1KC3A	O	O	O	O	O	O	X[2]	X[2]	9-57
1KC50A	O	O	O	O	O	O	X	X	9-57
1KC230A	O	O	O	O	O	O	X[2]	X[2]	9-57
1KC56A	O	X	O	O	O	O	O	O	9-57
1KC320A	O	O	O	O	O	O	X	X	9-57
1KC332B	O	O	O	O	O	O	X	X	9-57
1KC333A	O	O	O	O	O	O	X	X	9-57
1KC305B	O	X	X	X	X	X	X	X	9-57
1KC315B	O	X	X	X	X	X	X	X	9-57
1KC338B	O	O	O	O	O	O	X[2]	X[2]	9-57
1KC424B	O	O	O	O	O	O	X[2]	X[2]	9-57
1KC425A	O	O	O	O	O	O	X[2]	X[2]	9-57
1KC429B	O	O	O	O	O	O	X	X	9-57
1KC430A	O	O	O	O	O	O	X	X	9-57
1KC464	O	O	O	O	O	O	X	X	9-57

Valve Number[1]	Unit Startup	Normal Unit Operation	Fast Unit Shutdown At 4 hrs	Fast Unit Shutdown At 20 hrs	Unit Shutdown At 4 hrs (LOCA on Other Unit)	Refueling	ESF Safety Injection	ESF Recircu-lation	Figure

Note:

Nomenclature: O - open X - closed

1. Valves listed in this table are isolation valves which are regularly manipulated to align the system for its various modes of operation. All other isolation valves remain in the position indicated on the flow diagram except for changes required for maintenance, or emergency situations.
2. Valves close on Phase B Containment Isolation Signal.

Table 9-24. Component Cooling System Malfunction Analysis

Component	Malfunction	Comments and Consequences
1. Component cooling water pump	Rupture of pump casing	Isolate pump and start redundant pump.
2. Component cooling water pump	Pump fails to start	Isolate pump and start redundant pump.
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	Valves are checked open by prestartup and operational checks.
5. Component cooling water pump	Loss of normal electric power	Switch to emergency diesel power.
6. Component cooling heat exchanger	Tube or shell rupture	Isolate leaking heat exchanger and valve in spare heat exchanger.
7. Component cooling heat exchanger vent or drain valve	Left Open	This is prevented by prestartup and operational checks.
8. Valves and piping	Rupture	Isolate equipment supplied and start redundant equipment or isolate entire header and start equipment on redundant header.
9. Component Cooling Surge Tank	Failure of baffle plate	Channel separation would be lost, but single failure dictates no other malfunction anywhere else in this system.
10. Component Cooling Surge Tank	Failure of one outside wall	Isolate channel affected and start up redundant channel.

Table 9-25. Refueling Water System Component Design Data

Refueling Water Storage Tank	
Number per unit	1
Internal Volume, gallons	395,000
Usable Volume, gallons	≥ 350,000
Design pressure, internal	ATM
Design temperature, °F	120
Material of Construction	Lined Carbon Steel
Type	Vertical, field constructed
Refueling Water Pumps	
Number per unit	1
Type	Centrifugal
Design pressure, psig	200
Design temperature, °F	200
Material of Construction	Stainless Steel
Design flow, gpm	Condition 1: 310
	Condition 2: 195
Design head, ft	Condition 1: 220
	Condition 2: 300
Refueling Water Pump Strainer	
Number per unit	1
Type	Basket
Design pressure, psig	50
Design temperature, °F	150
Design flow, gpm	310
Pressure loss at design flow	Negligible
Strainer openings, inches	1/16
Refueling Water Recirculation Pumps	
Number per unit	2
Type	Centrifugal
Design pressure, psig	50
Design temperature, °F	150
Material of construction	Stainless Steel

Design flow, gpm	100
Design head, ft	35
Refueling Water Pipe Trench Sump Pumps	
Number Per Unit	2
Type	Centrifugal
Design temperature, °F	130
Design flow, gpm	20
Design head, ft	23

Table 9-26. Normal Sampling of Secondary Side for Radioactivity

Location	Method of Sampling	Frequency	Method of Analysis
Unit 1 Turbine Room Sump	grab sample	1/Week	Gross Gamma
Unit 2 Turbine Room Sump	grab sample	1/Week	Gross Gamma

Table 9-27. Deleted Per 1992 Update

Table 9-28. Compressed Gas Vessel Design Parameters

Vessel	Parameter
1. Oxygen	
Number (For welding)	16/Station
Design Pressure	3775 psig
Operating Pressure	2300-2500 psig
Total energy released if vessel should rupture	1232 Btu
Location (Note 1, 2 and 3)	Maintenance shop and yard
2. Nitrogen:	
Number	9/Station
Design Pressure	2450 psig
Operating Pressure	2300 psig
Total energy released if vessel should rupture	58,000 Btu
Location (Note 1, 2 and 3)	Yard
3. Hydrogen:	
Number	9/Station
Design Pressure	2450 psig
Operating Pressure	2300 psig
Total energy released if vessel should rupture	57,500 Btu
Location (Note 1, 2 and 3)	Yard
4. Chlorine:	
Number	0/Station
Design Pressure	525 psig
Operating Pressure	120-170 psig
Total energy released if vessel should rupture	1800 Btu
Location (Note 1, 2 and 3)	Yard
5. Carbon Dioxide:	
Number	16/Station
Design Pressure	3000 psig
Operating Pressure	700-1000 psig
Total energy released if vessel should rupture	1435 Btu
Location (Note 1, 2 and 3)	Turbine Building
6. Instrument Air Receivers:	

Vessel	Parameter
Number	3/Station
Design Pressure	115 psig
Operating Pressure	100 psig
Total energy released if vessel should rupture	8650 Btu
Location (Note 1, 2 and 3)	Service Building
7. Diesel Generator Starting Air:	
Number	2/Diesel
Design Pressure	250 psig
Operating Pressure	230 psig
Total energy released if vessel should rupture	6550 Btu
Location (Note 1, 2 and 4)	Diesel Building
8. Acetylene:	
Number	8/Station
Design Pressure	3775 psig
Operating Pressure	2300-2500 psig
Total energy released if vessel should rupture	2750 Btu
Location (Note 1, 2 and 3)	Maintenance Shop
9. Instrument Compressed Air Tanks	
Number	4/Station
Design Pressure	115 psig
Operating Pressure	100 psig
Total energy released if vessel should rupture	2440 Btu
Location Note 1, 2 and 3)	Auxiliary Building
10. Oxygen:	
Number (Bulk Storage)	4/Station
Design Pressure	2450 psig
Operating pressure	2300 psig
Total energy released if vessel should rupture	58,200 Btu
Location (Note 1, 2 and 3)	Yard
11. Station Air Receivers	
Number	2/Station
Design Pressure	125 psig

Vessel	Parameter
Operating Pressure	100 psig
Total energy released if vessel should rupture	8650 Btu
Location (Note 1, 2 and 3)	Service Building
12. High Pressure Station Air Receivers	
Number	2/Station
Design Pressure	200 psig
Operating Pressure	100-140 psig
Total energy released if vessel should rupture	710 Btu
Location (Note 1, 2 and 3)	Service Building
13. High Pressure Breathing Air Receiver	
Number	1/Station
Design Pressure	125 psig
Operating Pressure	115 psig
Total energy released if vessel should rupture	890 BTU
Location (Note 1, 2 and 3)	Service Building
14. Reactor Coolant Drain Tank Hydrogen Storage Cylinder	
Number	4/Station
Design Pressure	3775 psig
Operating Pressure	2265 psig
Total energy released if vessel should rupture	1540 Btu
Location (Note 1, 2 and 3)	Yard

Notes:

1. ASME codes apply; therefore, designed against rupture.
2. OSHA 29CFR 1910 applies.
3. Tanks separated from essential equipment.
4. The diesels are separated from each other by missile barriers.

