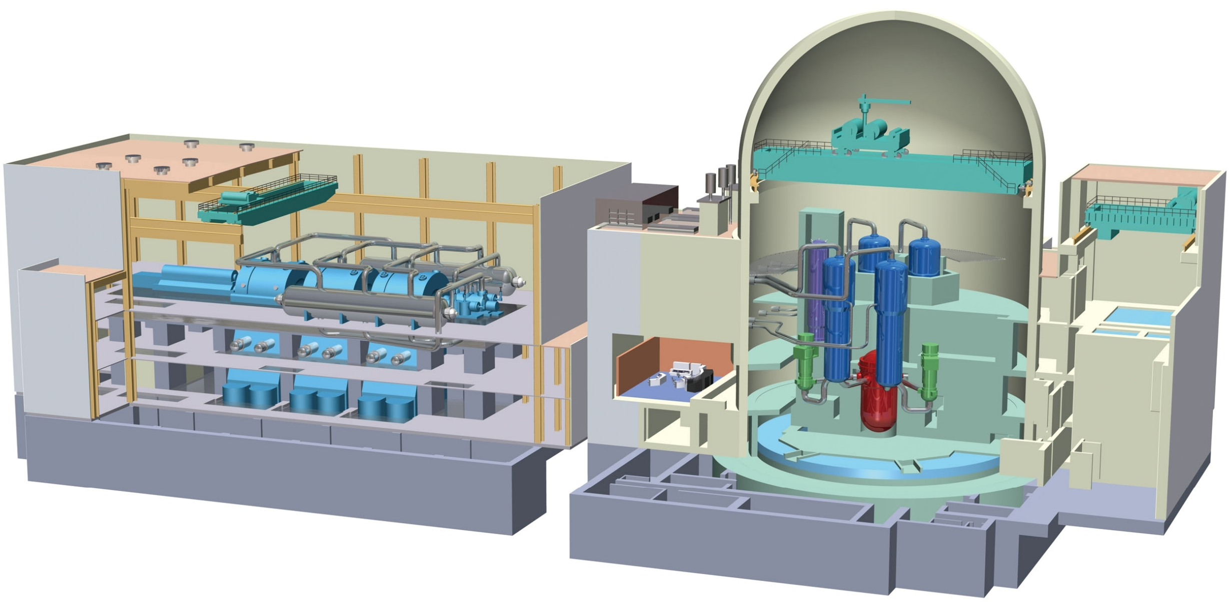
DESIGN CONTROL DOCUMENT FOR THE
US-APWR
Tier 1

MUAP- DC0020
REVISION 2
OCTOBER 2009



MITSUBISHI HEAVY INDUSTRIES, LTD.

Mitsubishi Heavy Industries, Ltd.

16-5, Konan 2-chome, Minato-ku

Tokyo 108-8215 Japan

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

Page

CONTENTS (Continued)

Page

TABLES

TABLES (Continued)

Page

TABLES (Continued)

Page

TABLES (Continued)

TABLES (Continued)

Page

TABLES (Continued)

Page

TABLES (Continued)

Page

TABLES (Continued)

TABLES (Continued)

Page

FIGURES

Page

FIGURES (Continued)

Page

FIGURES (Continued)

Page

ACRONYMS AND ABBREVIATIONS

AAC	alternate alternating current
A/B	auxiliary building
ABVS	auxiliary building ventilation system
ac	alternating current
AC/B	access building
ALARA	as low as reasonably achievable
AOO	anticipated operational occurrence
APWR	advanced pressurized-water reactor
ARMS	area radiation monitoring system
ASME	American Society of Mechanical Engineers
ASSS	auxiliary steam supply system
ATWS	anticipated transient without scram
BISI	bypassed and inoperable status indication
BRS	boron recycle system
BTU	british thermal unit
C/V	containment vessel
CAGS	compressed air and gas system
CAS	central alarm station
CBP	computer-based procedure
CCF	common cause failure
CCW	component cooling water
CCWS	component cooling water system
CDS	condensate system
CFR	Code of Federal Regulations
CFS	condensate and feedwater system
CHS	containment hydrogen monitoring and control system
CIS	containment isolation system
CIV	containment isolation valve
COL	Combined License
CPS	condensate polishing system
CRDM	control rod drive mechanism
CRE	control room envelope
CS	containment spray
CS/RHR	containment spray/residual heat removal
CSS	containment spray system
CVCS	chemical and volume control system
CVVS	containment ventilation system

ACRONYMS AND ABBREVIATIONS (Continued)

CWS	circulating water system
DAAC	diverse automatic actuation cabinet
DAS	diverse actuation system
DBA	design-basis accident
DBPB	design-basis pipe break
DBT	design basis threat
dc	direct current
DCD	Design Control Document
DCS	data communication system
DF	decontamination factor
DHP	diverse HIS panel
D-RAP	design reliability assurance program
EAB	exclusion area boundary
ECC	emergency core cooling
ECCS	emergency core cooling system
ECWS	essential chilled water system
EFW	emergency feedwater
EFWS	emergency feedwater system
EMI	electromagnetic interference
EOF	emergency operations facility
EOP	emergency operating procedure
EPA	containment electric penetration assembly
EPS	emergency power source
ERDS	emergency response data system
ESF	engineered safety features
ESFAS	engineered safety features actuation system
ESFVS	engineered safety features ventilation system
ESWP	essential service water pump
ESWPT	essential service water pipe tunnel
ESWS	essential service water system
FA	function allocation
FHA	fire hazard analysis
FLB	feedwater line break
FOS	fuel oil storage and transfer system
FPS	fire protection system
FRA	functional requirements analysis

ACRONYMS AND ABBREVIATIONS (Continued)

FSAR	Final Safety Analysis Report
FSS	fire protection water supply system
FWS	feedwater system
GDC	General Design Criteria
GLBS	generator load break switch
GSI	Generic Safety Issue
GSS	gland seal system
GTG	gas turbine generator
GWMS	gaseous waste management system
HA	human action
HCLPF	high confidence of low probability of failuer
HED	human engineering deficiency
HEPA	high-efficiency particulate air
HFE	human factors engineering
HPME	high pressure melt ejection
HRA	human reliability analysis
HSI	human-system interface
HSIS	human-system interface system
HVAC	heating, ventilation, and air conditioning
I&C	instrumentation and control
I/O	input/output
IAS	instrument air system
ICIGS	incore instrument gas purge system
ICIS	incore instrumentation system
IEEE	Institute of Electrical and Electronics Engineers
ITAAC	inspections, tests, analyses, and acceptance criteria
ITP	initial test program
IV	intercept valve
LBB	leak before break
LCS	local control station
LLHS	light load handling system
LOCA	loss-of-coolant accident
LOOP	loss of offsite power
LPT	low-pressure turbine
LPMS	loose parts monitoring system
LPZ	low-population zone
LTOP	low temperature overpressure protection
LWMS	liquid waste management system

ACRONYMS AND ABBREVIATIONS (Continued)

M/D	motor-driven
M/G	motor generator
MCC	motor control center
MCES	main condenser evacuation system
MCR	main control room
MFRV	main feedwater regulatory valve
MFBRV	main feedwater bypass regulation valve
MG	main generator
MOV	motor operated valve
MS/R	moisture separator reheater
MSBIV	main steam bypass isolation valve
MSCV	main steam check valve
MSDV	main steam depressurization valve
MS/FW	main steam / feedwater
MSIV	main steam isolation valve
MSLB	main steam line break
MSRV	main steam relief valve
MSRVBV	main steam relief valve block valve
MSS	main steam supply system
MSSV	main steam safety valve
MT	main transformer
MTCV	main turbine control valve
MTSV	main turbine stop valve
N/E	normal/emergency
NaTB	sodium tetraborate decahydrate
NPSH	net positive suction head
NRC	U.S. Nuclear Regulatory Commission
NRCA	non-radiological controlled area
NS	non-seismic
NSSS	nuclear steam supply system
OBE	operating-basis earthquake
OER	operating experience review
OHLHS	overhead heavy load handling system
PA	postulated accident
PAM	post accident monitoring
PCCV	prestressed concrete containment vessel
PCMS	plant control and monitoring system

ACRONYMS AND ABBREVIATIONS (Continued)

PERMS	process effluent radiation monitoring and sampling system
PMWP	probable maximum winter precipitation
PMWS	primary makeup water system
PRA	probabilistic risk assessment
PS/B	power source building
PSFSV	power source fuel storage vault
PSMS	protection and safety monitoring system
PSS	process and post-accident sampling system
PSWS	potable and sanitary water systems
QA	quality assurance
R/B	reactor building
RAT	reserve auxiliary transformer
RCA	radiological controlled area
RCCA	rod cluster control assembly
RCL	reactor coolant loop
RCP	reactor coolant pump
RCPB	reactor coolant pressure boundary
RCS	reactor coolant system
RFI	radio frequency interference
RG	Regulatory Guide
RHR	residual heat removal
RHRS	residual heat removal system
RMI	reflective metal insulation
RO	reactor operator
RPS	reactor protection system
RSC	remote shutdown console
RSR	remote shutdown room
RSV	reheat stop valve
RT	reactor trip
RTB	reactor trip breaker
RV	reactor vessel
RWS	refueling water storage system
RWSAT	refueling water storage auxiliary tank
RWSP	refueling water storage pit
SAS	secondary alarm station
SBO	station blackout
SC	steel concrete
SCIS	secondary side chemical injection system

