ACRONYMS AND ABBREVIATIONS

A/B	auxiliary building
ac	alternating current
AC/B	access building
ALARA	as low as reasonably achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BTP	branch technical position
CCWS	component cooling water system
CFR	Code of Federal Regulations
CGS	compressed gas system
COL	Combined License
CRDM	control rod drive mechanism
CRE	control room envelope
CS/RHRS	containment spray/residual heat removal system
C/V	containment vessel
CVCS	chemical and volume control system
CWS	circulating water system
dc	direct current
DCD	Design Control Document
DWS	demineralized water system
ECCS	emergency core cooling system
EIA	Energy Information Administration
EPRI	Electric Power Research Institute
ESF	engineered safety features
ESW	essential service water
ESWP	essential service water pump
ESWPC	essential service water pipe chase
ESWPT	essential service water pipe tunnel
ESWS	Essential Service Water System
FCC	Federal Communications Commission
FMEA	failure mode and effects analysis
FOS	fuel oil storage and transfer system
FSAR	Final Safety Analysis Report
GDC	General Design Criteria

MIC-03-09-00010

DCD_12.03-12.04-40
MIC-03-09-00010

Security-Related Information – Withheld Under 10 CFR 2.390

Figure 9.1.2-3 Location of Containment Racks

MIC-03-09-00006
MIC-03-09-00010

Security-Related Information – Withheld Under 10 CFR 2.390

Figure 9.1.4-1 Plan View of Light Load Handling System

MIC-03-09-00006
MIC-03-09-00010

Security-Related Information – Withheld Under 10 CFR 2.390

Figure 9.1.5-1 Traveling Route of Spent Fuel Cask

MIC-03-09-00006
MIC-03-09-00010

Security-Related Information – Withheld Under 10 CFR 2.390

Figure 9.1.5-2 Traveling Route of Irradiation Sample Container

Security-Related Information – Withheld Under 10 CFR 2.390

MIC-03-09-00006
MIC-03-09-00010

Figure 9.1.5-3 Traveling Route of Equipment Maintenance

intermixing of the fluids from both sides so that any leakage will go to the outside of the heat exchanger except when a hole is developed in the plates—a rare event with titanium plates. Gasket failure directs leakage towards the outside of the CCW heat exchanger, hence radioactive contamination of the ESWS propagating to the UHS and ultimately to the environment is not considered credible. Any leakage from the CCW heat exchangers is collected into the nonradioactive floor drains thus ensuring that no ESWS water is released directly to the environment. For conservatism, however, radiation monitors are provided in each discharge line of the CCW HX essential service water (ESW) side. See also the description of these monitors in DCD Subsection 11.5.2.2.2. Radiation alarms are provided to alert the operator if radioactive leakage from the CCW side has entered the ESW side. The operator then isolates the leaking train to prevent uncontrolled radiation contamination of the ESWS and UHS. Prior to any radiation leakage being detected in the ESWS, however, radiation alarms in the CCWS side would have already alerted the operators of contamination in the CCWS. The affected CCWS train is immediately isolated followed by the isolation of the aligned ESWS to prevent possible contamination of the UHS and the environment. A local grab sampling line is installed downstream of the CCW heat exchanger to determine any trace amounts of radioactivity prior to release to the UHS. ESW discharge sampling is performed periodically. [[For discharge to cooling towers, the ESW is sampled prior to blowdown releases.]]

The ESWS is arranged into four independent trains (A, B, C, and D). Each train consists of one ESWP, two 100% strainers in the pump discharge line, one CCW HX, one essential chiller unit, and associated piping, valves, instrumentation and controls. This arrangement assures that failures and postulated events in one train do not affect the safety-related functions of the other trains. During normal ESWS operation, at least two trains out of four are required to be operable to meet the safety-related design requirements. During accidents and other design basis events, such as a LOCA or safe shutdown with a LOOP, a postulated single active component failure in one train coincident with on-line maintenance in another train do not prevent the ESWS from performing its safety-related functions with the two remaining operable trains. Instrumentation is also provided independently and not shared among the trains.

