Appendix 10A. Tables

Table 10-1. Design and Performance Characteristics of the Major Equipment and Tanks

Name	Number	Capacity/Design
Condenser	3	One-third capacity shells
Condenser Hotwell	1	170,000 gallons
Hotwell Pumps	3	One-half system requirement
Condensate Booster Pumps	3	One-half system requirement
Feedwater Pumps	2	One-half system requirement
Condensate Polishing Demineralizer	1	17,000 GPM
Condensate Feedwater		
Heaters		
G	3	One-third system requirement
F	3	One-third system requirement
E	3	One-third system requirement
D	3	One-third system requirement
C	3	One-third system requirement
B	3	One-third system requirement
A	3	One-third system requirement
Steam Generators	4	One-fourth system requirement 3,810,000 lbm/hr feedwater
Turbine-Generator	1	Tandem compound - six flow turbine with a 1,450,000 KVA generator and moisture separator reheater units
Upper Surge Tanks	2	85,000 gallons total
Condensate Storage Tank	1	30,000 gallons
“C” Heater Drain Tanks	3	8,800 gallons/tank
“G” Heater Drain Tanks	3	3,000 gallons/tank
Auxiliary Feedwater Storage Tank	1	300,000 gallons
Auxiliary Feedwater Condensate Storage Tank	2/station	42,500 gallons/tank

Table 10-2. Main Steam Supply System Main Steam Line Safety Valves

Number of main steam lines (per Unit)	4	
Number of valves per main steam line	5	
Total Number of safety valves (per Unit)	20	
Design Data For Valves In Each Main Steam Line		
Valve No.	(psig)	(lb/hr)
1	1170	671,083
2	1190	682,416
3	1205	908,050
4	1220	919,220
5	1225	922,950
	Total per line	4,103,719
Total capacity for four lines lb/hr = 16,414,846		

Table 10-3. Main Condenser Performance And Data

Characteristics	Shell A	Shell B	Shell C
Total heat load, Btu/hr	2.5589×10^9	2.5589×10^9	2.5589×10^9
Design absolute pressure in condensing zone in. Hg (with 60°F circulating water temperature at inlet to shells)	1.46	1.46	1.46
Circulating water flow, GPM	319,867	319,867	319,867
Average velocity in tube, ft/sec	7.0	7.0	7.0
Effective surface area, ft^2	245,370	245,370	245,370
Cleanliness factor, %	95	95	95
Tube outside diameter, in.	1.0	1.0	1.0
Tube BWG	22	22	22
Tube overall length, ft.	45.01	45.01	45.01
Number of Tubes: 304 Stainless Steel	20,944	20,944	20,944
Condensate stored at normal operating level, gal.	56,667	56,667	56,667

Table 10-4. Failure Mode And Effects Analysis Of The Control Systems And Valves Of The Turbine Bypass System

Component	Valve Nos.	Malfunction	Comment
1. Main Steam Power Relief Valves	1SV1, 1SV7, 1SV13, 1SV19	Fail	These valves will fail closed and can be isolated for repair by electric motor operated valves.
Deleted per 2003 update.			
2. Turbine Bypass to Condenser Valves (40% capacity)	1SB3, 1SB6, 1SB9, 1SB12, 1SB15, 1SB18, 1SB21, 1SB24, 1SB27	Fail	These valves will fail closed and can be isolated for repair by manually operated valves.
3. Turbine Bypass Control System		Fail	The main steam safety valves are designed to relieve 100% of full load steam flow to assure integrity of the Steam and Power Conversion System in the event of failure of the Turbine Bypass Control System.
4. Main Steam Safety Valves (100% capacity)	1SV2, 1SV3, 1SV4, 1SV5, 1SV6, 1SV8, 1SV9, 1SV10, 1SV11, 1SV12, 1SV14, 1SV15, 1SV16, 1SV17, 1SV18, 1SV20, 1SV21, 1SV22, 1SV23, 1SV24	Fail	The failure on one valve would cause loss of steam to the atmosphere, but would not effect safe operation of the Steam and Power Conversion System.