ACRONYMS AND ABBREVIATIONS (Continued)

SDCV	spatially dedicated continuously visible
SFP	spent fuel pit
SFPCS	spent fuel pit cooling and purification system
SG	steam generator
SGBDS	steam generator blowdown system
SGWFCV	steam generator water filling control valve
SIS	safety injection system
SLS	safety logic system
SPDS	safety parameter display system
SPTS	sound powered telephone system
SRO	senior reactor operator
SRP	Standard Review Plan
SSA	signal selector algorithm
SSAS	station service air system
SSC	structure, system, and component
SSE	safe-shutdown earthquake
SST	station service transformer
SWMS	solid waste management system
T/B	turbine building
T/D	turbine driven
T/G	turbine generator
T_{avg}	average temperature
TBS	turbine bypass system
TBV	turbine bypass valve
TCS	turbine component cooling water system
TMI	Three Mile Island
TN	transmission network
TSC	technical support center
UAT	unit auxiliary transformer
UHS	ultimate heat sink
UHSRS	ultimate heat sink related structures
UMC	unit management computer
UPS	uninterruptible power supply
USI	Unresolved Safety Issue
V&V	verification and validation
VCT	volume control tank
VDU	visual display unit

ACRONYMS AND ABBREVIATIONS (Continued)

VWO	valve wide open
VWS	chilled water system
WMS	waste management system

1.0 INTRODUCTION

This chapter identifies the purpose and scope of this Tier 1 document; defines various terms used; identifies general provisions associated with design descriptions and inspections, tests, analyses, and acceptance criteria (ITAAC); and provides a legend for symbols used in the Tier 1 figures.

1.1 PURPOSE

The purpose of this document is to provide information on the design of the US-APWR to support approval and certification of this standard nuclear power plant by the U.S. Nuclear Regulatory Commission (NRC) under the provisions of 10 Code of Federal Regulations (CFR) Part 52.

1.2 SCOPE

The US-APWR is an advanced light-water reactor plant with reactor thermal power of 4451 MWt designed by Mitsubishi Heavy Industries, Ltd. (MHI). Figure 1-1 shows a typical US-APWR plant site.

The main power block of the US-APWR standard design is comprised of the following buildings and structures:

- The reactor building (R/B), including the prestressed concrete containment vessel (PCCV) and the containment internal structure
- The power source buildings (PS/Bs)
- The power source fuel storage vaults (PSFSVs)
- The essential service water pipe tunnel (ESWPT)
- The auxiliary building (A/B)
- The turbine building (T/B)
- The access building (AC/B)

Although the system descriptions of the PSFSVs and ESWPT are within the scope of the US-APWR standard design, the structural design of the PSFSVs and ESWPT, including seismic and dynamic qualification as applicable, are to be finalized based on the site-specific arrangement.

The information in this document comprises the design information related to the US-APWR standard nuclear power plant that is to be certified by the NRC. This technical information is commonly referred to as the certified design material or Tier 1 material.

The US-APWR Design Control Document (DCD) is divided into two parts.

The Tier 1 document provides top-level information on the plant design, including the principal performance characteristics and safety functions of the structures, systems, and components (SSCs). It provides ITAAC to be used to provide reasonable assurance that the as-built plant will operate in conformity with the Combined License (COL), the provisions of the Atomic Energy Act, and applicable NRC regulations. It also identifies significant site parameters and requirements for significant interfaces between the US-APWR standard design and those portions of site specific.

The separate Tier 2 document provides more-detailed information on the plant design. This information is to be approved but not certified by NRC. Information contained in the Tier 1 document was derived from the Tier 2 document.

The Tier 1 document is organized into three chapters, with this chapter providing introductory information.

Chapter 2 identifies site parameters and provides design descriptions and associated ITAAC for different aspects of the US-APWR standard design. The content of the design descriptions and the tables that provide ITAAC are discussed further in Section 1.4.

Chapter 3 addresses interface requirements focused on the safety design attributes and performance characteristics that ensure that the site-specific portion of the design is in conformance with the certified design. The site-specific portions of the design are those portions of the design that are dependent on characteristics of the site, such as the design of the ultimate heat sink. This chapter also identifies the scope of the design to be certified by specifying the systems that are completely or partially out of scope of the certified design.

In each chapter section or subsection, tables follow the text and figures follow the tables. The tables and figures are identified by numbers associated with the section or subsection in which they appear. For example, Figure 2.4.1-1 is the first figure in Subsection 2.4.1. Pages are numbered sequentially and identified by both the section number and the page number within that section.

The Tier 1 document addresses all major plant systems and structures, including systems not important to safety, in order to completely define the US-APWR design. However, descriptions of site-specific systems provide less technical information than those of safety-significant systems, and some site-specific systems are described only by their name. Relevant Unresolved Safety Issues (USIs), Generic Safety Issues (GSIs), Three Mile Island (TMI) items and operating experience are considered in the US-APWR design and reflected in the Tier 2 document upon which this Tier 1 document is based.

The Tier 1 document contains no proprietary information.

1.3 DEFINITIONS

The following definitions are used in the design descriptions and the related ITAAC to ensure precision and consistency.

Acceptance criteria refer to the performance, physical condition, or analysis result for an SSC, to demonstrate that the design requirement/commitment is met.

Analysis means a calculation, mathematical computation, or engineering/ technical evaluation. Engineering or technical evaluations could include, but are not limited to, comparisons with operating experience or design of similar SSCs.

As-built means the physical properties of the SSC following the completion of its installation or construction activities at its final location at the plant site. Determination of physical properties of the as-built structure, system, or component may be based on measurements, inspections, or tests that occur prior to installation, provided that subsequent fabrication, handling, installation, and testing do not alter the properties.

ASME Code means Section III of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

Column line is the designation applied to a plant reference grid used to define the locations of building walls and columns. Column lines may not represent the centerline of walls and columns.

Containment, when this term is used as “the containment,” means the containment vessel or, as it is sometimes referred to, the prestressed concrete containment vessel.

Design commitment means that portion of the design description that is verified by ITAAC.

Design description means that portion of the design that is certified.

Design plant grade means the elevation of the soil around the nuclear island assumed in the design (i.e., “plant grade” or “finished grade level”) in relation to plant structures to which other plant elevations are correlated and which is set at 2’-7”.

Division (for electrical systems or equipment) is the designation applied to a given safety-related system (or set of components) that is (are) physically, electrically, and functionally independent from other redundant sets of components.

Division (for mechanical systems or equipment) is the designation applied to a specific set of safety-related components within a system.

Exists, when this term is used in the acceptance criteria, means that the item is present and consistent with the design description.

Functional arrangement (for a system) means the physical arrangement of systems and components to provide the function for which the system is intended as described in the ITAAC design description and shown in the specified figures.

Harsh environment means the limiting environmental conditions resulting from a design basis accident.

Inspection means visual observations, physical examinations, or reviews of records based on visual observation or physical examination that compare the SSC condition to one or more design commitments. Examples include walkdowns, configuration checks, measurements of dimensions, or nondestructive examinations.

Operate means the actuation and running of the equipment.

Physical arrangement (for a structure) means the arrangement of the building features (e.g., floors, ceilings, walls, doorways, and basemat) and of the SSCs within the building, as described in the ITAAC design description and as shown in the figures.

Qualified for a harsh environment means that the subject equipment can withstand environmental conditions that would exist before, during, and after a design basis accident and still perform its safety function.

Tag number means the identifying number assigned to individual hardware items. Tag numbers in Tier 1 provide unique identification of the items and include system designation. Tag numbers used elsewhere, e.g., Tier 2, may include additional information. Refer to Section 1.6 for additional explanation of the Tier 1 numbering methodology.

Test means actuation or operation, or establishment of specified conditions to evaluate the performance or integrity of as-built SSCs, unless explicitly stated otherwise, to determine whether an ITAAC acceptance criterion is met.

Tier 1 means the portion of the design-related information contained in the DCD that is approved and certified by NRC in the design certification rule, commonly referred to as Tier 1 information or Tier 1 material.

Tier 2 means the portion of the design-related information contained in the DCD that is approved but not certified by NRC (Tier 2 information). Compliance with Tier 2 is required, but generic changes to and plant-specific departures from Tier 2 are governed by the change process in the design certification rule. Compliance with Tier 2 provides a sufficient method for complying with Tier 1, but not the only acceptable method.

Transfer open (or transfer closed) means to move from a closed position to an open position (or vice versa).

Type test means a test performed on one or more sample components to qualify other components of the same type and manufacturer. A type test is not necessarily a test of the as-built SSC.

1.4 GENERAL PROVISIONS

The following information is provided to help place information contained in Chapter 2 and Chapter 3 into context.

1.4.1 Design Descriptions

A design description is simply a written narrative briefly describing a certain aspect of the US-APWR design. The narrative is typically supplemented by tables and figures.

The design descriptions address the most safety-significant aspects of each of the systems of the design, describing the top-level design features and performance characteristics most significant to safety. The amount of design information provided is proportional to the safety significance of the structure or system.