Table 9-29. Compressed Air Design Parameters

Instrument Air, Centrifugal Air Compressors D, E, F	
Number per Station	3
Design Pressure, PSIG	115
Design Flow, ICFM (Nominal)	1550
Normal Operating Pressure, PSIG	100
Instrument Air, Reciprocating Air Compressors A, B, C	
Number per Station	3
Design Pressure, PSIG	115
Design Temperature, °F	350
Design Flow, SCFM	650
Normal Operating Pressure, PSIG	100
Instrument Air, Diesel Powered Air Compressors	
Number Per Station	2
Design Pressure, PSIG	100
Design Flow, SCFM (Outlet)	1200
Normal Operating Pressure, PSIG	100
Instrument Air Centrifugal Compressor Inlet Filter, D	
Number per Station	1
Design Flow, CFM	1550 (min)
Filter Retention, Microns (primary/secondary)	10 @ 99.97% efficiency/ 2 @ 98% efficiency
Instrument Air Centrifugal Compressor Inlet Filter, E & F	
Number per Station	2
Design Flow, CFM	1550 (min)
Filter Retention, Microns	4 @ 98% efficiency
Instrument Air Reciprocating Compressor Inlet Filter, A, B, C	
Number per Station	3
Design Flow, SCFM	1,320
Filter Retention, Microns	10
Instrument Air, Reciprocating Air Compressor Aftercoolers	

Number, Both Units	2
Design Flow, SCFM	1,800
Design Pressure, PSIG	115
Design Temperature, °F	105
Normal Operating Pressure, PSIG	100
Maximum Operating Temperature, °F	95
Terminal Difference, °F	15
Instrument Air, Air Receivers	
Number per Station	3
Storage Capacity, ft^3	312
Design Pressure, PSIG	115
Normal Operating Pressure, PSIG	100
Instrument Air, Air Dryers A, B, C	
Number per Station	1
Dew Point, °F	–40
Design Flow, SCFM	200
Design Pressure, PSIG	115
Design Temperature, °F	105
Instrument Air, Pre-Filters A, B, C	
Number per Station	3
Design Flow, SCFM	1800
Design Pressure Drop, PSID	10
Filter Retention, Microns	1 Particulate/0.3 Coalescing
Instrument Air, After Filters A, B, C	
Number per Station	3
Design Flow, SCFM	1800
Design Pressure Drop, PSID	10
Filter Retention, Microns	0.9
Instrument Air, Pre-Filter E	
Number per Station	1
Design Flow, SCFM	300
Design Pressure Drop, PSID	0.15

Filter Retention, Microns	1.0
Instrument Air, After Filters E	
Number per Station	1
Design Flow, SCFM	350
Design Pressure Drop, PSID	1.2
Filter Retention, Microns	5
Instrument Air, Dryer Bypass Filter	
Number per Station	1
Design Flow, SCFM	2400
Design Pressure Drop, PSID	10
Filter Retention, Micron	1.0
Instrument Compressed Air Tanks	
Number per Station	4
Storage Capacity, ft^3	96
Design Pressure, PSIG	115
Normal Operating Pressure, PSIG	100
Station Air, Oil Remover Filter	
Number per Station	2
Design Flow, SCFM	900
Design Pressure, PSIG	200
Filter Retention (solid/oil) Microns	0.6 micron 99.95% eff./ 0.1 micron 99.75% eff.
Station Air, Air Receivers	
Number per Station	2
Storage Capacity, ft^3	312
Design Pressure, PSIG	125
Normal Operating Pressure, PSIG	100
Station Air, High Pressure Air Compressors	
Number per Station	2
Design Flow, SCFM	26
Design Pressure, PSIG	200
Station Air, High Pressure Air Filters	
Number	2
Design Flow, SCFM	26

Filter Retention, Microns	10
Station Air, High Pressure Air Receivers	
Number per Station	2
Storage Capacity, gal	
Tank 'A'	80
Tank 'B'	120
Design Pressure, PSIG	200
Normal Operating Pressure, PSIG	140
Breathing Air, Air Compressors	
Number per Station	2
Design Pressure, PSIG	125
Design Flow, SCFM	450
Normal Operating Pressure, PSIG	115
Breathing Air, Purifiers	
Number per Station	2
Design Outlet Flow, SCFM @ 125 psig inlet pressure	464
Design Pressure, PSIG	150
Breathing Air, Air Receiver	
Number per Station	1
Storage Capacity, Ft^3	32
Design Pressure, PSIG	125
Normal Operating Pressure, PSIG	115
Station Air, Air Compressors	
Number per Station	1
Design Pressure, PSIG	115
Design Temperature, °F	350
Design Flow, SCFM	750
Normal Operating Pressure, PSIG	100
Station Air, Air Filters	
Number per Station	1
Design Flow, SCFM	750
Filter Retention, Microns	10
Station Air, Air Compressor Aftercoolers	

Number per Station	1
Design Flow, SCFM	750
Design Pressure, PSIG	115
Design Temperature, °F	105
Normal Operating Pressure, PSIG	100
Maximum Temperature °F	95
Terminal Difference, °F	15

Table 9-30. Valves Aligned to Blackout Air Supply

Number	Location	Blackout Air Header Alignment	Valve Name
1CA36AB	AB	B	Aux FDWP No 1 Disch to Stm Gen 1D Control
1CA40B	AB	B	Aux FDWP 1B Disch to Stm Gen 1D Control
1CA44B	AB	B	Aux FDWP 1B Disch to Stm Gen 1C Control
1CA48AB	AB	A	Aux FDWP No 1 Disch to Stm Gen 1C Control
1CA52AB	AB	A	Aux FDWP No 1 Disch to Stm Gen 1B Control
1CA56A	AB	A	Aux FDWP 1A Disch to Stm Gen 1B Control
1CA60A	AB	A	Aux FDWP 1A Disch to Stm Gen 1A Control
1CA64AB	AB	A	Aux FDWP No 1 Disch to Stm Gen 1A Control
1CA162B	AB	B	U1 CA Pump FLEX Suct Auto Supply Isol
1NC32B	RB	B	Pressurizer No 1 Power Operated Safety Relief
1NC34A	RB	A	Pressurizer No 1 Power Operated Safety Relief
1NC36B	RB	B	Pressurizer No 1 Power Operated Safety Relief
1NV1A	RB	A	NC Letdown Isol to Regenerative HX No 1
1NV2A	RB	A	NC Letdown Isol to Regenerative HX No 1
1NV13B	RB	B	NV Supply to NC Loop 1 Isolation
1NV16A	RB	B	NV Supply to NC Loop 4 Isolation
1NV21A	RB	A	NV Aux Spray Supply to Pressurizer Isolation
INV24B	RB	B	1C NC Loop to Excess LD HX Isol
1NV25B	RB	B	NC Loop 3 Supply to Excess letdown HX No 1 Isolation
1NV26B	RB	B	Excess Letdown HX No 1 Tube Outlet Control
1NV35A	RB	A	Letdown Orifice 1A Outlet Containment Isolation
1NV124	AB	A	Low Pressure Letdown Control
1NV137A	AB	A	NC Filters Outlet Three Way Control