Table 10-5. Condensate And Feedwater System Feedwater Heater Data

Characteristics	Data						
Heater Identification	A	B	C	D	E	F	G
Quantity per Unit	3	3	3	3	3	3	3
Type	Vert. U-Tube	Vert. U-Tube	Vert. U-Tube	Vert. U-Tube	Vert. U-Tube	Horz. U-Tube	Horz. U-Tube
Design heat duty. Btu/hr	219.37×10^6	214.55×10^6	240.3×10^6	122.43×10^6	182.70×10^6	154.62×10^6	182.38×10^6
Overall heat transfer Coefficient. condensing zone/subcooling zone/ Btu/hr. ft^2 °F	817/522	803/578	788/--	747/373	710/472	642/452	566/--
Shell side:							
Fluid	Steam & Drains	Steam & Drains	Steam & Flash Vapor	Steam & Drains	Steam & Drains	Steam & Drains	Steam & Drains
Design Temp. °F	570	480	390	390	310	300	300
Design operating temp. inlet. steam/drains. °F	448.6/539.4	411.5/450.2	372.1/372.1	358.4/--	280.9/275.2	216.7/222.1	174.8/174.8
Design operating temp. outlet. steam/drains. °F	414.5/414.5	377.3/377.3	372.1/372.1	275.2/--	222.1/222.1	179.2/179.2	174.8/174.8
Design pressure. psig	500 & full vacuum	325 & full vacuum	200 &full vacuum	75 & full vacuum	50 & full vacuum	50 & full vacuum	50 & full vacuum
Design operating flow, steam/drains. lb/hr	239,698/279,044	234,327/697,551	315,032/6,308	126,743/--	178,552/126,743	145,102/328,357	193,722/40,940
Pressure Loss at design flow condensing zone/ subcooling zone. psi	Nil/3.8	Nil/4.1	Nil/--	Nil/0.6	Nil/3.2	Nil/1.4	Nil/--
Design fouling factor. condensing zone/subcooling zone. hr. $ft.^2$ °F/Btu	.0003	.0003	---	.0003	.0003	.0003	.0003
Tube side:							
Fluid	Feedwater	Feedwater	Condensate	Condensate	Condensate	Condensate	Condensate
Design temp. °F	470	430	390	320	310	300	300

Characteristics	Data						
Design operating temp. inlet °F	406.5	368.3	299.0	265.2	214.1	169.2	103.3
Design operating temp. outlet °F	444.6	406.5	364.1	299.0	265.2	212.7	167.8
Design pressure. psig	1425	1425	700	700	700	269	269
Design operating flow. lb/hr	5,283,972	5,283,972	3,536,179	3,536,179	3,536,179	3,536,179	2,831,252
Pressure loss at design flow. psi	13.6	13.6	11	11.5	12.0	14.6	15
Design fouling factor, hr ft^2 °F/Btu	.000225	.000225	.000215	.00022	.00022	.00022	.00022
Shell diameter, in.	64-3/8	68	46-1/8	50-7/8	52-1/8	58-7/8	52-1/8
Tube outside diameter, in.	5/8	5/8	1	7/8	7/8	3/4	3/4
Tube BWG	20	20	20	20	20	20	20
Materials of Construction:							
Shell	A-515-70	A-515-70	A-515-70	A-515-70	A-515-70	A-515-70	A-515-70
Tubes	A-249-304	A-249-304	A-249-304	A-249-304	A-249-304	A-249-304	A-249-304
Tubesheets	A-266-II	A-266-II	A-516-70	A-516-70	A-516-70	A-516-70	A-516-70

Table 10-6. Hotwell Pump Design Data

Quantity per Unit	3
Type	Vertical Centrifugal
Fluid	Condensate
Design Pressure, PSIG	269
Design Temperature, °F	95.8 min - 180 max
Design Flow Rate, GPM	9820
Design Heat, FT	470
NPSH Required at Design Flow, Ft.	28.5
NPSH Available Ft.	31
Rate RPM	1180
Driver:	
Type	Motor
Rated BHP	1500
Rated RPM	1179
Service Factor	1.25

Table 10-7. Condensate Booster Pump Design Data

Quantity per Unit	3
Type	Horizontal Centrifugal
Fluid	Condensate
Design Pressure, PSIG	670
Design Temperature, °F	220
Design Flow Rate, GPM	12720
Design Head, Ft.	735
NPSH Required at Design Flow, Ft.	95
NPSH Available at Design Flow, Ft.	330
Rate RPM	3560
Driver:	
Type	Motor
Rated BHP	3000
Rated RPM	3555
Service Factor	1.25

Table 10-8. Steam Generator Feedwater Pump Design Data

Quantity per Unit	2
Type	Horizontal Centrifugal
Fluid	Condensate
Design Pressure, PSIG	1167
Design Temperature, °F[1]	366.8
Design Flow Rate, GPM[1]	17,965
Design Head, Ft.[1]	2045
NPSH Required at Design Flow, Ft.	160
NPSH Available at Design Flow, Ft. [1]	613
Rate RPM[1]	5210
Turbine Driver:	
Type	Single flow - Condensing
Steam Inlet Pressure, Psia	166
Back Pressure, in. Hg. A	1.7
Rated BHP	12,200
Rated RPM	5510