The applicable requirements from regulations, codes, and standards are stated in the design descriptions. However, these are not cited or referenced except in certain cases involving reference to various parts of Section III of the ASME Code.

Design descriptions also address matters not directly associated with specific systems, such as structural and systems engineering and the general design features of piping systems and components. The tables and figures identify the components, equipment, system piping, building walls, etc. that must be verified by ITAAC.

1.4.2 Treatment of Individual Items

The design descriptions describe the US-APWR in sufficient detail to support NRC certification of the standard design. However, they are not necessarily all encompassing.

The licensee is not prohibited from using an item not described in Tier 1. Such an item would not have to be discussed in the design descriptions or shown in the accompanying tables or figures unless its use would prevent an item addressed in the design description from performing its described safety function.

If an inspection, test, or analysis requirement does not specify the temperature or other conditions under which the inspection, test or analysis must be conducted, then the conditions for the inspection, test or analysis is not constrained.

As noted in the definition, the term “operates” or “operation” as utilized in Tier1 is intended to refer to the actuation and running of equipment. It is not meant to include the term “operable” in the context of the ongoing reliability and availability of equipment.

1.4.3 ITAAC Tables

The ITAAC tables are arranged with three columns, with all ITAAC numbered for control purposes. The column headings are as follows:

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria

The first column of the ITAAC table identifies the proposed design requirement and/or commitment to be verified. This column generally contains the specific text of the design commitment, which is extracted from the design description. In cases where a specific design commitment is summarized, the statement in the first column retains the principal performance characteristics and safety functions of the design feature to be verified.

The second column of the ITAAC table identifies the proposed method – inspection, testing, analysis, or some combination of the three – by which the licensee will verify the design requirement/commitment described in the first column. If specified parameters are not provided in this column, there are no restrictions on the test condition.

The third column of the ITAAC table identifies the proposed specific acceptance criteria for the inspections, tests, and/or analyses described in the second column that, if met, demonstrate that the licensee has met the design requirements/commitments in the first column.

The ITAAC are tailored to the specific subject matter or type of system as discussed in Subsection 1.4.4. While site parameters are addressed in Chapter 2, no ITAAC is provided for site parameters. Instead key site design parameters associated with the US-APWR standard design are identified and their values specified. An actual site for construction of a US-APWR plant is acceptable if its characteristics fall within the specified design parameter values.

The acceptance criteria are designed to be objective and unambiguous to prevent misinterpretation. When numeric performance values for SSCs are specified, these values are those assumed in the safety analyses, rather than the design values.

In some cases, an ITAAC statement in one section may refer to ITAAC in another Tier 1 section to avoid duplication. In these cases, completion of the ITAAC action will satisfy the requirements of both sections.

1.4.4 Examples of ITAAC

The focus of ITAAC varies with subject matter. For example:

- ITAAC for structural and systems engineering focus on building structures and the structural aspects of major components, such as the reactor vessel, the pressurizer, and the steam generators.
- The ITAAC for piping systems and components address the design, along with dynamic qualification, welding, fasteners, and safety classification of SSCs.
- ITAAC for instrumentation and control equipment address compliance with NRC regulations and applicable Institute of Electrical and Electronics Engineers (IEEE) guidance as they pertain to safety systems.
- ITAAC for the human factors interface system address the minimum inventory of alarms, controls, and indications appropriate for the main control room and the remote shutdown console.

Typical ITAAC address matters such as system functional arrangement, pressure boundary integrity, welding, seismic qualification, environmental qualification, and motor-operated valves. The approach taken on each of these matters is as follows:

- The design commitment on functional arrangement generally indicates that the functional arrangement of a system is as shown in the system figure. The appropriate inspection, test, or analysis is typically an inspection of the as-built system. The acceptance criterion is typically that the system conforms to the functional arrangement shown in the figure.
- The design commitment on pressure boundary integrity typically states that the ASME Code components of the system retain their pressure boundary integrity under internal pressures that are experienced during service. The appropriate inspection, test, and analysis is typically stated as follows: a hydrostatic test will be conducted on those components of the system required to be hydrostatically tested by the ASME Code, and preoperational non-destructive examination will be conducted on those components of the system for which inspections are required by the ASME Code. The acceptance criterion is typically that the results

of the hydrostatic test of the ASME Code components of the system conform to the requirements in Section III of the ASME Code.

- The design commitment on welding typically states that pressure boundary welds associated with the ASME Code components of the system meet the requirements of Section III of the ASME Code. The appropriate inspection, test, and analysis are usually non-destructive tests of the as-built pressure boundary welds as specified in Section III of the ASME Code. The acceptance criteria indicate that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
- The design commitment on seismic qualification typically states that the specified seismic Category I components can withstand design basis seismic loads and continue to serve their safety function. Type tests and/or analyses of the seismic Category I components are specified to verify the design commitment. The acceptance criteria typically indicate that the results of the type tests and/or analyses concludes that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
- The design commitment on environmental qualification typically indicates that the specified components can maintain functional operability under all service conditions, including design basis accidents. The appropriate inspection, test, and analysis typically involve inspections of the components and the associated wiring, cabling, and terminations located in a harsh environment, along with type tests and/or analyses. The acceptance criteria indicates that the results of the type tests and/or analyses conclude that the Class 1E equipment as being qualified for a harsh environment can withstand the environmental conditions.
- The design commitment on motor-operated valves typically states that the specified valves open, close, or both open and close under differential pressure, fluid flow, and temperature conditions. The appropriate inspection, test, or analysis typically involves tests of the installed valves under system preoperational conditions. The acceptance criteria typically entail the appropriate operation upon receipt of the actuating signal.

1.4.5 Implementation of Inspections, Tests, and Analyses

Although ITAAC are identified separately for each design commitment, this practice does not mean that a separate inspection, test, or analysis is required for each design commitment. A single inspection, test, or analysis may suffice for verification of multiple design commitments.

The licensee is responsible for performance of the specified inspections, tests, and analyses. However, this effort may be accomplished by authorized vendors, contractors, or consultants, and not only by the licensee organization.

The specified inspections, tests, and analyses must be completed before fuel load. However, they do not have to be performed as part of a separate ITAAC program. For example, certain inspections, tests, and analyses could be performed as part of quality assurance activities performed in accordance with 10 CFR Part 50, Appendix B.

In those cases where a design description mentions operations – such a noting a particular valve position in a certain operational mode – this information is provided only to help establish context for the design descriptions. In no way do any such discussions imply that operators should take a particular action under the given circumstances.

1.5 FIGURES AND FIGURE LEGEND

The figures provided in support of design descriptions are simplified schematic drawings. They provide the following information, as applicable:

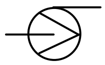
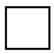
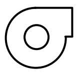
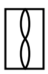
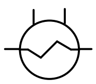
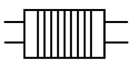
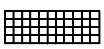
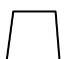
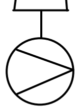
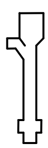
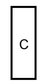
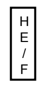
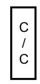
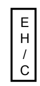
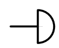
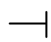
- The figures depict the functional arrangement of the significant SSCs of the standard design.
- The amount of information depicted is based on the safety significance of the SSCs, with figures for non safety-related systems having less detail than figures for safety-related systems.
- The figures show components discussed in the design description.
- The figures clearly delineate system boundaries with other systems.

These figures are generalized schematic illustrations of SSCs. Unless otherwise specified, they are not to scale and are not intended to represent characteristics such as location or spatial relationships.

The symbols used on the figures are identified on the following pages.

MECHANICAL EQUIPMENT

SYMBOL DESCRIPTION

Symbol	Description
	CENTRIFUGAL PUMP
	TANK
	CENTRIFUGAL FAN
	AXIAL FAN
	HEAT EXCHANGER (SHELL & TUBE TYPE)
	HEAT EXCHANGER (PLATE TYPE)
	ECC/CS STRAINER
	STEAM TURBINE
	DRIVEN PUMP
	ESSENTIAL SERVICE WATER PUMP
	HIGH EFFICIENCY PATECULATE AIR (HEPA) FILTER
	CHARCOAL ADSORBER
	HIGH EFFICENCY FILTER
	CHILLED WATER COOLING COIL
	ELECTERIC HEATING COIL
	CAPPED STUB END
	BLIND FLANGE
	ORIFICE

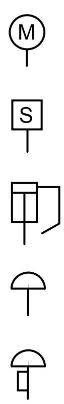
VALVE

SYMBOL DESCRIPTION

- CHECK VALVE
- GATE VALVE
- BUTTERFLY VALVE
- GLOVE VALVE
- METAL DIAPHRAGM VALVE
- PRESSURE RELIEF VALVE
- THREE-WAY VALVE