Each supply line after the strainer is tapped to supply cooling water to each component. Each CCW HX is provided with piping and isolation valves around the heat exchanger which facilitates back flushing of the CCW HX of the ESW side when required. Heat from the reactor auxiliaries is removed from the CCW HX and the heated service water flows to the UHS via independent lines. The ESW flow of 13,000 gpm is maintained at all operating conditions, including accident conditions and safe shutdown with a LOOP. The ESWS is designed to operate at a water temperature as low as 32° F. For the ESWS piping and components in the R/B and the PS/Bs except essential service water pipe chase (ESWPC), freezing of the ESW in the standby trains is precluded by the HVAC system operating between 50° F and 105° F. [[Piping running through tunnels and trenches are below grade so that freezing of the ESW is not a concern. Stagnant and exposed portions of the system are heat traced to ensure that the ESW inside these structures is maintained above 32° F.]] MIC-03-09-00010

The ESW piping from the pump discharge after passing through the discharge strainers runs to the PS/Bs and ~~reactor building~~the R/B through the ESW pipe tunnels. After serving the CCW HXs and the essential chiller units ESW piping runs to the UHS. MIC-03-09-00010

heat exchanger following a high differential pressure alarm that ~~may likely be~~is caused by accumulation of debris materials inside the heat exchanger plate flow channels. DCD_09.02.01-33

To prevent potential CCW heat exchanger fouling, periodic inspection, monitoring, maintenance, performance and functional testing (including the heat transfer capability of the CCW heat exchangers consistent with GL 89-13) will be provided as discussed in Subsections 9.2.1.3 and 9.2.1.4. Further, adequate fouling factor margins in accordance with the manufacturer's standards and the system water chemistry will be required in the design specifications. Periodic inspection, monitoring and maintenance will ensure that the actual fouling is within design fouling factor margins to accomodate heat transfer for a minimum of the UHS design of 30 days. DCD_09.02.01-52 DCD_09.02.05-11

The design of CCW heat exchangers will incorporate specific features regarding industry operating experience as discussed in EPRI TR 1013470 to minimize leakage from plate-type heat exchangers and potential blockage of the heat exchanger flow passages (Ref. 9.1.7-27). DCD_09.02.02-81

9.2.1.2.2.4 Essential Chiller Units

Four 50% capacity chiller units, one per train, are provided. A detailed description of the essential chiller units is given in Subsection 9.2.7.

9.2.1.2.2.5 Piping

Carbon steel piping designed, fabricated, installed and tested in accordance with ASME Section III, Class 3 requirements, is used for the safety-related portion of the ESWS. Piping is arranged to permit access for inspection. The essential service water pipe tunnel (ESWPT), including the ESW piping from this tunnel to the ESW pump intake and discharge structures and the UHS, ~~is~~and the ESW piping in the essential service water pipe chase (ESWPC) are site specific but the existence and function of which are required in the standard design. The COL Applicant is to locate the pipes entering and exiting the pipe tunnel based on the location of the UHSRS, as required. [[The piping located in trenches will be externally lined carbon steel and the lining material specification will vary according to the site soil chemistry. The rest of the ESWS piping will be carbon steel or internally lined carbon steel depending on ESWS water chemistry requirements. Cathodic protection will be provided for buried piping. Access manholes will be provided as required for periodic inspection.]] The piping will be inspected per ASME Section XI, article IWA 5244 requirements. MIC-03-09-00012

9.2.1.2.2.6 Valves

The water in the ESWS does not normally contain radioactivity and, therefore, special provisions against leakage to the atmosphere are not necessary. Isolation valves are provided upstream and downstream of each component to facilitate its removal from service.

A motor operated valve is provided at the discharge of each pump. The starting logic of the ESWP interlocks the motor operated valve with the pump operation. The closed discharge valve opens after starting the ESWP. This feature minimizes transient effects

Subsection 9.2.1.4. Section 6.6 lists appropriate ASME Section XI requirements for the safety-related portion of the system.