Number	Location	Blackout Air Header Alignment	Valve Name
1NV238	AB	A	Centrifugal Charging Pumps Disch Control
1NV241	AB	B	Regenerative HX No 1 Tube Inlet Control
1NV267A	AB	A	Boric Acid to Boric Acid Blender Control
1NV457A	RB	A	Letdown Orifice 1C Outlet Containment Isolation
1NV458A	RB	A	Letdown Orifice 1B Outlet Containment Isolation
1NV459	RB	A	Letdown Orifice 1A Outlet
Deleted Per 2011 Update			
1SM1AB	DH	A	Main Steam 1D Isolation
1SM3ABC	DH	B	Main Steam 1C Isolation
1SM5AB	DH	B	Main Steam 1B Isolation
1SM7AB	DH	A	Main Steam 1A Isolation
1SV1AB	DH	A	Main Steam 1D Power Operated Relief
1SV7ABC	DH	B	Main Steam 1C Power Operated Relief
1SV13AB	DH	B	Main Steam 1B Power Operated Relief
1SV19AB	DH	A	Main Steam 1A Power Operated Relief
Deleted Per 2011 Update			
1RV79A	AB	A	Upper Cont Vent Unit Supply Cont Isolation
1RV80B	RB	B	Upper Cont Vent Unit Supply Cont Isolation
1RV101A	RB	A	Upper Cont Vent Unit Discharge Cont Isolation
1RV102B	AB	B	Upper Cont Vent Unit Discharge Cont Isolation
1RF821A	AB	A	U1 Cont Fire Protection Supply Cont Isolation
2CA36AB	AB	B	Aux FDWP No 2 Disch to Stm Gen 2D Control
2CA40B	AB	B	Aux FDWP 2B Disch to Stm Gen 2D Control
2CA44B	AB	B	Aux FDWP 2B Disch to Stm Gen 2C Control
2CA48AB	AB	A	Aux FDWP No 2 Disch to Stm Gen 2C Control
2CA52AB	AB	A	Aux FDWP No 2 Disch to Stm Gen 2B Control

Number	Location	Blackout Air Header Alignment	Valve Name
2CA56A	AB	A	Aux FDWP 2A Disch to Stm Gen 2B Control
2CA60A	AB	A	Aux FDWP 2A Disch to Stm Gen 2A Control
2CA64AB	AB	A	Aux FDWP No 2 Disch to Stm Gen 2A Control
2CA162B	AB	A	U2 CA Pump FLEX Suct Auto Supply Isol
2NC32B	RB	B	Pressurizer No 2 Power Operated Safety Relief
2NC34A	RB	A	Pressurizer No 2 Power Operated Safety Relief
2NC36B	RB	B	Pressurizser No 2 Power Operated Safety Relief
2NV1A	RB	A	NC Letdown Isol to Regenerative HX No 2
2NV2A	RB	A	NC Letdown Isol to Regenerative HX No 2
2NV13B	RB	B	Unit 2 NV Supply to 2A NC Loop Isolation
2NV16A	RB	A	Unit 2 NV Supply to 2D NC Loop Isolation
2NV21A	RB	A	NV Aux Spray Supply to Pressurizer Isolation
2NV24B	RB	B	2C NC Loop to Excess LD HX Isol
2NV25B	RB	B	2C NC Loop to Excess LD HX Isol
2NV26B	RB	B	Excess Letdown HX No 2 Tube Outlet Control
2NV35A	RB	A	Letdown Orifice 2A Outlet Containment Isolation
2NV124	AB	A	Low Pressure Letdown Control
2NV137A	AB	A	NC Filters Outlet Three Way Control
2NV238	AB	A	Centrifugal Charging Pumps Disch Control
2NV241	AB	B	Regenerative HX No 2 Tube Inlet Control
2NV267A	AB	A	Boric Acid to Boric Acid Blender Control
2NV457A	RB	A	Letdown Orifice 2C Outlet Containment Isolation
2NV458A	RB	A	Letdown Orifice 2B Outlet Containment Isolation
2NV459	RB	A	Letdown Orifice 2A Outlet
2SM1AB	DH	A	Main Steam 2D Isolation
2SM3ABC	DH	B	Main Steam 2C Isolation

Number	Location	Blackout Air Header Alignment	Valve Name
2SM5AB	DH	B	Main Steam 2B Isolation
2SM7AB	DH	A	Main Steam 2A Isolation
2SV1AB	DH	A	Main Steam 2D Power Operated Relief
2SV7ABC	DH	B	Main Steam 2C Power Operated Relief
2SV13AB	DH	B	Main Steam 2B Power Operated Relief
2SV19AB	DH	A	Main Steam 2A Power Operated Relief
2RV79A	AB	A	Upper Cont Vent Unit Supply Cont Isolation
2RV80B	RB	B	Upper Cont Vent Unit Supply Cont Isolation
2RV101A	RB	A	Upper Cont Vent Unit Discharge Cont Isolation
2RV102B	AB	B	Upper Cont Vent Unit Discharge Cont Isolation
1RF832A	AB	A	U2 Cont Fire Protection Supply Cont Isolation

Table 9-31. Valves Aligned to Blackout Air Supply

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 - 120
Maximum mixed bed demineralizer purification , gpm	150 [1]
Charging Flow (excludes seal water):	
Normal, gpm	~55 - 100
Normal operational limit, gpm	144 [2]
Temperature of letdown reactor coolant entering system, °F	556
Temperature of charging flow directed to Reactor Coolant System, °F	514
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 at the end of a core cycle with the most reactive control rod stuck out of the core, gallons	See COLR
Maximum pressurization required for hydrostatic testing of Reactor Coolant System, psig	3107

Notes:

1. Based on single mixed bed demineralizer alignment.
2. Higher flows are allowed for infrequent operation (e.g. start-up, shutdown,..) as limited by the regenerative heat-exchange design.