VALVE OPERATORS

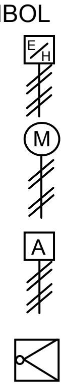
SYMBOL DESCRIPTION



- MOTOR OPERATOR
- SOLENOID OPERATOR
- SYTEM MEDIUM OPERATOR
- AIR OPERATOR
- AIR OPERATOR WITH POSITIONER

DAMPERS

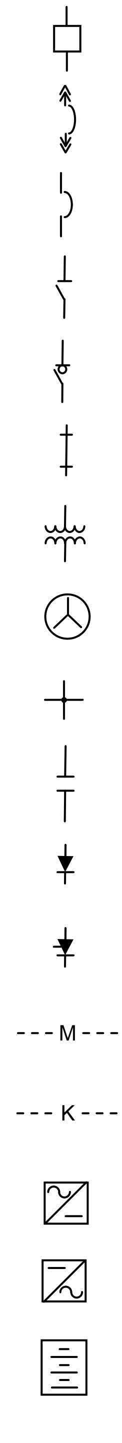
SYMBOL DESCRIPTION



- ELECTRO HYDRAULIC OPERATED DAMPER
- MOTOR OPERATED DAMPER
- AIR OPERATED DAMPER
- TORNADO DAMPER

ELECTRICAL EQUIPMENT

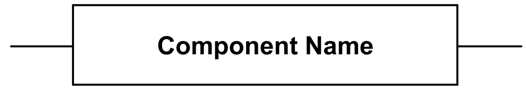
SYMBOL DESCRIPTION



- HIGH VOLTAGE CIRCUIT BREAKER
- DRAWOUT TYPE CIRCUIT BREAKER
- MOLDED CASE CIRCUIT BREAKER
- DISCONNECTING SWITCH
- LOAD BREAK SWITCH
- LINKS
- TRANSFORMER
- GENERATOR
- WIRING
- CONTACTOR
- DIODE
- RECTIFIER
- MECHANICAL INTERLOCK
- MECHANICAL KEY INTERLOCK
- AC/DC CONVERTER
- INVERTER
- BATTERY

MISCELLANEOUS

A component that is part of the system functional arrangement shown on the figure and is Included in the design commitments for the system.

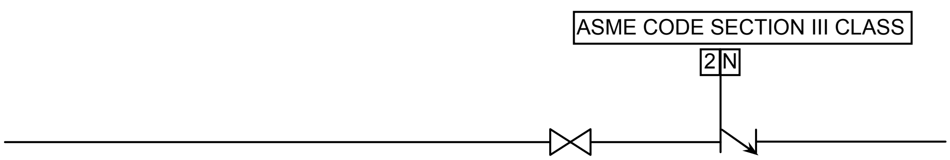


A component that is part of the system functional arrangement shown on the figure.

A system or component of another system that is not part of the system functional arrangement shown on the figure.

ASME CODE CLASS BREAK

A ASME Code class break is identified by a single line to the designated location for the class break, as shown in the example below



1.6 Tag numbers

Tag numbers are used to uniquely identify hardware items in the US-APWR. An example of the Tier 1 tag number format is shown below for the steam generator in Division A is shown below:

RCS – MHX – 001A

Where:

RCS is the System Code for reactor coolant system
MHX is the Equipment Function Code for heat exchanger
001 is the Serial Number
A is the suffix

The Tier 1 tag number format conforms to the full equipment number from which plant designator and safety designator are omitted.

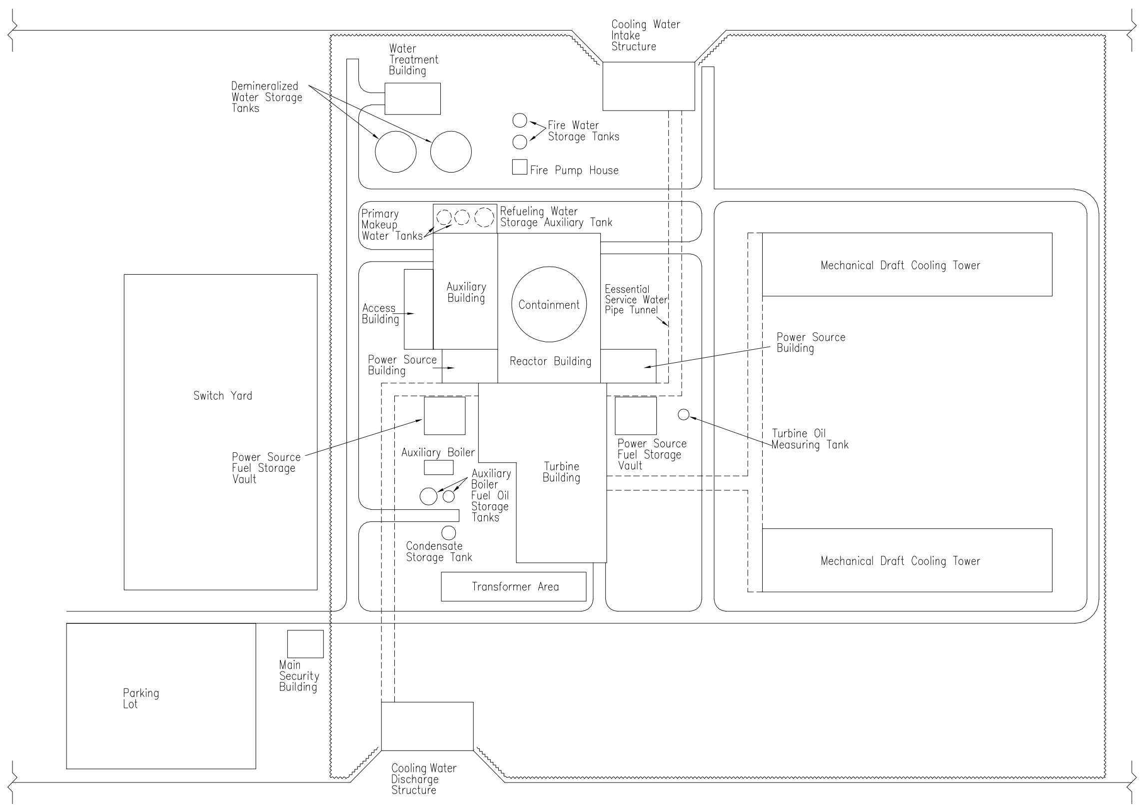


Figure 1-1 US-APWR Plant Typical Site Arrangement

2.0 DESIGN DESCRIPTIONS AND ITAAC

This chapter identifies site parameters and provides design descriptions and related ITAAC for different aspects of the US-APWR standard design.

The information in this chapter is organized as follows:

Section	Subject
2.1	SITE PARAMETERS
2.2	STRUCTURAL AND SYSTEMS ENGINEERING
2.3	PIPING SYSTEMS AND COMPONENTS
2.4	REACTOR SYSTEMS
2.5	INSTRUMENTATION AND CONTROLS
2.6	ELECTRICAL SYSTEMS
2.7	PLANT SYSTEMS
2.8	RADIATION PROTECTION
2.9	HUMAN FACTORS ENGINEERING
2.10	EMERGENCY PLANNING
2.11	CONTAINMENT SYSTEMS
2.12	PHYSICAL SECURITY HARDWARE
2.13	DESIGN RELIABILITY ASSURANCE PROGRAM
2.14	INITIAL TEST PROGRAM

2.1 SITE PARAMETERS

This section identifies key site parameters postulated for the US-APWR standard plant design. These parameters apply to the design of safety-related aspects of SSCs of the US-APWR.

2.1.1 Design Description

The design descriptions applicable to this section are reflected in the specified key site parameters identified in Table 2.1-1. An actual site for construction of a US-APWR plant will be acceptable if its characteristics fall within the design parameter values specified in Table 2.1-1. In case of deviation from these parameters, justification may be provided that the proposed facility is acceptable at the proposed site.

2.1.2 Inspections, Tests, Analyses, and Acceptance Criteria

This section does not provide ITAAC.

Table 2.1-1 Key Site Parameters
(Sheet 1 of 7)

Meteorology		
Parameter Description		**Parameter Value**
Normal winter precipitation roof load(11)		50 lb/ft^2
Extreme winter precipitation roof load(12) (100-year snowpack maximum snow weight including contributing portion of either extreme frozen winter precipitation event or extreme liquid winter precipitation event)		75 lb/ft^2
48-hr probable maximum winter precipitation(13) (PMWP)		36 in.
Tornado maximum wind speed		230 mph
		184 mph maximum rotational
		46 mph maximum translational
Radius of maximum rotational speed		150 ft
Tornado maximum pressure drop		1.2 psi
Rate of pressure drop		0.5 psi/s
Tornado-generated missile spectrum and associated velocities		15 ft long schedule 40 steel pipe moving horizontally at 135 ft/s(1)
		4,000 lb automobile moving horizontally at 135 ft/s(1)
		1 in diameter steel sphere moving horizontally at 26 ft/s(1)
Extreme wind speed (other than in tornado)		155 mph for 3-second gusts at 33 ft above ground level based on 100-year return period, with importance factor of 1.15 for seismic category I/II structures
Ambient design air temperature (5% exceedance maximum)	Secondary HVAC	95°F dry bulb, 77°F coincident wet bulb, 79°F non-coincident wet bulb
	Normal Plant Heat Sink	92°F dry bulb, 75°F coincident wet bulb, 76°F non-coincident wet bulb
Ambient design air temperature (1% annual exceedance maximum)		100°F dry bulb, 77°F coincident wet bulb, 81°F non-coincident wet bulb
Ambient design air temperature (0% annual exceedance maximum)		115°F dry bulb, 80°F coincident wet bulb, 86°F non-coincident wet bulb, historical limit excluding peaks <2 hr
Ambient design air temperature (5% exceedance minimum)		-5°F dry bulb
Ambient design air temperature (1% annual exceedance minimum)		-10°F dry bulb
Ambient design air temperature (0% annual exceedance minimum)		-40°F dry bulb, historical limit excluding peaks <2 hr