Failure mode and effects analysis (FMEA) Table 9.2.1-2 concludes that no single failure, coincident with one train being unavailable due to maintenance and a loss of offsite power compromises the safety functions of ESWS.

The ESWS is not shared with multi-units.

The COL Applicant is to provide the evaluation of the ESWP at the lowest probable water level of the UHS. The COL Applicant is to develop recovery procedure in the event of approaching low water level of UHS.

The ESWS is designed for operation at low water temperature of 32° F during all modes of plant operation. The COL Applicant is to provide protection of the site specific safety related portions of the ESWS including [[such as the ESWS blowdown line, FSS supply line, ESWSPT piping running between the nuclear island and UHSRS, and any ESWS piping in the UHSRS]] against adverse environmental, operating, and accident conditions that can occur such as countermeasures to freezing by safety-related heat tracing, low temperature operation, and thermal overpressurization. Temperature in the reactor building is maintained through ventilation and therefore heat tracing is not required. The SSCs outside the scope of the certified design building such as the branch piping to the pump discharge pressure sensor, [[to the conductivity cell]], to the pump ESWS header pressure sensor, to the pump discharge strainer differential pressure sensor, [[the UHS basin blowdown bypass lines]] and the standby strainer lines would become stagnant, therefore, the possibility for freezing depends on the location which is determined by the COL Applicant. DCD_09.02.01-35 MIC-03-09-00010 DCD_09.02.01-35 DCD_09.02.01-35

The COL Applicant is to provide the safety evaluation of the capability of the ESWS to: (1) isolate its site-specific, nonsafety-related portions [[such as the ESWS blowdown line and FSS supply line with clarification for their connecting locations and their boundaries when applicable]]; and (2) provide measures to prevent long-term corrosion and organic fouling that may degrade its performance, per Generic Letter (GL) 89-13. DCD_09.02.01-33

Some portions of the system are nonsafety-related, e. g., sections of pipe in heat exchanger drain piping after the isolation valves. These boundary isolation valves which provide separation between the safety-related and nonsafety-related portions are normally closed. During a design basis event, postulated simultaneous failure of all nonsafety-related piping would not impact operation of any ESWS train, thus will not affect the ESWS capability to perform its safety related functions.

The COL Applicant is to specify appropriate sizes of piping and pipe fittings such as restriction orifices to prevent potential plugging due to debris buildup, and develop maintenance and test procedures to monitor debris build up and flush out debris.

9.2.1.4 Inspection and Testing Requirements

The ESWS is hydrostatically tested prior to initial startup. Preoperational testing is described in Section 14.2. System performance during normalpower operation is verified by monitoring system pressures, temperatures and flows. DCD_09.02.01-43

Table 9.2.7-1 Essential Chilled Water System Component Design Data

Essential Chiller Unit	
Type	Centrifugal Type, Electric-drive
Quantity	4
Refrigeration Capacity	~~3,600,000~~3,720,000 Btu/hr-unit
Chilled Water Inlet temperature	~~40~~56° F
Chilled Water Outlet temperature	~~56~~40° F
Chilled Water Flow Rate	~~440~~460 gpm
Cooling water inlet temperature	95° F
Cooling water outlet temperature	111° F ;delta T= 16° F
Essential chilled water pump	
Type	Centrifugal type
Quantity	4
Flow rate	~~440~~460 gpm
Head	165 feet

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DCD_09.02.02-78

MIC-03-09-00012

Table 9.2.7-2 Essential Chilled Water Heat Load and Flow Rate (Sheet 1 of 2)