Table 9-32. CVCS Component Data Summary

Reciprocating Charging Pump	
Number	1 (per unit)
Design pressure, psig	3200
Design temperature, °F	300
Design flow, gpm	98
Design head, ft.	5800
Material	Austenitic stainless steel
Maximum operating pressure, psig (for Reactor Coolant System hydrotest purposes)	3125
Centrifugal Charging Pumps	
Number	2 (per unit)
Design pressure, psig	2800
Design temperature, °F	300
Design flow, gpm	150
Design head, ft	5800
Material	Austenitic stainless steel
Boric Acid Transfer Pump	
Number	2 per unit
Design pressure, psig	150
Design temperature, °F	250
Design flow, gpm	75
Design head, ft	235
Material	Austenitic stainless steel
Deleted per 2003 update.	
Regenerative Heat Exchanger	
Number	1 (per unit)
Heat transfer rate at design conditions, Btu/hr	11.0×10^6
Tube Side	
Design pressure, psig	2735
Design temperature, °F	650
Fluid	Borated reactor coolant
Material	Austenitic stainless steel

Shell Side		
Design pressure, psig	2485	
Design temperature, °F	650	
Fluid	Borated reactor coolant	
Material	Austenitic stainless steel	
Shellside (Letdown)		
Flow, lb/hr	37,200 – 59,500	
Inlet temperature, °F	560	
Outlet temperature, °F	288	
Tube Side (Charging)		
Flow, lb/hr	27,300 – 49, 600	
Inlet temperature, °F	130	
Outlet temperature, °F	514	
Letdown Heat Exchanger		
Number	1 (per unit)	
Heat transfer rate at design conditions, Btu/hr	16.0×10^6	
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		
	~ 120 gpm letdown	~ 75 gpm letdown
Flow, lb/hr	498,000	200,000
Inlet temperature, °F	95	95
Outlet temperature, °F	127	128
Tube Side (Letdown)		

	~ 120 gpm letdown	~ 75 gpm letdown
Flow, lb/hr	59,600 [1]	37,200
Inlet temperature, °F	380	290
Outlet temperature, °F	115	114
Excess Letdown Heat Exchanger		
Number	1 (per unit)	
Heat transfer rate at design conditions, Btu/hr	5.2×10^6	
	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	95	560
Outlet temperature, °F	137	165
Fluid	Component cooling	Borated reactor coolant
Material	Carbon steel	Austenitic stainless steel
Seal Water Heat Exchanger		
Number	1 (per unit)	
Heat transfer rate at design conditions, Btu/hr	1.6×10^6	
	Shell Side	Tube Side
Design pressure, psig	150	150
Design temperature, °F	250	250
Design flow, lb/hr	125,000	66,000
Inlet temperature, °F	95	139
Outlet temperature, °F	108	115
Fluid	Component cooling water	Borated reactor coolant
Material	Carbon steel	Austenitic stainless steel
Volume Control Tank		
Number	1 (per unit)	
Volume, ft^3	400	
Design pressure, psig	75	

Design temperature, °F	250
Material	Austenitic stainless steel
Boric Acid Tanks	
Number	1 per unit[2]
Capacity, gal	46,000
Design pressure	Atmospheric
Design temperature, °F	200
Material	Austenitic stainless steel
Batching Tank	
Number	1 (shared)
Capacity, gal	800
Design pressure	Atmospheric
Design temperature, °F	300
Material	Austenitic stainless steel
Mixed Bed Demineralizers	
Number	2 (per unit)
Design pressure, psig	300
Design temperature, °F	250
Design flow, gpm	150
Material, (vessel)	Austenitic stainless steel
Seal Water Injection Filters	
Number	2 (per unit)
Design pressure, psig	2735
Design temperature, °F	200
Design flow, gpm	80
Retention for 5-micron particles, percent	98
Material, (vessel)	Austenitic stainless steel
Seal Water Return Filter	
Number	1 (per unit)
Design pressure, psig	300
Design temperature, °F	250

Design flow, gpm	150
Retention for 25-micron particles, percent	98
Material, (vessel)	Austenitic stainless steel
Boric Acid Filter	
Number	1 (per unit)
Design pressure, psig	300
Design temperature, °F	250
Design flow, gpm	150
Retention for 25-micron particles, percent	98
Material, (vessel)	Austenitic stainless steel
Boric Acid Blender	
Number	1 (per unit)
Design pressure, psig	150
Design temperature, °F	250
Material	Austenitic stainless steel
Letdown Orifice	45 gpm
Number	1 (per unit)
Design flow, lb/hr	22,230
Differential pressure at design flow, psi	1900
Design pressure, psig	2485
Design temperature, °F	650
Material	Austenitic stainless steel

Note:

1. Value is nominal design. Higher allowable flows (1.25-2.0 factor higher) are permissable for non-steady state operation (short duration for start-up/shutdown auxiliary letdown operation).
2. One tank is normally aligned with each unit. However, connections are provided to allow either tank to supply either unit.

Table 9-33. Boron Thermal Regeneration System Component Data

The Boron Thermal Regeneration System has been functionally disabled and will be decommissioned at a later date. This information is provided as historical reference only.		
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	59,640	59,650
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
Number	1 (per unit)	
Design heat transfer, BTU/hr	1.49×10^6	
	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	70	
Material of construction	Stainless Steel	
Chillers		
Number	3 (one per unit plus one shared)	
Capacity, BTU/hr	1.66×10^6	
Design flow, gpm	352	
Inlet temperature, °F	48.4	
Outlet temperature, °F	39	

Table 9-34. Boron Recycle System Component Data Summary

Recycle Evaporator Feed Pumps	
Number	2
Design pressure, psig	150
Design temperature, °F	200
Design flow, gpm	30
Design head, ft	320
Material	Stainless steel
Recycle Holdup Tanks	
Number	2
Capacity, gal	112,000
Design pressure	Atmospheric
Design temperature, °F	200
Material	Stainless steel
Recycle Evaporator Reagent Tank	
Number	1
Capacity, gal	5
Design pressure	150
Design temperature, °F	200
Material	Stainless steel
Recycle Evaporator Feed Demineralizers	
Number	2
Design pressure, psig	200
Design temperature, °F	250
Design flow, gpm	120
Resin volume, ft^3	39
Material	Stainless steel
Recycle Evaporator Condensate Demineralizer	
Number	1
Design pressure, psig	200
Design temperature, °F	250
Design flow, gpm	18 (min)/75 (max)
Resin volume, ft^3	27

Material	Stainless steel
Recycle Evaporator Feed Filters	
Number	2
Design pressure, psig	300
Design temperature, °F	250
Design flow, gpm	150
Particle retention	98% of 5 micron size
Material, (vessel)	Stainless steel
Recycle Evaporator Condensate Filter	
Number	1
Design pressure, psig	200
Design temperature, °F	250
Design flow, gpm	35
Particle retention	98% of 25 micron size
Material, (vessel)	Stainless steel
Recycle Evaporator Concentrates Filter	
Number	1
Design pressure, psig	200
Design temperature, °F	250
Design flow, gpm	35
Particle retention	98% of 25 micron size
Material, (vessel)	Stainless steel
Recycle Evaporator Package	
Number	1
Design pressure, psig	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	150
Design temperature, °F	200
Suction flow, SCFM	1 of H_2