Table 2.1-1 Key Site Parameters
(Sheet 2 of 7)

Parameter Description	Parameter Value
Atmospheric dispersion factors (χ/Q values) for onsite locations:	
Exclusion area boundary (EAB) 0-2 hrs	5.0×10^{-4} s/m^3
EAB annual average	1.6×10^{-5} s/m^3
Atmospheric dispersion factors (χ/Q values) for offsite locations:	
Low-population zone (LPZ) boundary 0-8 hrs 8-24 hrs 1-4 days 4-30 days	 2.1×10^{-4} s/m^3 1.3×10^{-4} s/m^3 6.9×10^{-5} s/m^3 2.8×10^{-5} s/m^3
Food production area annual average	5.0×10^{-6} s/m^3
Deposition factor (D/Q value) for onsite and offsite locations:	
EAB annual average	4.0×10^{-8} 1/m^2

Table 2.1-1 Key Site Parameters
(Sheet 3 of 7)

Atmospheric dispersion factors (χ/Q values) for main control room (MCR) heating, ventilation, and air conditioning (HVAC) intake for specified release points[(2)]:	
Plant vent [(5)]	
0-8 hrs	1.1×10^{-3} s/m^3
8-24 hrs	6.6×10^{-4} s/m^3
1-4 days	4.2×10^{-4} s/m^3
4-30 days	1.9×10^{-4} s/m^3
Ground-level containment releases[(4)]	
0-8 hrs	2.2×10^{-3} s/m^3
8-24 hrs	1.3×10^{-3} s/m^3
1-4 days	8.3×10^{-4} s/m^3
4-30 days	3.6×10^{-4} s/m^3
Main steam relief valve and safety valve releases[(6)]	
0-8 hrs	5.3×10^{-3} s/m^3
8-24 hrs	3.1×10^{-3} s/m^3
1-4 days	2.0×10^{-3} s/m^3
4-30 days	8.7×10^{-4} s/m^3
Steam line break releases [(8)]	
0-8 hrs	1.9×10^{-2} s/m^3
8-24 hrs	1.1×10^{-2} s/m^3
1-4 days	7.1×10^{-3} s/m^3
4-30 days	3.1×10^{-3} s/m^3
Fuel handling area releases [(7)]	
0-8 hrs	1.1×10^{-3} s/m^3
8-24 hrs	6.4×10^{-4} s/m^3
1-4 days	4.1×10^{-4} s/m^3
4-30 days	1.8×10^{-4} s/m^3

Table 2.1-1 Key Site Parameters (Sheet 4 of 7)

Atmospheric dispersion factors (χ/Q values) for MCR inleak for specified release points[(3)]:	
Plant vent [(9)] 0-8 hrs 8-24 hrs 1-4 days 4-30 days	 1.3×10^{-3} s/m^3 7.8×10^{-4} s/m^3 4.9×10^{-4} s/m^3 2.2×10^{-4} s/m^3
Plant vent [(10)] 0-8 hrs 8-24 hrs 1-4 days 4-30 days	 1.4×10^{-3} s/m^3 8.0×10^{-4} s/m^3 5.1×10^{-4} s/m^3 2.2×10^{-4} s/m^3
Ground-level containment releases to Class 1E electrical room HVAC intake [(4)] 0-8 hrs 8-24 hrs 1-4 days 4-30 days	 2.4×10^{-3} s/m^3 1.4×10^{-3} s/m^3 9.1×10^{-4} s/m^3 4.0×10^{-4} s/m^3
Main steam relief valve and safety valve releases [(6)] 0-8 hrs 8-24 hrs 1-4 days 4-30 days	 5.3×10^{-3} s/m^3 3.1×10^{-3} s/m^3 2.0×10^{-3} s/m^3 8.7×10^{-4} s/m^3
Steam line break releases [(8)] 0-8 hrs 8-24 hrs 1-4 days 4-30 days	 1.9×10^{-2} s/m^3 1.1×10^{-2} s/m^3 7.1×10^{-3} s/m^3 3.1×10^{-3} s/m^3
Fuel handling area releases [(7)] 0-8 hrs 8-24 hrs 1-4 days 4-30 days	 1.1×10^{-3} s/m^3 6.7×10^{-4} s/m^3 4.3×10^{-4} s/m^3 1.9×10^{-4} s/m^3

Table 2.1-1 Key Site Parameters
(Sheet 5 of 7)

Atmospheric dispersion factors (χ/Q values) for Technical Support Center (TSC) HVAC intake for specified release points(2):	
Plant vent (5)	
0-8 hrs	1.4×10^{-3} s/m^3
8-24 hrs	8.0×10^{-4} s/m^3
1-4 days	5.1×10^{-4} s/m^3
4-30 days	2.2×10^{-4} s/m^3
Ground-level containment releases(4)	
0-8 hrs	1.9×10^{-3} s/m^3
8-24 hrs	1.1×10^{-3} s/m^3
1-4 days	7.2×10^{-4} s/m^3
4-30 days	3.2×10^{-4} s/m^3
Main steam relief valve and safety valve releases(6)	
0-8 hrs	1.7×10^{-3} s/m^3
8-24 hrs	9.9×10^{-4} s/m^3
1-4 days	6.3×10^{-4} s/m^3
4-30 days	2.8×10^{-4} s/m^3
Steam line break releases (8)	
0-8 hrs	1.4×10^{-3} s/m^3
8-24 hrs	8.4×10^{-4} s/m^3
1-4 days	5.3×10^{-4} s/m^3
4-30 days	2.3×10^{-4} s/m^3
Fuel handling area releases (7)	
0-8 hrs	6.7×10^{-4} s/m^3
8-24 hrs	3.9×10^{-4} s/m^3
1-4 days	2.5×10^{-4} s/m^3
4-30 days	1.1×10^{-4} s/m^3

Table 2.1-1 Key Site Parameters
(Sheet 6 of 7)

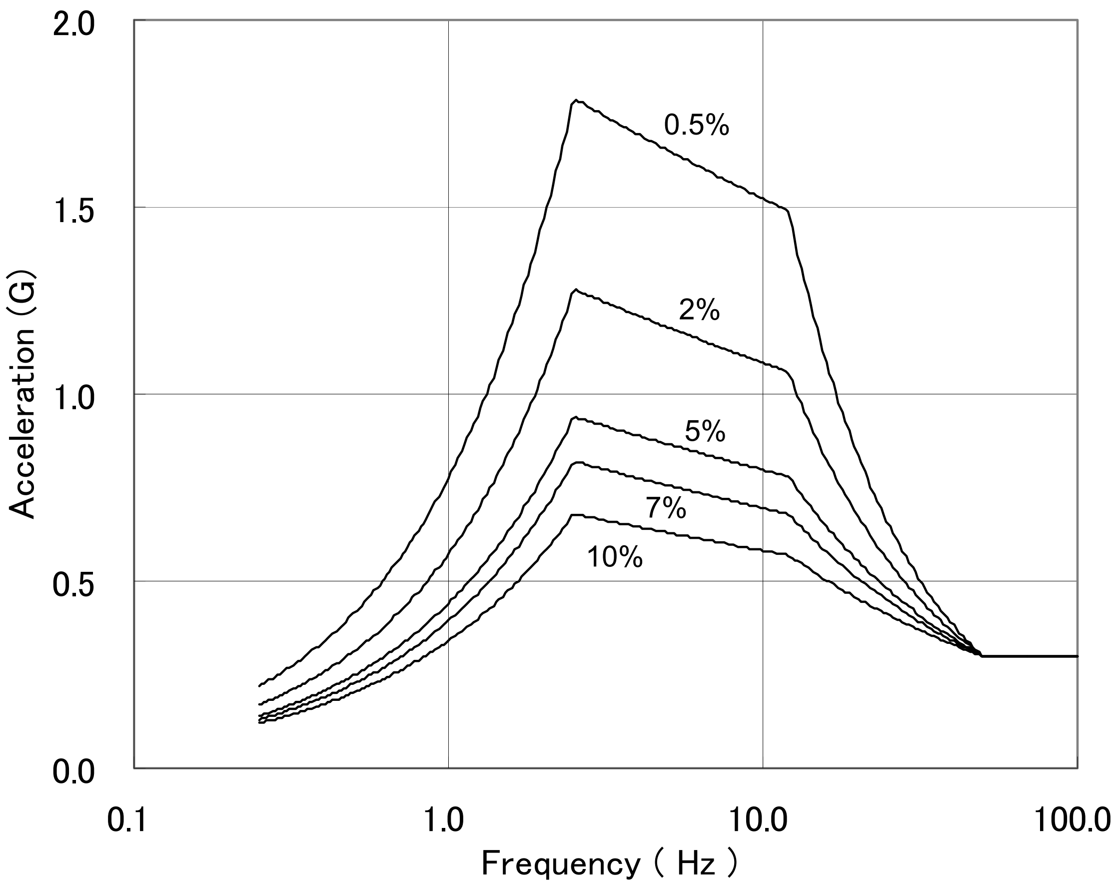
Atmospheric dispersion factors (χ/Q values) for TSC inleakage for specified release points(3):	
Plant vent (5) 0-8 hrs 8-24 hrs 1-4 days 4-30 days	1.4×10^{-3} s/m^3 8.0×10^{-4} s/m^3 5.1×10^{-4} s/m^3 2.2×10^{-4} s/m^3
Ground-level containment releases (4) 0-8 hrs 8-24 hrs 1-4 days 4-30 days	1.9×10^{-3} s/m^3 1.1×10^{-3} s/m^3 7.2×10^{-4} s/m^3 3.2×10^{-4} s/m^3
Main steam relief valve and safety valve releases (6) 0-8 hrs 8-24 hrs 1-4 days 4-30 days	1.7×10^{-3} s/m^3 9.9×10^{-4} s/m^3 6.3×10^{-4} s/m^3 2.8×10^{-4} s/m^3
Steam line break releases (8) 0-8 hrs 8-24 hrs 1-4 days 4-30 days	1.4×10^{-3} s/m^3 8.4×10^{-4} s/m^3 5.3×10^{-4} s/m^3 2.3×10^{-4} s/m^3
Fuel handling area releases (7) 0-8 hrs 8-24 hrs 1-4 days 4-30 days	6.7×10^{-4} s/m^3 3.9×10^{-4} s/m^3 2.5×10^{-4} s/m^3 1.1×10^{-4} s/m^3