Train	Component	Flow rate (gpm)		Heat Load (10^3 Btu/h)		
		~~Normal Operation~~	~~Abnormal Operation~~	~~Normal Operation~~	~~Abnormal Operation~~	DCD_09.02.02-72 S01
A	Main Control Room AHU	~~45~~	~~45~~44	~~341~~	341	
	Class 1E electrical room AHU	~~285~~	~~285~~308	~~1,650~~	~~1,650~~1,760	DCD_09.02.02-78 MIC-03-09-00012
	Safeguard component area AHU	-	~~26~~24	-	180	
	Emergency feedwater pump area AHU	~~11~~	11	~~60~~	~~60~~65	DCD_09.02.02-78 MIC-03-09-00012
	Penetration area AHU	-	42	-	330	
	Annulus emergency exhaust filtration unit area AHU	-	4	-	10	
	CCW pump area AHU	-	4	-	30	
	Essential chiller unit area AHU	-	4	-	30	
	Charging pump area AHU	-	4	-	10	
	Spent fuel pit pump area AHU	-	15	-	100	
	Essential Chilled Water Pump		-		72	
B	Main Control Room AHU	~~45~~	~~45~~44	~~341~~	341	
	Class 1E electrical room AHU	~~285~~	~~285~~308	~~1,650~~	~~1,650~~1,760	DCD_09.02.02-78 MIC-03-09-00012
	Safeguard component area AHU	-	~~26~~24	-	180	
	Emergency feedwater pump area AHU	-	15	-	~~110~~115	
	Penetration area AHU	-	42	-	330	
	Annulus emergency exhaust filtration unit area AHU	-	4	-	10	
	CCW pump area AHU	-	4	-	30	
	Essential chiller unit area AHU	-	4	-	30	
	Spent fuel pit pump area AHU	-	15	-	100	
	Essential Chilled Water Pump		-		72	

Note:
(1) Dash (-) indicates no requirement:
(2) The trains C and D Class 1E Electrical Room AHU heat load conservatively includes additional non-safety related heat loads. This higher heat load is used for the heat removal capability design for each of the ECWS trains. DCD_09.02.02-78

Table 9.2.7-2 Essential Chilled Water Heat Load and Flow Rate (Sheet 2 of 2)

DCD_09.02.02-72 S01

Train	Component	Flow rate (gpm)		Heat Load (10^3 Btu/h)	
		~~Normal Operation~~	~~Abnormal Operation~~	~~Normal Operation~~	~~Abnormal Operation~~
C	Main Control Room AHU	~~45~~	~~45~~44	~~341~~	341
	Class 1E electrical room AHU	~~285~~	~~285~~308	~~2,250,~~	~~2,250~~2,400
	Safeguard component area AHU	~~-~~	~~26~~24	~~-~~	180
	Emergency feedwater pump area AHU	~~-~~	15	~~-~~	~~110~~115
	Penetration area AHU	~~-~~	42	~~-~~	330
	Annulus emergency exhaust filtration unit area AHU	~~-~~	4	~~-~~	10
	CCW pump area AHU	~~-~~	4	~~-~~	30
	Essential chiller unit area AHU	~~-~~	4	~~-~~	30
	Spent fuel pit pump area AHU	~~-~~	15	~~-~~	100
	Essential Chilled Water Pump		-		72
D	Main Control Room AHU	~~45~~	~~45~~44	~~341~~	341
	Class 1E electrical room AHU	~~285~~	~~285~~308	~~2,250~~	~~2,250~~2,400
	Safeguard component area AHU	~~-~~	~~26~~24	~~-~~	180
	Emergency feedwater pump area AHU	~~11~~	11	~~60~~	~~60~~65
	Penetration area AHU	~~-~~	42	~~-~~	330
	Annulus emergency exhaust filtration unit area AHU	~~-~~	4	~~-~~	10
	CCW pump area AHU	~~-~~	4	~~-~~	30
	Essential chiller unit area AHU	~~-~~	4	~~-~~	30
	Charging pump area AHU	~~-~~	4	~~-~~	10
	Spent fuel pit pump area AHU	~~-~~	15	~~-~~	100
	Essential Chilled Water Pump		-		72

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DCD_09.02.02-78 MIC-03-09-00012

Note:
(1) Dash (-) indicates no requirement:
(2) The trains C and D Class 1E Electrical Room AHU heat load conservatively includes additional non-safety related heat loads. This higher heat load is used for the heat removal capability design for each of the ECWS trains.