Motive flow, SCFM	40 of N_2
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, °F	200
Tank Operating Temperature, °F	110
Material of Construction	Lined Carbon Steel
[1] Not including hydrostatic head.	
Recycle Evaporator Concentrates Pump	
Number	1
Type	Double mechanical seal
Design pressure, psig	150
Design temperature, °F	250
Material of construction	Stainless steel
Design flow, gpm	35
Head at design flow, ft.	125
Seal cooling water requirements	
Flow, gpm	1 min
Temperature, °F	110 max.
Supply head, ft	90 min
Mechanical Seal Cooling Water Pump	
Number	1
Type	Gear
Design pressure, psig	150
Design temperature, °F	140
Material of construction	Bronze
Design flow, gpm	2
Head at design flow, ft.	200
Mechanical Seal Cooling Water Heat Exchanger	

Number	1
Type	Coil
Heat transfer rate at normal conditions,	3.0 x 10^4 BTU/hr
Shell Side Data	
Design pressure, psig	150
Design temperature, °F	140
Normal inlet temperature	95
Normal outlet temperature	101
Design flow rate, gpm	10
Pressure loss of normal operating conditions	4 psid
Material of construction	Carbon steel
Tube Side Data	
Design pressure, psig	150
Design temperature, °F	140
Normal outlet temperature	less than 110
Design flow rate, gpm	2
Pressure loss at normal operating conditions	2 psid
Material of construction	Stainless steel
Mechanical Seal Cooling Water Tank	
Number	1
Internal volume, gal	8.9
Design pressure, internal, psig	Atmospheric
Design pressure, external, psig	Atmospheric
Material of construction	Stainless steel
Mechanical Seal Cooling Water Filter	
Number	1 (for both units)
Type	Disposable synthetic cartridge
Design pressure, psig	100
Design temperature, °F	140
Design flow, gpm	2
Pressure drop, psid	Negligible
Retention, percent at 5 micron particle size	98
Material of construction	Stainless steel

Table 9-35. Reactor Makeup Water Specifications

1. Electrical Conductivity	Less than 2.0 µmhos/cm at 25 C
2. Oxygen	Less than or equal to 1.0 ppm
3. Chloride	Less than 0.15 ppm
4. Fluoride	Less than 0.15 ppm
5. Specific Activity	Less than 0.005 µc/cc Beta-Gamma, excluding tritium which is maintained @ 2.5 µc/cc or less
6. Boron	Less than 10 ppm as boron

Table 9-36. Auxiliary Building Fuel Handling Area Ventilation System Failure Analysis

Component	Failure	Comments and Consequences
1. Fuel Handling Area Fan	Fan fails to start or stops running and cannot be restarted	Fuel handling will not be initiated or will be terminated upon loss of one or both of the fans.
2. Fuel Handling Filter Train	Filter Failure	Filter failure is considered unlikely. Fuel handling will not be initiated unless filter train is acceptable. Filter failure during fuel handling will terminate handling operation.
3. Damper	Damper closes fails to reopen	Fuel handling operation terminated on loss of flow in filter train.

Table 9-37. Comparison of Auxiliary Building Fuel Handling Area Exhaust System with Regulatory Guide 1.52, Revision O

Paragraph	Compliance Status
C-1-a	In compliance with exception of relative humidity, see Exceptions and Comments section of this table
C-1-b	See Exceptions and Comments section of this table
C-1-c	In compliance
C-1-d	In compliance
C-1-e	In compliance
C-2-a	See Exceptions and Comments section of this table
C-2-b	See Exceptions and Comments section of this table
C-2-c	Filter Train proper (Prefilters, HEPA's and Carbon Adsorber) is Seismic Category 1. See Exceptions and Comments section of this table
C-2-d	See Exceptions and Comments section of this table
C-2-e	In compliance
C-2-f	See Exceptions and Comments section of this table
C-2-g	See Exceptions and Comments section of this table
C-2-h	See Exceptions and Comments section of this table
C-2-i	See Exceptions and Comments section of this table
C-2-j	See Exceptions and Comments section of this table
C-2-k	In compliance
C-2-l	See Exceptions and Comments section of this table
C-2-m	In compliance
C-3-a	See Exceptions and Comments section of this table
C-3-b	See Exceptions and Comments section of this table
C-3-c	In compliance
C-3-d	In compliance
C-3-e	See Exceptions and Comments section of this table
C-3-f	In compliance
C-3-g	In compliance
C-3-h	In compliance
C-3-i	In compliance
C-3-j	In compliance
C-3-k	In compliance

Paragraph	Compliance Status
C-3-l	In compliance
C-3-m	See Exceptions and Comments section of this table
C-3-n	In compliance
C-4-a	In compliance
C-4-b	In compliance
C-4-c	See Exceptions and Comments section of this table
C-4-d	See Exceptions and Comments section of this table
C-4-e	In compliance
C-4-f	In compliance
C-4-g	In compliance
C-4-h	In compliance
C-4-i	In compliance
C-4-j	In compliance
C-4-k	In compliance
C-4-l	In compliance
C-4-m	In compliance
C-5-a	See Exceptions and Comments section this table
C-5-b	In Compliance
C-5-c	See Exceptions and Comments section this table
C-5-d	See Exceptions and Comments section this table
C-6-a	See Exceptions and Comments section this table
C-6-b	See Exceptions and Comments section this table
C-1-a	No method is provided to control the relative humidity of the air entering the clean-up system; i.e., clean-up system heaters are not provided.
C-1-b	Services are not shielded from the atmosphere clean-up system.
C-2-a	Passive system elements (filter units and ductwork) are not redundant. The atmosphere clean-up systems consists of prefilters, HEPA filters before the adsorber, gasketless-type iodine adsorber, ducts and dampers, fans and necessary instrumentation. No demisters, HEPA filters after the adsorbers, or heaters are included.
C-2-b	The fans are separated by a distance of approximately 10 feet. The only rotating machinery in the immediate area are the fans serving the filter unit. Due to the physical arrangement of the fans relative to each other, the internal energy of the wheel would cause any missile generated by one wheel to move in a direction away from the other fan. Further, the wheels are contained in the fan scroll themselves and separated by a common, steel intake plenum. In effect, the generation of missiles has been considered in the design arrangement.