Table 2.1-1 Key Site Parameters
(Sheet 7 of 7)

Hydrologic Engineering	
Parameter Description	**Parameter Value**
Maximum flood (or tsunami) level	1 ft below plant grade
Maximum rainfall rate (hourly)	19.4 in/hr for seismic category I/II structures
Maximum rainfall rate (short-term)	6.3 in/5 min for seismic category I/II structures
Maximum groundwater level	1 ft. below plant grade
Geology, Seismology, and Geotechnical Engineering	
Parameter Description	**Parameter Value**
Maximum slope for foundation-bearing stratum	20° from horizontal in untruncated strata
Safe-shutdown earthquake (SSE) ground motion	0.3 g peak ground acceleration
SSE (certified seismic design) horizontal ground response spectra	Regulatory Guide (RG) 1.60, enhanced spectra in high frequency range (See Figure 2.1-1)
SSE (certified seismic design) vertical ground response spectra	RG 1.60, enhanced spectra in high frequency range (See Figure 2.1-2)
Potential for surface tectonic deformation at site	None within the EAB
Subsurface stability – minimum allowable static bearing capacity	15,000 lb/ft^2
Subsurface stability – minimum allowable dynamic bearing capacity, normal conditions plus SSE	60,000 lb/ft^2
Subsurface stability – minimum shear wave velocity at SSE input at ground surface	1,000 ft/s
Subsurface stability – shear wave velocity for defining firm rock	3,500 ft/s
Subsurface stability – shear wave velocity for defining firm to hard rock	6,500 ft/s
Subsurface stability – shear wave velocity for defining hard rock	8,000 ft/s
Subsurface stability – liquefaction potential	None (for seismic category I structures)
Total settlement of R/B complex foundation(14)	6.0 in.
Differential settlement across R/B complex foundation(14)	2.0 in.
Maximum differential settlement between buildings(14)	0.5 in.
Maximum tilt of R/B complex foundation generated during operational life of the plant(14)	1/2000

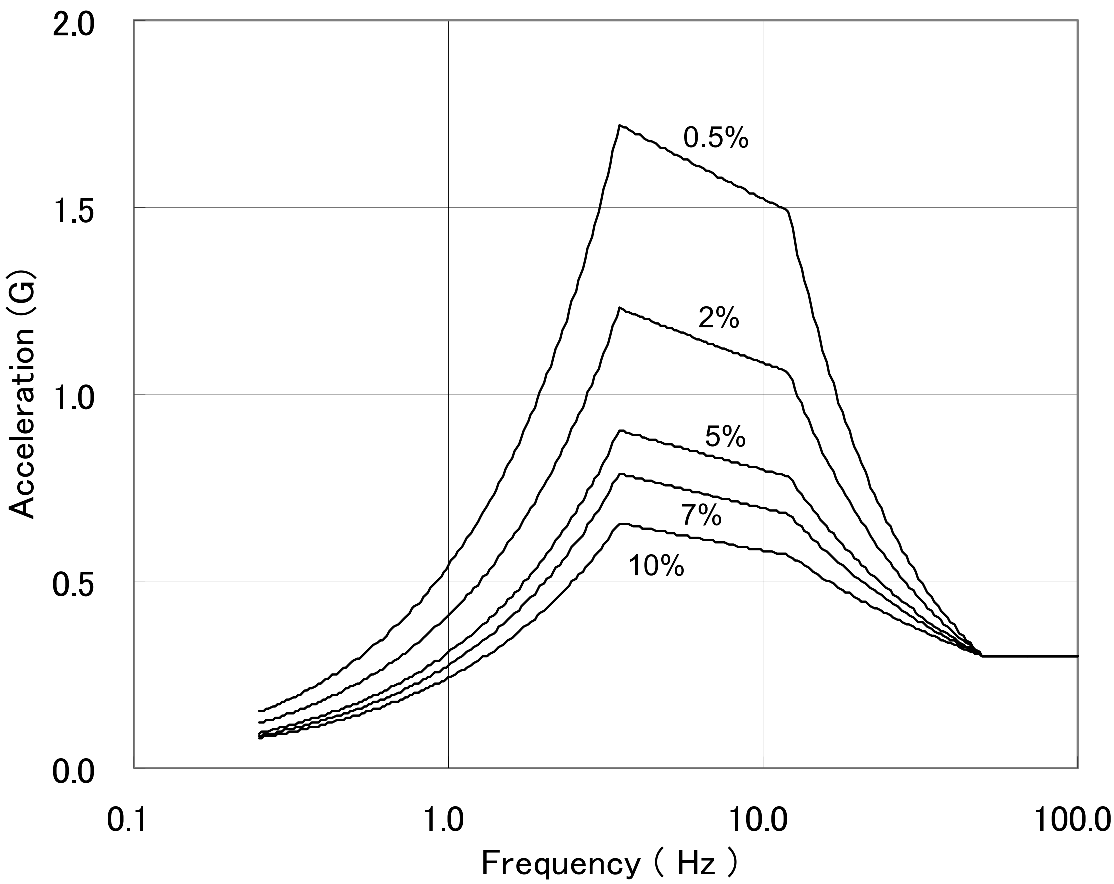
NOTES:

1. The specified missiles are assumed to have a vertical speed component equal to 2/3 of the horizontal speed.
2. These dispersion factors are chosen as the maximum values at all intake points.
3. These dispersion factors are chosen as the maximum values at all inleak points.
4. These dispersion factors are used for a loss-of-coolant accident (LOCA), a rod ejection accident.
5. These dispersion factors are used for a loss-of-coolant accident (LOCA), a rod ejection accident, a failure of small lines carrying primary coolant outside containment and a fuel-handling accident inside the containment.
6. These dispersion factors are used for a steam generator (SG) tube rupture, a steam system piping failure, a reactor coolant pump (RCP) rotor seizure, and a rod ejection accident.
7. These dispersion factors are used for a fuel handling accident occurring in the fuel handling and storage area.
8. These dispersion factors are used for a steam system piping failure.
9. These dispersion factors are used for a LOCA
10. These dispersion factors are used for a rod ejection accident, a failure of small lines carrying primary coolant outside containment and a fuel-handling accident inside the containment.
11. Normal winter precipitation roof load is determined by converting ground snow load p_g based on the highest ground-level weight of:
    - the 100-year return period snowpack,
    - the historical maximum snowpack,
    - the 100-year return period snowfall event, or
    - the historical maximum snowfall event in the site region.
12. The extreme winter precipitation roof load is based on the sum of the normal ground level winter precipitation plus the highest weight at ground level resulting from either the extreme frozen winter precipitation event or the extreme liquid winter precipitation event. The extreme frozen winter precipitation event is assumed to accumulate on the roof on top of the antecedent normal winter precipitation event. The extreme liquid winter precipitation event may not accumulate on the roof, depending on the geometry of the roof and the type of drainage provided. The extreme winter precipitation roof load is included as live load in extreme loading combinations using the applicable load factor indicated.
13. The 48-hour PMWP is based on interpolation of 24-hour PMP and 72-hour PMP data for the month of March
14. Acceptable parameters for settlement without further evaluation.



Note: spectra for damping 0.5, 2, 5, 7, 10%.

Figure 2.1-1 US-APWR Certified Seismic Design Response Spectra (Horizontal)



Note: spectra for damping 0.5, 2, 5, 7, 10%.

Figure 2.1-2 US-APWR Certified Seismic Design Response Spectra (Vertical)

2.2 STRUCTURAL AND SYSTEMS ENGINEERING

This section addresses four matters related to structural and systems engineering: (1) building structures, (2) protection against hazards, (3) system structural design, and (4) the generic and specific-system ITAAC.

2.2.1 Building Structures Design Description

The scope of the US-APWR standard design of the buildings and structures are described in Section 1.2. The US-APWR safety-related structures are comprised of the R/B that includes the PCCV and the containment internal structures on a common basemat, and two PS/Bs. The design descriptions of each building and structure are described herein, and its classifications are provided in Table 2.2-1.