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DCD_09.02.01-40

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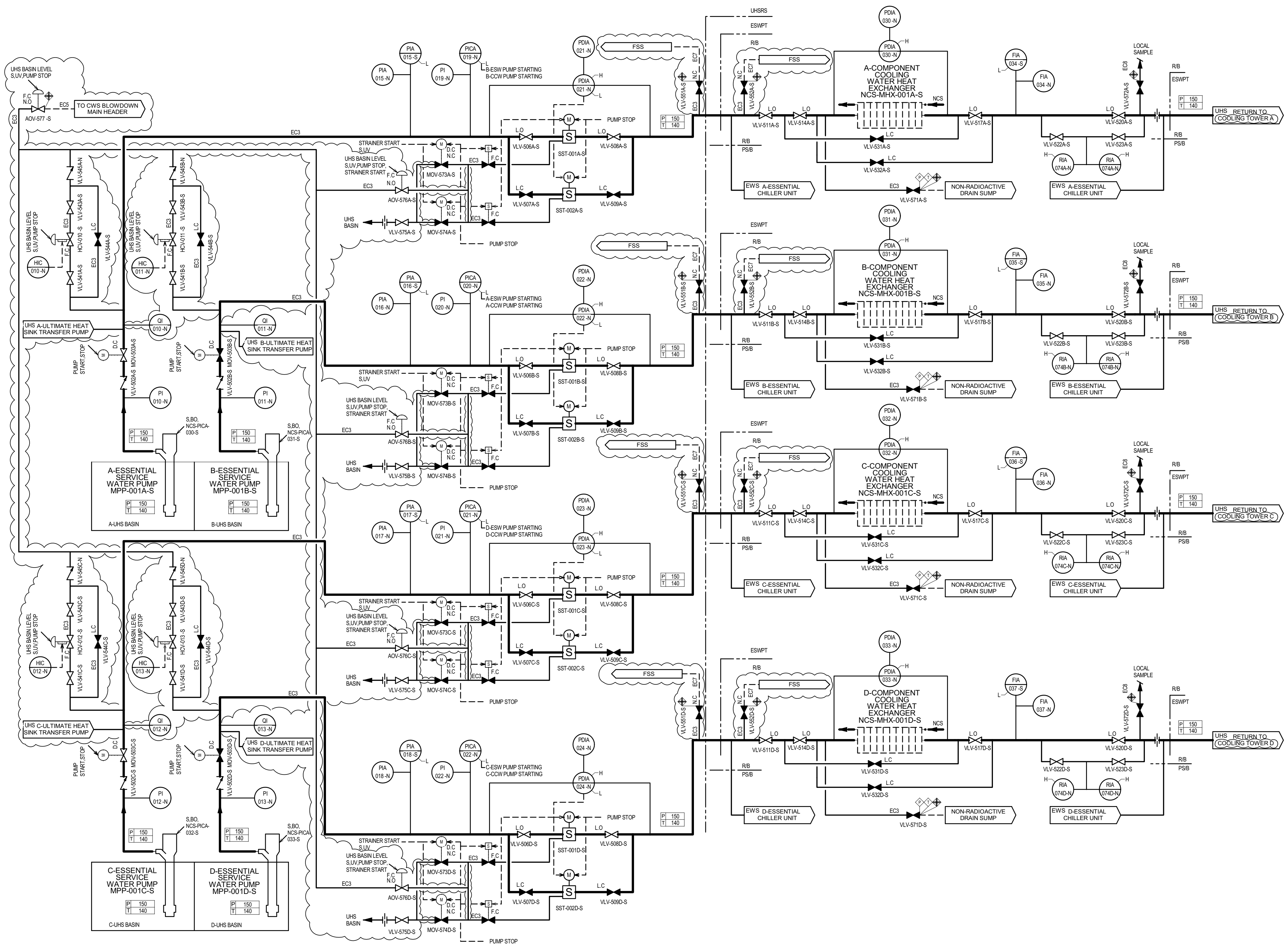

Figure 9.2.1-1 Essential Service Water System Piping and Instrumentation Diagram (Sheet 1 of 3)

9.4.8-29 Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning. RG 4.21, Rev.0,U.S. Nuclear Regulatory Commission, Washington, DC, June 2008.