Paragraph	Compliance Status
C-2-c	Filter train and all of its internal components are seismic Category 1. External components (fans, ductwork, dampers) are of a heavy-duty, industrial design but are not qualified to seismic Category 1 conditions.
C-2-d	This atmosphere clean-up system is not subject to any containment pressure surges.
C-2-f	The volumetric air flow rate is 35,000 cfm. The arrangement is six HEPA filters wide and four HEPA filters high.
C-2-g	Fuel Pool Exhaust air flow rate, fan status and filter unit fire alarm are located in the Control Room. Filter unit pressure drops are indicated locally.
C-2-h	Neither the power, electrical distribution system, instrumentation nor control is Class 1E.
C-2-i	A dampered by-pass is provided around the Fuel Pool exhaust filter train. By-pass position is indicated both locally and in the Control Room. When a radiation signal is received by the radiation monitors sampling the incoming exhaust air, the dampers are automatically positioned such that the air is processed by the filter train. Reset of the bypass and monitor is accomplished manually.
C-2-j	Filter train will not be removable as an intact unit. Gasketless iodine adsorbers will be used - the design of which permits the fluidizing of carbon for external filling and removal which permits a minimum of exposure to operating personnel.
C-2-l	The filter unit will not be located in a high radiation zone nor will it be subject to any DBA pressure surges.
C-3-a	The filter train contains no demisters.
C-3-b	The filter train contains no heaters.
C-3-e	HEPA filters reach a maximum height of approximately 10 feet above the filter train floor level as does the adsorber. However, since the adsorber is of the gasketless design, no material handling problems will be encountered due to this height as the carbon is fluidized for filling and removing. The HEPA filter section includes permanent galleries for ease of servicing.
C-3-m	Ductwork is designed to meet or exceed the requirements of the SMACNA High Velocity Duct Construction Manual, 1969.
C-4-c	Minimum access door size will be 20" x 50" in the filter train. No vacuum breakers are provided to aid in door opening.
C-4-d	It is recognized that 5'-0" is needed upstream of carbon tray designs. However, design is of the gasketless type which does not require 5'-0" upstream for servicing. There is approximately 4'-0" from the HEPA mounting rack to the nearest obstacle. Compliance with the 5'-0" separation requirement is not practical because space allocations for the filter train were established before the issuance of Regulatory Guide 1.52.
C-5-a	The ANSI N510-1975, Appendix "A", "check list for visual inspection" was used as a guideline to develop the visual inspection checklist used at MNS. Applicability to all items is impractical because the design of the filter train was established prior to the issuance of Regulatory Guide 1.52.

Paragraph	Compliance Status
C-5-c	The need to conduct in-place DOP testing of HEPA filters following the effects of welding, painting, fire, and chemical release are defined in the MNS, "Ventilation Filter Testing Program." The penetration criteria is defined in the MNS "Standardized Technical Specifications." Silicone sealants are used as gasket material for bolted/flanged joints as found in ductwork to equipment (i.e., dampers, fans, etc.) joints.
C-5-d	The need to conduct in-place DOP testing of HEPA filters following the effects of welding, painting, fire, and chemical release are defined in the MNS, "Ventilation Filter Testing Program." The penetration criteria is defined in the MNS "Standardized Technical Specifications." After the adsorber bypass leakage test is complete, the filtration system will be operated for approximately 8 hours to purge the filter media of refrigerant gas.
C-5-a	Testing of the activated carbon is in accordance with the MNS "Standardized Technical Specifications."
C-5-b	In lieu of the sample canister method, carbon test samples will be extracted by deep bed sampling, using a grain theft method. Also, Testing of the activated carbon is in accordance with the MNS "Standardized Technical Specifications."

Table 9-38. Comparison of Auxiliary Building Filtered Ventilation Exhaust System with Regulatory Guide 1.52, Revision 0

Paragraph	Compliance Status
C-1-a	In compliance with exception of relative humidity, see Exceptions and Comments section of this table
C-1-b	See Exceptions and Comments section of this table
C-1-c	In compliance
C-1-d	In compliance
C-1-e	In compliance
C-2-a	See Exceptions and Comments section of this table
C-2-b	See Exceptions and Comments section of this table
C-2-c	Filter Train proper (Prefilters, HEPA's and Carbon Absorber) is Seismic Category 1. See Exceptions and Comments section of this table
C-2-d	See Exceptions and Comments section of this table
C-2-e	In compliance
C-2-f	See Exceptions and Comments section of this table
C-2-g	See Exceptions and Comments section of this table
C-2-h	See Exceptions and Comments section of this table
C-2-i	See Exceptions and Comments section of this table
C-2-j	See Exceptions and Comments section of this table
C-2-k	In compliance
C-2-l	See Exceptions and Comments section of this table
C-2-m	In compliance
C-3-a	See Exceptions and Comments section of this table
C-3-b	See Exceptions and Comments section of this table
C-3-c	In compliance
C-3-d	In compliance
C-3-e	See Exceptions and Comments section of this table
C-3-f	In compliance
C-3-g	In compliance
C-3-h	In compliance
C-3-i	In compliance
C-3-j	In compliance
C-3-k	In compliance

Paragraph	Compliance Status
C-3-l	In compliance
C-3-m	See Exceptions and Comments section of this table
C-3-n	In compliance
C-3-o	In compliance
C-4-a	In compliance
C-4-b	In compliance
C-4-c	See Exceptions and Comments section of this table
C-4-d	See Exceptions and Comments section of this table
C-4-e	In compliance
C-4-f	In compliance
C-4-g	In compliance
C-4-h	In compliance
C-4-i	In compliance
C-4-j	In compliance
C-4-k	In compliance
C-4-l	In compliance
C-4-m	In compliance
Note: The following paragraphs have been compared to Regulatory Guide 1.52 Revision 2.	
C-5-a	See Exceptions and Comments section this table
C-5-b	In Compliance
C-5-c	See Exceptions and Comments section this table
C-5-d	See Exceptions and Comments section this table
C-6-a	See Exceptions and Comments section this table
C-6-b	See Exceptions and Comments section this table
Exceptions and Comments:	
C-1-a	No method is provided to control the relative humidity of the air entering the clean-up system; i.e., clean-up system heaters are not provided.
C-1-b	Services are not shielded from the atmosphere clean-up system.
C-2-a	Passive system elements (filter units and ductwork) and the filter bypass damper are not redundant. The atmosphere clean-up systems consists of prefilters, HEPA filters before the adsorber, gasketless-type iodine adsorber, ducts and dampers, fans and necessary instrumentation. No demisters, HEPA filters after the adsorbers, or heaters are included.

Paragraph	Compliance Status
C-2-b	Two fans, each 50% capacity (at design flow rate), serve each filter unit. Should one fan be out of service for any reason, a flow rate of approximately 66% would still be maintained through the filter train. Since the Auxiliary Building is common to both reactor units, should the loss of both fans be experienced, the other unit's filter train and fans would be available to process the Auxiliary Building environment before release to the unit vent. The only rotating machinery in the immediate area are the fans serving the Auxiliary Building Fuel Handling Area Supply and Exhaust Ventilation Systems. The closest any of these fans is to the Auxiliary Building Filtered Ventilation Exhaust System is approximately 25 feet. The physical arrangement of the fan systems to each other is such that the internal energy of a wheel would cause any missile generated by the wheel to move in a direction away from the other fan systems. Also, the initial impact would be taken by the fan scrolls themselves which would absorb the majority of the energy generated by the missile. Therefore, the generation of missiles and system redundancy has been considered in the system design.
C-2-c	Filter train and all of its internal components are seismic Category 1. External components (fans, ductwork, dampers) are of a heavy-duty, industrial design but are not qualified to seismic Category 1 conditions.
C-2-d	This atmosphere clean-up system is not subject to any containment pressure surges.
C-2-f	The volumetric air flow rate is 45,700 cfm for Unit 1 and 40,500 cfm for Unit 2. The arrangement is seven HEPA filters wide and five HEPA filters high.
C-2-g	Exhaust fan flow status and filter unit fire alarm are located in the Control Room. Filter unit pressure drops and flow rate are indicated locally.
C-2-h	The power supply, electrical distribution system and the control system which provides the safety function for the Auxiliary Building Filtered Ventilation Exhaust system meet all applicable requirements for Class 1E systems. The fan motors for this system were not originally purchased as Class 1E motors; however, they have since been replaced with Class 1E motors in order to maintain electrical system integrity.
C-2-i	A dampered by-pass is provided around the Auxiliary Building Filtered Ventilation Exhaust System. By-pass position is indicated both locally and in the Control Room. When a radiation signal is received by the radiation monitors sampling the incoming exhaust air, the dampers are automatically positioned such that the air is processed by the filter train. Under LOCA conditions the bypass is automatically positioned to allow flow through the filter train. Reset of the bypass and monitor is accomplished manually.
C-2-j	Filter train will not be removable as an intact unit. Gasketless iodine adsorbers will be used - the design of which permits the fluidizing of carbon for external filling and removal which permits a minimum of exposure to operating personnel.
C-2-l	The filter unit will not be located in a high radiation zone nor will it be subject to any DBA pressure surges.
C-3-a	The filter train contains no demisters.
C-3-b	The filter train contains no heaters.