The critical building dimensions are described in Figures 2.2-1 and 2.2-2. The definition of concrete thicknesses, column line locations, floor elevations, and radiation shielding capability for the safety-related structures are provided in Table 2.2-2 and Figures 2.2-3 through 2.2-13.

The safety-related structures are designed and constructed to withstand design-basis loads as specified in the design description without loss of structural integrity and the safety-related functions. The design basis loads are as follows:

- Normal plant operation (including dead loads, live loads, lateral earth pressure loads, and equipment loads, including hydrodynamic loads, temperature, and equipment vibration)
- External events (including rain, snow, flood, tornado, tornado generated missiles, and earthquake)
- Internal events (including flood, pipe rupture, equipment failure, and equipment failure generated missiles).

2.2.1.1 Reactor Building (R/B)

The R/B has five main floors. The building contains the PCCV near its center and is founded on a common basemat. The outer perimeter of the R/B is rectangular, and is constructed of reinforced concrete walls, floors, and roofs. The basemat is a reinforced concrete structure isolated from the adjacent A/B, the PS/Bs, and the T/B.

The R/B consists of the following five areas and is designed according to the following functions:

- The PCCV facility is comprised of the containment vessel and the annulus enclosing the containment penetration area, and provides an efficient leak-tight barrier and environmental radiation protection under all postulated conditions, including LOCA. The PCCV is a prestressed concrete structure designed to endure the peak pressure for LOCA, and steamline and feedline break conditions.

- The safety system pump areas are located at the lowest level of the R/B to secure the required net positive suction head. Four redundant safety systems containing radioactive material are located in each zone of the four quadrants surrounding the containment structure. The safety system heat exchangers are located at the floor elevation above the pump room.
- The fuel storage and handling area is located at the same level of the R/B as the PCCV operating floor, and houses the following facilities:
  - Fuel handling machine
  - Fuel transfer system
  - Cask pit with the spent fuel cask handling crane
  - New fuel storage pit
  - Cask washdown pit
  - Spent fuel pit
  - Fuel inspection pit
- The main steam and feedwater piping areas are located in the R/B, and between the PCCV and the T/B. The piping rooms are located on the top floor of this area where they pass between the PCCV and the T/B.
- The safety-related electrical area has two floors and is located in the R/B below the main steam and feedwater areas. This area is a non-radioactive zone and is completely separated from the radioactive zones of the R/B. This area houses the following safety-related facilities:
  - Main control room
  - Switchgear and batteries
  - I&C cabinet room

The finished grade level is located at the elevation of 2’-7”. The embedment depth of the R/B (from the top of the basemat to the finished grade) is 28’-11”.

2.2.1.2 Prestressed Concrete Containment Vessel (PCCV)

The geometric shape of the PCCV is a vertically oriented cylinder topped by a hemispherical dome with no ring girder at the dome/cylinder interface.

The PCCV consists of a prestressed concrete shell containing unbonded tendons and reinforcement steel. Prestressing is obtained through post-tensioning – a method of prestressing in which tendons are tensioned after concrete has hardened. Reinforcing steel is provided overall in the cylinder and dome. Additional reinforcement is provided at discontinuities such as the cylinder-basemat interface, around penetrations and openings, at buttresses, and at other areas.

The concrete shell inner surface is lined with a minimum 1/4-in. carbon steel plate that is anchored to the concrete shell and dome to provide the required pressure boundary leak tightness. The liner plate system is not designed or considered as a structural member in providing for the overall PCCV load resistance. The liner plate system is attached to the PCCV shell with an anchorage system.

The design pressure is 68 pounds per square inch, gauge (psig). The structural integrity test pressure condition is 1.15 times the design pressure. The accident pressure cited above includes a 10% margin above the accepted peak calculated containment pressure following LOCA, or a steam or feedwater line break. External or internal events such as containment spray actuation may induce a negative pressure on the PCCV. Therefore, in addition to the design-basis accident pressure, the PCCV is designed for an external pressure of 3.9 psig.

During normal operation, a linear temperature gradient across the containment wall thickness develops. After a LOCA, however, the sudden increase in temperature in the liner and adjacent concrete produces a nonlinear transient temperature gradient. The temperature versus time is considered when combining with the accident pressure in the specified load combinations, and the worst-case temperature gradients in the structure are used in the thermal analyses.

The operating-basis earthquake (OBE) sets at maximum 1/3 of the safe-shutdown earthquake (SSE) ground motion. Certain structural elements of the containment are evaluated for fatigue resulting from the one-third of SSE induced stress cycles.

The crane or other attachment loads, hydrodynamic, pressures from soil, and flooding are also investigated in the overall design and also for local effects.

For thermal loads, the effect of concrete cracking is considered in developing the internal forces and moments in the section.

The liner plate is not designed or analyzed as a strength structural element. The minimum concrete design compressive strength (f’c) for the PCCV is 6000 psi. The minimum concrete design compressive strength (f’c) for the basemat is 4000 psi.

The steel liner plate is designed as SA-516 grade 60 or equivalent material, 1/4-inch minimum thickness.

All tendons are un-bonded (un-grouted) and have the capability to be de-tensioned and re-tensioned to a higher value, and have a wire or strand removed after de-tensioning during a tendon surveillance operation.

The ultimate capacity for the PCCV is estimated based on cumulative yield strength of steel materials such as rebars, tendons, and liner plate.

2.2.1.3 Containment Internal Structures

Containment internal structures in the PCCV, but not part of the containment pressure boundary, provide support of the reactor coolant system (RCS) components and related piping systems and equipment. Steel concrete (SC) module walls provide radiation shielding as well as sub-compartments within the PCCV. Table 2.2-4 provides the

ITAAC requirements and acceptance criteria for the special modular construction techniques to be utilized for the fabrication, shipping, handling, and installation of the SC modules, and the reconciliation of the as-built configuration of the plant with the structural design basis of the licensed facility.

The reactor vessel support system consists of eight steel support pads which are integrated with the inlet and outlet nozzle forgings. The support pads are placed on support brackets, which are supported by steel structure around the reactor vessel. The support system is designed for operating and accident load cases caused by seismic and postulated pipe rupture, including LOCA.

Each steam generator is supported by three lateral supports: 1) an upper lateral support structure, 2) an intermediate lateral support structure and 3) a lower lateral support structure, and support columns.

The reactor coolant pump support system consists of a lateral support structure, and support columns.

The pressurizer is supported by an upper support structure and lower support skirt.

The reactor vessel is located at the center of the PCCV. A cylindrical-SC module wall referred to as the primary shield wall is connected with the refueling cavity.

The primary shield wall also serves as the support point for the reactor vessel. The primary shield wall and other walls inside PCCV are fabricated as SC module walls.

The secondary shield walls surround the primary loops from the steam generator compartments. These SC module walls also form supports for intermediate floors and the operating floors.

The refueling cavity is located inside the PCCV, and connects to the fuel transfer tube that penetrates the north end of the PCCV. The walls of the refueling cavity are formed by SC modules lined with stainless steel over the carbon steel plate (Clad steel).

The refueling water storage pit (RWSP) is located at the lowest level of the PCCV. The RWSP is formed by wall of SC module using clad steel.

The containment internal structure includes several sub-compartments designed to provide containment, radiation shielding, and protection of safety-related components. These compartments are formed by a series of SC and/or reinforced concrete structures.

An internal polar crane is supported by the PCCV.

Structural steel framing within the PCCV is primarily for support of equipment, distribution systems, and access platforms. All structural steel are capable of resisting loads and load combinations to which they may be subjected.

2.2.1.4 Power Source Buildings (PS/Bs)

The seismic Category I PS/Bs are arranged adjacent to the R/B. These buildings are freestanding on a reinforced concrete basemat. Each building contains two identical emergency power sources and one alternate ac power source which are separated from each other by a physical barrier. In addition, the safety-related essential chilled water system (ECWS) chillers are also located in these buildings.

The finished grade level is located at the elevation of 2'-7". The embedment depth of the PS/Bs (from the top of the basemat to the finished grade) is 28'-11".

2.2.1.5 Power Source Fuel Storage Vault (PSFSV)

The PSFSV is an underground structure constructed with reinforced concrete, and is classified as seismic Category I. The vaults contain the fuel oil tanks of emergency power sources.

2.2.1.6 Essential Service Water Pipe Tunnel (ESWPT)

The ESWPT is an underground structure constructed with reinforced concrete, and is classified as seismic Category I. Terminating in part under the T/B, the structure is isolated from other structures to prevent any seismic interaction. The other termination point is located at the ultimate heat sink related structure (UHSRS) that connects to the ultimate heat sink (UHS) water.

2.2.1.7 Auxiliary Building (A/B)

The A/B is located adjacent to the R/B, and is designed as a seismic Category II structure to assure that there is no negative impact on nearby seismic Category I SSCs. The basemat is a reinforced concrete structure independent of the nearby seismic Category I basemats. The structure consists of reinforced concrete walls, floors, and roofs.

2.2.1.8 Turbine Building (T/B)

The T/B is located adjacent to the R/B, and is designed as a seismic Category II structure to assure that there is no negative impact on nearby Category I SSCs. The basemat is a reinforced concrete structure independent of the nearby seismic Category I basemats. The structure consists of structural steel and supporting reinforced concrete walls, floors, and roofs on a common basemat separated from the turbine generator pedestal.