9.4.8-30 "Safety-Related Air Conditioning, Heating, Cooling and Ventilation Systems Calculations," MUAP-10020-P Rev. ~~1~~2 (Proprietary) and MUAP-10020-NP Rev. ~~1~~2 (Non-Proprietary), ~~November, 2010~~March 20~~11~~13.

9.4.8-31 "Safety Criteria for HVAC Systems Located Outside Primary Containment," ANSI/ANS 59.2-1985.

MIC-03-09-00014
DCD_09.04.05-21
DCD_03.02.02-22

Table 9.4-1 Area Design Temperature and Relative Humidity (Sheet 1 of 4)

Area	Location Note2	Service System Note1		Normal condition				Abnormal Condition Note3			
				Temperature °F		Relative Humidity %		Temperature °F		Relative Humidity %	
		Normal	Abnormal	Min	Max	Min	Max	Min	Max	Min	Max
Containment	PCCV	Containment Fan Cooler System		-	120°F	-	-	-	150°F Note5	-	-
		Containment Purge System (b)	-	65°F Note4	85°F Note4	-	-	-	-	-	-
Main Control Room	RB	Main Control Room HVAC System (a)		73°F	78°F	25%RH	60%RH	73°F	78°F	-	-
Class 1E I&C Room	RB	Class 1E Electrical Room HVAC System (a)		68°F	79°F	-	-	68°F	79°F	-	-
Class 1E Electrical Room	RB			50°F	95°F	-	-	50°F	95°F	-	-
Class 1E UPS Room	RB			50°F	95°F	-	-	50°F	95°F	-	-
Emergency Filtration Unit Room	RB			50°F	105°F	-	-	50°F	130°F	-	-
Remote Shutdown Console Room	RB			73°F	78°F	25%RH	60%RH	73°F	78°F	-	-
Class 1E Battery Room	PSB			65°F	77°F	-	-	65°F	77°F	-	-
Class 1E Battery Charger Room	PSB			50°F	95°F	-	-	50°F	95°F	-	-
Class 1E MOV Inverter Room	PSB			50°F	95°F	-	-	50°F	95°F	-	-
MCR/Class 1E Electrical Room HVAC equipment Room	RB			50°F	105°F	-	-	50°F	130°F	-	-
CRDM Panel Room	RB			50°F	95°F	-	-	-	-	-	-
M-G Set and M-G Set Panel Room	RB			50°F	95°F	-	-	-	-	-	-
Leak Rate Testing Room	RB			50°F	95°F	-	-	-	-	-	-

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Table 9.4.3-1 Equipment Design Data (Sheet 1 of 2)

Auxiliary Building Air Handling Unit		
Number of Units	2	
Equipment Class	9	
Seismic Category	Non-Seismic	
Unit Airflow Capacity, cfm	~~98,000~~111,000	MIC-03-09-00012
Unit Fan Type	Centrifugal	
Low Efficiency Filter Efficiency	10-35%	
Medium Efficiency Filter Efficiency	45-75%	
Cooling Coil Type	Chilled Water	
Heating Coil Type	Steam	
Auxiliary Building Exhaust Fan		
Number of Fans	3	
Equipment Class	8	
Seismic Category	Non-Seismic	
Fan Airflow, cfm	~~108,000~~123,000	MIC-03-09-00012
Fan Type	Centrifugal	
Non-Class 1E Electrical Room Air Handling Unit		
Number of Units	2	
Equipment Class	9	
Seismic Category	Non-Seismic	
Unit Airflow Capacity, cfm	40,000	
Unit Fan Type	Centrifugal	
Low Efficiency Filter Efficiency	10-35%	
High Efficiency Filter Efficiency	85-95%	
Cooling Coil Type	Chilled Water	
Heating Coil Type	Steam	
Non-Class 1E Electrical Room Return Air Fan		
Number of Units	2	
Equipment Class	9	
Seismic Category	Non-Seismic	
Fan Airflow Capacity, cfm	~~36,250~~38,300	MIC-03-09-00012
Fan Type	Vane Axial	
Non-Class 1E Battery Room Exhaust Fan		
Number of Fans	2	
Equipment Class	5	
Seismic Category	Non-Seismic	
Fan Airflow Capacity, cfm	~~7,500~~3,400	MIC-03-09-00012
Fan Type	Vane Axial	