Note:

1. 100 % of all valves wide open

Table 10-9. Auxiliary Feedwater System Motor Driven Pump Design Data

Quantity per Unit	2
Type	Horizontal Centrifugal
Fluid	Water
Design Pressure (rerated), PSIG	1900
Design Temperature (rerated), °F	160
Design Flow Rate, GPM	450
Design Head, Ft.	3200
NPSH Required at Design Flow, Ft.	14
Minimum NPSH Available at Design Flow, Ft. (CA Storage Tank Supply)	100
Rate RPM	3560
Driver:	
Type	Motor
Rated BHP	500
Rated RPM	3600
Service Factor	1.25

Table 10-10. Auxiliary Feedwater System Turbine Driven Pump Design Data

Quantity per Unit	1
Type	Horizontal Centrifugal
Fluid	Water
Design Pressure (rerated), PSIG	2003
Design Temperature (rerated), °F	160
Design Flow Rate, GPM	900
Design Head, Ft.	3200
NPSH Required at Design Flow, Ft.	16
Minimum NPSH Available at Design Flow, Ft. (CA Storage Tank supply)	100
Rate RPM	3600
Driver:	
Type	Single Stage Turbine
Steam Inlet Pressure, PSIG	
Operating Minimum Maximum	957 - 1092 110 1205
Back Pressure, PSIG	0
Rated BHP	1040
Rated RPM	3600

Table 10-11. Component Failure Analysis for Condensate and Feedwater System

Component	Malfunction	Comment
Condensate Hotwell Pump	Any failure of pump or valves	Isolate to repair and use redundant pump
Condensate Cooler	Plug or rupture	Isolate to repair and use redundant cooler or use bypass
Steam Packing Exhauster Condenser	Plug or rupture	Use Bypass
Condensate Booster Pump	Any failure of pump or valves	Isolate to repair and use redundant pump
Main Feedwater Pump	Fail	Bring plant to safe shutdown conditions if shutdown trip limits are exceeded using Auxiliary Feedwater System
One Low or High Pressure Heater Train	Fail	Use remaining two trains to pass full feedwater flow
Two Low or High Pressure Heater Trains	Fail	Use remaining train and bypass to pass full feedwater flow

Table 10-12. Component Failure Analysis for Auxiliary Feedwater System

Component	Malfunction	Comment
Condensate supply	Failure of normal condensate supply	Water can be supplied from the Nuclear Service Water System by automatic switchover on low suction pressure.
Motor Driven Auxiliary Feedwater Pump	Either pump failure	Use the turbine driven auxiliary feedwater pump or the redundant motor driven auxiliary feedwater pump.
Turbine Driven Auxiliary Feedwater Pump	Fail	Use motor driven Auxiliary Feedwater Pumps.
Control Room	No access to control room	The system can be monitored and controlled from the panels located near the pumps.
Electrical Power Supply	Failure of normal and offsite power	All necessary components will automatically switch to operation from power supplied by the emergency diesel generators.
	Failure of power supply of components associated with one of the motor driven pumps	Components associated with the redundant motor driven pump are supplied power from physically separated switchgear and cabling.

Table 10-13. Auxiliary Feedwater System Instrumentation and Controls

	Control Room	Local
Controls		
Motor stop/start	x	x
Turbine stop/start	x	x
Individual auxiliary Feedwater regulators for control valves CA40, CA44, CA56, CA60, CA36, CA48, CA52, and CA64	x	x
Individual auxiliary feedwater isolation valves CA42, CA46, CA58, CA62, CA38, CA50, CA54, and CA66 open/close	x	x
Deleted Per 2002 Update		
Auxiliary Feedwater Storage Tank Supply Valve CA2 open/close	x	x
Auxiliary Feedwater Condensate Storage Tanks Supply Valve CA6 open/close	x	x
Auxiliary feedwater pump suction valves CA7A, CA9B, and CA11B open/close	x	x
Nuclear service water supply valves RN69A, RN162B, CA15A, CA18B, CA86A, CA116B, open/close	x	x
Deleted Per 2002 Update		
Manual block of normal automatic auxiliary feedwater pump start logic	x	
Alarms		
Deleted per 2002 Update		
Individual low auxiliary feedwater pump suction pressure	x	
Low turbine stop valve steam pressure	x[1]	
Remote control of the pumps overridden by local control	x	
Low level in auxiliary feedwater storage tank	x	
Auxiliary Feedwater Condensate Storage Tanks Not Full	x	
Auxiliary feedwater injection line check valve upstream temperature	x[1]	
Indicators		
Steam generator A, B, C and D levels	x	x
Steam generator A, B, C and D pressure	x	x
Turbine driven pump suction and discharge pressure	x	x
Motor driven pump 1A suction and discharge pressure	x	x