Paragraph	Compliance Status
C-3-e	HEPA filters reach a maximum height of approximately 12 feet above the filter train floor level as does the adsorber. However, since the adsorber is of the gasketless design, no material handling problems will be encountered due to this height as the carbon is fluidized for filling and removing. The HEPA filter section includes permanent galleries for ease of servicing.
C-3-m	Ductwork is designed to meet or exceed the requirements of the SMACNA High Velocity Duct Construction Manual, 1969.
C-4-c	Minimum access door size will be 20" x 50" in the filter train. No vacuum breakers are provided to aid in door opening.
C-4-d	It is recognized that 5'-0" is needed upstream of carbon tray designs. However, design is of the gasketless type which does not require 5'-0" upstream for servicing. There is approximately 4'-6" from the HEPA mounting rack to the nearest obstacle. Compliance with the 5'-0" separation requirement is not practical because space allocations for the filter train were established before the issuance of Regulatory Guide 1.52.
C-5-a	The ANSI N510-1975, Appendix "A", "check list for visual inspection" was used as a guideline to develop the visual inspection checklist used at MNS. Applicability to all items is impractical because the design of the filter train was established prior to the issuance of Regulatory Guide 1.52.
C-5-c	The need to conduct in-place DOP testing of HEPA filters following the effects of welding, painting, fire, and chemical release are defined in the MNS, "Ventilation Filter Testing Program." The penetration criteria is defined in the MNS "Standardized Technical Specifications." Silicone sealants are used as gasket material for bolted/flanged joints as found in ductwork to equipment (i.e., dampers, fans, etc.) joints.
C-5-d	The need to conduct in-place DOP testing of HEPA filters following the effects of welding, painting, fire, and chemical release are defined in the MNS, "Ventilation Filter Testing Program." The penetration criteria is defined in the MNS "Standardized Technical Specifications." After the adsorber bypass leakage test is complete, the filtration system will be operated for approximately 8 hours to purge the filter media of refrigerant gas.
C-6-a	Testing of the activated carbon is in accordance with the MNS "Standardized Technical Specifications."
C-6-b	In lieu of the sample canister method, carbon test samples will be extracted by deep bed sampling, using a grain theft method. Also, Testing of the activated carbon is in accordance with the MNS "Standardized Technical Specifications."

Table 9-39. Purge System Isolation Valve Design and Test Criteria

Design:	Pressure	15 psig
	Differential Pressure	15 psi
	Temperature	250°F
	Radiation	1 x 10^7 rads
	Deleted Per 2008 Update	
Tests:	Valve stem ultrasonically tested	
	Hydrotest to 150% of design pressure	
	5 cycles open and shut by operator followed by a leak test across valve for zero leakage	
	Valve minimum wall measurement	
	Deleted Per 2008 Update	

Table 9-40. Comparison of Reactor Building Containment Purge Exhaust System with Regulatory Guide 1.52 Rev. 1

Paragraph	Compliance Status
C-1-a	In compliance with exception of relative humidity, see Exceptions and Comments section of this table
C-1-b	See Exceptions and Comments section of this table
C-1-c	In compliance
C-1-d	In compliance
C-1-e	In compliance
C-2-a	See Exceptions and Comments section of this table
C-2-b	See Exceptions and Comments section of this table
C-2-c	Filter Train proper (Prefilters, HEPA's and Carbon Absorber) is Seismic Category 1. See Exceptions and Comments section of this table
C-2-d	See Exceptions and Comments section of this table
C-2-e	In compliance
C-2-f	See Exceptions and Comments section of this table
C-2-g	See Exceptions and Comments section of this table
C-2-h	See Exceptions and Comments section of this table
C-2-i	See Exceptions and Comments section of this table
C-2-j	In compliance
C-2-k	In compliance
C-3-a	See Exceptions and Comments section of this table
C-3-b	See Exceptions and Comments section of this table
C-3-c	In compliance
C-3-d	In compliance
C-3-e	In compliance
C-3-f	See Exceptions and Comments section of this table
C-3-g	In compliance
C-3-h	In compliance
C-3-i	In compliance
C-3-j	In compliance
C-3-k	In compliance
C-3-l	In compliance
C-3-m	In compliance

Paragraph	Compliance Status
C-3-n	See Exceptions and Comments section of this table
C-3-o	In compliance
C-4-a and C-4-b	See Exceptions and Comments section of this table.
C-4-c	See Exceptions and Comments section of this table
C-4-d	In compliance
C-4-e	In compliance
C-4-f	In compliance
C-4-m	In compliance
C-5-a	See Exceptions and Comments section this table
C-5-b	In Compliance
C-5-c	See Exceptions and Comments section this table
C-5-d	See Exceptions and Comments section this table
C-6-a	See Exceptions and Comments section this table
C-6-b	See Exceptions and Comments section this table
Exceptions and Comments:	
C-1-a	No method is provided to control the relative humidity of the air entering the clean-up system; i.e., clean-up system heaters are not provided.
C-1-b	Services are not shielded from the atmosphere clean-up system.
C-2-a	Passive system elements (filter units and ductwork) are not redundant. The atmosphere clean-up systems consists of prefilters, HEPA filters before the adsorber, gasketless-type iodine adsorber, ducts and dampers, fans and necessary instrumentation. No demisters, HEPA filters after the adsorbers, or heaters are included.
C-2-b	Each filter train is a separate unit with its own fan. The fans are separated by a distance of approximately 25 feet. The only rotating machinery in the immediate area are the fans serving the filter units. Due to the physical arrangement of the fans relative to each other, the internal energy of the wheel would cause any missile generated by one wheel to move in a direction away from the other fan. Further, the wheels are contained in the fan scroll. In effect, the generation of missiles has been considered in the design arrangement.
C-2-c	Filter train and all of its internal components are seismic Category 1. External components (fans, ductwork, dampers) are of a heavy-duty, industrial design but are not qualified to seismic Category 1 conditions.
C-2-d	This atmosphere clean-up system is not subject to any containment pressure surges. Containment isolation valves which are closed except during purging, prevent the pressure surge from reaching the filter train.
C-2-f	The volumetric air flow rate is 10,500 cfm. The arrangement is five HEPA filters wide and two HEPA filters high.