Table 9.4.5-1 Equipment Design Data (Sheet 1 of 4)

Class 1E Electrical Room Air Handling Unit		
Number of Units	4	
Equipment Class	3	
Seismic Category	I	
Unit Airflow Capacity, cfm	~~40,000~~42,300 - train A, B ~~52,000~~54,400 - train C, D	MIC-03-09-00012
Unit Fan Type	Centrifugal	
Low Efficiency Filter Efficiency	25-35%	
High Efficiency Filter Efficiency	80-95%	
Cooling Coil Type	Chilled Water	
Cooling Coil Capacity, btu/hr	~~1,650,000~~1,760,000 - train A, B ~~2,290,000~~2,400,000 - train C, D	MIC-03-09-00012
Heating Coil Type	Electric	
Class 1E Electrical Room Return Air Fan		
Number of Fans	4	
Equipment Class	3	
Seismic Category	I	
Fan Airflow Capacity, cfm	~~37,400~~39,100 - train A, B ~~49,400~~51,200 - train C, D	MIC-03-09-00012
Fan Type	Axial	
Class 1E Battery Room Exhaust Fan		
Number of Fans	4	
Equipment Class	3	
Seismic Category	I	
Fan Airflow Capacity, cfm	~~2,600~~3,200	MIC-03-09-00012
Fan Type	Axial	
Annulus Emergency Exhaust Filtration Unit		
Number of Units	2	
Equipment Class	2	
Seismic Category	I	
Unit Airflow Capacity, cfm	5,600	
Unit Fan Type	Centrifugal	
HEPA Filter Efficiency	99.97%, 0.30 micron particles	
High Efficiency Filter Efficiency	80-95%	

Table 9.4.5-1 Equipment Design Data (Sheet 2 of 4)

Safeguard Component Area Air Handling Unit	
Number of Units	4
Equipment Class	3
Seismic Category	I
Unit Airflow Capacity, cfm	5,000
Unit Fan Type	Centrifugal
Cooling Coil Type	Chilled Water
Cooling Coil Capacity, btu/hr	180,000
Heating Coil Type	Electric
Emergency Feedwater Pump (M/D) Area Air Handling Unit	
Number of Units	2
Equipment Class	3
Seismic Category	I
Unit Airflow Capacity, cfm	2,100
Unit Fan Type	Centrifugal
Cooling Coil Type	Chilled Water
Cooling Coil Capacity, btu/hr	~~110,000~~115,000
Heating Coil Type	Electric
Emergency Feedwater Pump (T/D) Area Air Handling Unit	
Number of Units	2
Equipment Class	3
Seismic Category	I
Unit Airflow Capacity, cfm	~~1,300~~1,400
Unit Fan Type	Centrifugal
Low Efficiency Filter Efficiency	25-35%
Cooling Coil Type	Chilled Water
Cooling Coil Capacity, btu/hr	~~62,000~~65,000
Heating Coil Type	Electric
Penetration Area Air Handling Unit	
Number of Units	4
Equipment Class	3
Seismic Category	I
Unit Airflow Capacity, cfm	5,000
Unit Fan Type	Centrifugal
Cooling Coil Type	Chilled Water
Cooling Coil Capacity, btu/hr	330,000
Heating Coil Type	Electric

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MIC-03-09-00012