	Control Room	Local
Motor driven pump 1B suction and discharge pressure	x	x
Turbine steam inlet pressure	x	x
Turbine speed	x	x
Auxiliary feedwater control valves CA40, CA44, CA56, CA60 analog position	x	x
Indicators		
Auxiliary feedwater isolation valves CA42, CA46, CA58, CA62, CA50, CA54, and CA66 open/close position	x	x
TDCA PUMP-TO-SG control valves open/close position (CA64, 52, 48, 36)	x	x
Upper surge tank supply valves CS18 and CA4 open/close position	x	x
Auxiliary Feedwater Storage Tank Supply Valve CA2 open/close position	x	x
Auxiliary feedwater condensate storage tank supply valve CA6 open/close position	x	x
Auxiliary feedwater pump suction valves CA7A, CA9B, and CA11A open/close position	x	x
Nuclear service water supply valves RN69A, RN162B, CA15A, CA18B, CA86A, and CA116B open/close position	x	x
Individual auxiliary feedwater flows to A, B, C and D generators	x	x
Individual auxiliary feedwater pumps supply flows	x	
Main feedwater pressure	x	
Auxiliary Feedwater Storage Tank level	x	x
Deleted rows per 2002 Update	x	
Auxiliary Feedwater Condensate Storage Tanks level	x	x
Nuclear service water pond level	x	
Flow/No Flow indication in the Auxiliary Feedwater minimum flow lines	x	x
Motor running lights	x	x
Auxiliary feedwater check valves CA37, CA41, CA45, CA49, CA53, CA57, CA61, and CA65 upstream temperature	x[2]	

	Control Room	Local

Notes:

1. computer alarm
2. computer indicator

Table 10-14. Condensate Polishing Demineralizer Design Data

Quantity per Unit		4
Type		Powdered Resin/Filter
Design Flow, GPM		17000
Design Pressure Drop, PSID		30
Design Pressure, PSIG		285
Design Temperature, °F		180
Effluent Water Quality:		
Analysis	**Average**	**Maximum**
Total Dissolved Solids	25 PPB	50 PPB
Suspended Solids	20 PPB	25 PPB
Soluble Silica as SiO_2	5 PPB	10 PPB
Iron as Fe	--	5 PPB
Copper as Cu	--	2 PPB
Nickel as Ni	--	2 PPB
Chlorides as C1	--	5 PPB
Acid Conductivity	0.2 umhos	0.5 umhos

Table 10-15. Deleted Per 1992 Update

Table 10-16. Deleted Per 1992 Update

Table 10-17. Deleted Per 1992 Update

Table 10-18. Deleted Per 1992 Update

Table 10-19. Deleted Per 1992 Update

Table 10-20. Deleted Per 1992 Update

Table 10-21. Steam Generator Blowdown System Component Design Data

Steam Generator Blowdown Blowoff Tank	
Quantity (per unit)	1
Design Temperature, °F	338
Design Pressure, PSIG	100
Design Capacity, LBM/HR @ 338°F	180,000
Material	Carbon Steel
Code	ASME VIII
Steam Generator Blowdown Blowoff Tank Pumps	
Quantity (per unit)	2
Design Flow, GPM	280
Design TDH, Feet of H_2O	600
Design Temperature, °F	338

Table 10-22. Deleted Per 1992 Update

Table 10-23. Deleted Per 1999 Update

Table 10-24. "C" Heater Drain Tank Pump Design Data

Quantity per Unit	3
Type	Centrifugal - Vertical
Fluid	Condensate
Design Pressure, PSIG	785
Design Temperature, °F	390
Design Flow Rate, GPM	4380
Design Head, Ft.	850
NPSH Required at Design Flow, Ft.	16
Minimum NPSH Available at Design Flow, Ft.	19
Rate RPM	1780
Driver:	
Type	Motor
Rated bhp	1250
Rated rpm	1780
Service Factor	1.25

Table 10-25. "G" Heater Drain Tank Pump Design Data

Quantity per Unit	3
Type	Centrifugal - Horizontal
Fluid	Condensate
Design Pressure, PSIG	269
Design Temperature, °F	300
Design Flow Rate, GPM	1600
Design Head, Ft.	390
NPSH Required at Design Flow, Ft.	18
Minimum NPSH Available at Design Flow, Ft.	20
Rate RPM	3600
Driver:	
Type	Motor
Rated bhp	250
Rated rpm	3600