Paragraph	Compliance Status
C-2-g	Purge exhaust air flow rate and fan status are located on the main control panel outside the Control Room. Filter unit fire alarm and fan status are located in the Control Room. Filter unit pressure drops are indicated locally.
C-2-h	Niether the power, electrical distribution system, instrumentation nor control is Class 1E.
C-2-i	Filter train will not be removable as an intact unit. Gasketless iodine adsorbers will be used - the design of which permits the fluidizing of carbon for external filling and removal which permits a minimum of exposure to operating personnel. Adequate space has been provided for servicing the equipment.
C-3-a	The filter train contains no demisters.
C-3-b	The filter train contains no heaters.
C-3-f	HEPA filters reach a maximum height of approximately 6'-2" above the filter train floor level as does the adsorber. However, since the adsorber is of the gasketless design, no material handling problems will be encountered due to this height as the carbon is fluidized for filling and removing. The HEPA filter section includes permanent galleries for ease of servicing.
C-3-n	Ductwork is designed to meet or exceed the requirements of the SMACNA High Velocity Duct Construction Manual, 1969.
C-4-a and C-4-b	The filter train casing has been designed as a seismic Category 1 Unit. The ductwork is designed to meet or exceed the requirements of the SMACNA High Velocity Duct Construction Manual 1969. The adsorber is of the gasketless design, no material handling problems will be encountered due to physical dimensions as the carbon is fluidized for filling and removing. The HEPA filter section includes permanent galleries for ease of servicing.
C-4-c	It is recognized that 3'-0" is needed upstream of carbon tray designs. However, design is of the gasketless type which does not require 3'-0" upstream for servicing. There is 2'-6" from the HEPA filters to the nearest obstacle. Compliance with the 3'-0" separation requirement is not practical because space allocations for the filter train were established before the issuance of Regulatory Guide 1.52. for the filter train were established before the issuance of Regulatory Guide 1.52.
C-5-a	The ANSI N510-1975, Appendix "A", "check list for visual inspection" was used as a guideline to develop the visual inspection checklist used at MNS. Applicability to all items is impractical because the design of the filter train was established prior to the issuance of Regulatory Guide 1.52.
C-5-c	The need to conduct in-place DOP testing of HEPA filters following the effects of welding, painting, fire, and chemical release are defined in the MNS, "Ventilation Filter Testing Program." The penetration criteria is defined in the MNS "Standardized Technical Specifications." Silicone sealants are used as gasket material for bolted/flanged joints as found in ductwork to equipment (i.e., dampers, fans, etc.) joints.

Paragraph	Compliance Status
C-5-d	The need to conduct in-place DOP testing of HEPA filters following the effects of welding, painting, fire, and chemical release are defined in the MNS, "Ventilation Filter Testing Program." The penetration criteria is defined in the MNS "Standardized Technical Specifications." After the adsorber bypass leakage test is complete, the filtration system will be operated for approximately 8 hours to purge the filter media of refrigerant gas.
C-5-a	Testing of the activated carbon is in accordance with the MNS "Standardized Technical Specifications."
C-5-b	In lieu of the sample canister method, carbon test samples will be extracted by deep bed sampling, using a grain theft method. Also, Testing of the activated carbon is in accordance with the MNS "Standardized Technical Specifications."

Table 9-41. Single Failure Analysis for Total Communication System

Component	Malfunction	Comments and Consequences
1. Station-Commercial Interface	Totally disabled	Direct line may be used until interface is restored.
2. Station-Microwave Interface	Totally disabled	Direct line may be used until interface is restored.
3. Station Telephone-P.A. Interface	Totally disabled, leaving short or open circuit to special preamplifier.	P.A. handsets may be used for paging. Telephone system still in service without paging ability.
4. Supply to Rectifier/Battery Inverter Combination	Power interrupted.	Dedicated diesel generator will automatically start to accept the load. If the diesel generator fails, the 4-hour battery backup will supply the switch.
5. Telephone Switch	Totally disabled	Public Address System may be used for internal communications. Direct lines may be used for commercial and microwave calls.
6. Public Address System	Totally disabled, leaving a short or open circuit to station telephone-p.a. interface.	Station telephones are located throughout the station. This system is sufficient until P.A. system is restored.

Table 9-42. Failure Analysis for Lighting Systems

Component	Malfunction	Comments
Normal Turbine Building Lighting	Loss of Power	Undervoltage sensing relays mounted on individual normal lighting panelboards in the areas of selected stairs and corridors automatically energize the emergency 250 volt dc lighting system to provide lighting to the selected stairs and corridors until normal lighting is restored.
Normal Auxiliary Building Lighting	Loss of Power	Undervoltage sensing relays mounted on individual normal lighting panelboards in the areas of selected stairs and corridors automatically energize the emergency 250 volt dc lighting to the selected stairs and corridors until normal lighting is restored. Undervoltage sensing relays mounted on a selected normal lighting panelboard automatically energizes the emergency ac lighting system to provide lighting to the Cable Room and Equipment Room stairs and exits, Hot Machine Shop, Fuel Pool, Fuel Unloading Area, Diesel Rooms, Pump Rooms, Tank Rooms, Fan Rooms, Decontamination Rooms, Penetration Rooms, Purge Rooms and selected stairs, exits and corridors.
Containment	Loss of Power	The normal Containment lighting system is powered by two independent 600 volt ac sources. In the event that either one or both of these sources is lost, undervoltage sensing relays on the respective normal lighting panelboards automatically energize the emergency dc lighting system which provides lighting for selected stairs and corridors inside of the Reactor Building until normal lighting is restored. Undervoltage sensing relays monitoring a selected 208Y/120VAC normal lighting panelboard automatically energize the emergency ac lighting system to provide lighting to selected stairs and platforms.
Normal Control Room Lighting	Loss of Power	The normal Control Room lighting system is powered by two independent 600 volt ac sources. In the event that either one or both of these sources is lost, undervoltage sensing relays automatically energize the emergency dc lighting system and the emergency ac lighting system to provide lighting in the Control Room until normal lighting is restored.

Table 9-43. Diesel Generator Fuel Oil System Single Failure Analysis

Security-Related Information - Figure Withheld Under 10 CFR 2.390

Table 9-44. Deleted Per 2018 Update

Table 9-45. Containment Ventilation Cooling Water System Component Design

COMPONENT DESIGN PARAMETERS
Containment Ventilation Cooling Water System Pumps

Type, Number	Centrifugal, 3 (shared)
No. Stages	1
Design Capacity	3200 gpm
Required NPSH at design capacity	18 feet
Design TDH	175 feet
Shutoff head	240 feet
Design temperature	150°F
Minimum flow	700 gpm
Motor HP	200
Voltage	575 volts

Containment Ventilation Cooling Water System Suction Strainer

Type, Number	Duplex, 1 (shared)
Perforation	1/4 inch diameter
Design flow	8000 gpm
Estimated pressure drop at design flow, clean	1.5 psi
Design temperature	150°F
Design pressure	135 psig