2.2.1.9 Access Building (AC/B)

The AC/B is located adjacent to the A/B. The AC/B houses the access control area, and the chemical sampling and laboratory area.

2.2.2 Protection Against Hazards

2.2.2.1 External Flooding

Protection against external flooding is provided to preserve the safe shutdown capability. The main components protected against external flooding are listed in Table 2.2-3. The external walls that are below flood level are adequate thickness to protect against water seepage, and penetrations in the external walls below flood level are provided with flood protection features. Construction joints in the exterior walls and base mats are provided with water stops to prevent seepage of ground water. Additional protection is provided using a waterproofing system applied to below-grade surfaces.

2.2.2.2 Internal Flooding

Protection against internal flooding is provided to preserve the safe shutdown capability. The main components protected against internal flooding are listed in Table 2.2-3.

Elevation -26 ft, 4 in. in radiological controlled area (RCA) of the R/B is divided into four areas, by concrete walls and water-tight doors. A water-tight door is provided in each CS/RHR pump room and SIS pump room. And also water-tight doors are provided in doorways between A/B and R/B.

Elevation -26 ft, 4 in. in the non-radiological controlled area (NRCA) of the R/B is divided into two areas by concrete walls and water-tight doors installed in the corridor. The two trains of four emergency feedwater pump rooms are isolated by concrete walls and water-tight doors. Water-tight doors are provided in doorways at ground level between the T/B and the R/B.

2.2.2.3 Fire Barriers

Redundant safe shutdown components and associated electrical divisions outside the containment and the control room complex are separated by 3-hour rated fire barriers to preserve the capability to safely shut down the plant following a fire. The main components protected against fires are listed in Table 2.2-3. The 3-hour rated fire barriers are placed as required by the fire hazard analysis (FHA). All penetrations and openings through the fire barriers are protected with 3-hour rated components (i.e. fire doors in door openings, fire dampers in ventilation duct openings, and penetration seals).

2.2.2.4 Site Parameters

Section 2.1 contains specific site parameter requirements necessary to meet the engineering and design needs for construction and operation of the US-APWR standard plant. Site bounding parameters, and subsequent engineering design, are chosen to allow construction of the US-APWR within 75% to 80% of the landmass of the conterminous U.S. and includes all possible sites under current consideration. The design of the US-APWR standard plant and the site parameters are robust to meet most conditions expected to be encountered in all possible sites.

The COL application and Final Safety Analysis Report (FSAR) are to provide information concerning the geological, seismological, hydrological, environmental, and meteorological characteristics of the site and vicinity, in accordance with present and projected population distribution including land use relative to site activities and controls. The COL application and FSAR are to report on the COL specific site information as compared to the design envelope criteria required for construction and operation of the US-APWR standard plant. Site-specific characteristics that have influenced plant design and operating criteria are discussed to show the adequacy of the site characteristics from a safety viewpoint. Applicable regulatory requirements are to be identified, and discussions of how these regulatory requirements are met for the site envelope characteristics.

2.2.2.5 Internally Generated Missiles (Inside and Outside Containment)

Factors contributing to missile protection of potentially targeted SSCs are provided by one or more of the following methods:

- Locating the system or component in a missile-proof structure
- Separating redundant systems or components for the missile path or range
- Providing local shields and barriers for systems and components
- Designing the equipment to withstand the impact of the most damaging missile
- Providing design features to prevent the generation of missiles
- Orienting missile sources to prevent missiles from striking safety-related equipment
- Missile barriers are designed if the ability to achieve and maintain safe shutdown is not determined.

Table 2.2-4 provides the ITAAC requirements and acceptance criteria for SSCs that require physical missile protection from any credible internal missiles inside and outside the containment.

2.2.3 System Structural Design

The location, safety classification, quality group, seismic classification, and code requirements for systems and components that are important to safety, affect safety and/or support safety functions are provided in the subsections of specific systems. Table 2.2-4 provides the ITAAC requirements and acceptance criteria for SSCs.

2.2.3.1 Piping Systems and Components

Details are discussed in Section 2.3, Piping Systems and Components, for structural information pertaining to piping systems and components.

2.2.3.2 Seismic and Dynamic Qualification of Mechanical and Electrical Equipment

The safety-related mechanical and electrical equipment, including instrumentation, and, where applicable, their supports classified as seismic Category I are demonstrated to be capable of performing their intended safety-related functions under the full range of normal and accident loadings, including seismic. This includes equipment in the reactor protection system (RPS), engineered safety feature (ESF), Class 1E electrical equipment, the emergency power system, and all auxiliary safety-related systems and supports.

Test and/or Analysis are used for the seismic Category I active mechanical equipment to maintain structural integrity (including pressure retention), and operability. The methods used assure equipment functionality and operability for its intended function under all required plant conditions. Seismic Category I active mechanical equipment is designed to withstand seismic and dynamic loads.

Either testing or a combination of test and analysis demonstrates seismic qualification of seismic Category I instrumentation and electrical equipment. Type testing can be utilized on a sample of equipment representing a generic group that are similar in materials, design, and manufacturing and are in accordance with the manufacture’s quality control system and specifications for production units. The tested equipment is subjected to environmental and operating cycles that simulate the intended service conditions and safety-related functions for which they are to be qualified.

2.2.3.3 Seismic Margin Analysis

SSCs that require evaluation in the seismic fragilities task of a seismic margin analysis have sufficient seismic margin.

2.2.4 Inspection, Tests, Analyses, and Acceptance Criteria

The ITAAC for structures and systems are divided into building structures, system structural design, and protection against hazards with generic and specific ITAAC. The generic ITAAC apply to the building structures listed in Table 2.2-1 and Figures 2.2-3 through 2.2-13. A specific ITAAC applies to the verification that the failure of the indicated non-seismic and seismic Category II structures will not impair the ability of near-by safety-related SSCs to perform their safety-related functions. The system-specific ITAAC apply to certain parts, sections, or SSCs of specific systems that interact with structures. The ITAAC for specific piping systems and component design are located in their respective piping system sections, such as Section 2.3, and are cross-referenced within the Table 2.2-4. The ITAAC associated with specific external and internal environmental hazards are addressed specifically within Table 2.2-4. The following top-level specific structure and system parameters are included as ITAAC to assure plant safety:

- Pressure boundary integrity
- Normal loads
- Seismic loads
- Flood, wind and tornado
- Rain and snow
- Pipe rupture
- Codes and standards

Table 2.2-1 Seismic Classification of Structures (Note 1)

Structure	**Seismic Category** (Note 1)
Reactor Building (R/B)	I
Prestressed Concrete Containment Vessel (PCCV)	I
Containment Internal Structure	I
Power Source Building (PS/B)	I
Power Source Fuel Storage Vault (PSFSV)	I
Essential Service Water Pipe Tunnel (from/to UHS) (ESWPT)	I
Auxiliary Building (A/B)	II
Turbine Building (T/B)	II
Access Building (AC/B)	NS

NOTES:

1. Seismic Category I (I)
   Seismic Category II (II)
   Non-seismic (NS)

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 1 of 15)

Wall or Section Description	Column Lines(1)	Floor Elevation or Elevation Range(1)	Concrete Thickness(2)(3)	Applicable Radiation Shielding Wall (Yes/No)
Prestressed Concrete Containment Vessel				
Cylindrical wall of PCCV	Not Applicable	From 3’-7” to 153’-9”	4’-4”	Yes
Hemispherical wall of PCCV	Not Applicable	From 153’-9” to 232’-0”	3’-8”	Yes
Basemat of PCCV	Disk –shaped portion within a 74’-7” radius from the center of the PCCV	From -36’-3” to 1’-11”	38’-2”	No
Basemat of PCCV	Portion outside a 74’-7” radius from the center of the PCCV	From -36’-3” to 3’-7”	39’-10”	No
Containment Internal Structure (Primary Shield Wall, Secondary Shield Wall, Steam Generator Compartments, Pressurizer Compartment, Refueling Water Storage Pit, Refueling Cavity, etc)				
Primary Shield Wall	Not Applicable	From -12’-6” to 35’-11”	9’-2”	Yes
Secondary Shield Wall	Not Applicable	From 3’-7” to 97’-9”	4’-0”	Yes
Secondary Shield Wall	Not Applicable	From 97’-9” to 112’-0”	4’-0”	Yes
Pressurizer Compartment	Not Applicable	From 58’-5” to 112’-4”	4’-0”	Yes
Pressurizer Compartment	Not Applicable	From 112’-4” to 139’-6”	3’-0”	Yes
Refueling Cavity	Not Applicable	From 34’-5” to 76’-5”	4’-8”	Yes
North side of Refueling Cavity	Not Applicable	From 34’-5” to 76’-5”	5’-7”	Yes

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 2 of 15)

Wall or Section Description	Column Lines(1)	Floor Elevation or Elevation Range(1)	Concrete Thickness(2)(3)	Applicable Radiation Shielding Wall (Yes/No)
Refueling Water Storage Pit Wall	Not Applicable	From 1'-11" to 21'-11"	3'-3"	Yes
North side of floor	Not Applicable	25'-3"	3'-4"	No
South side of floor	Not Applicable	25'-3"	3'-4"	Yes
East side of floor	Not Applicable	25'-3"	4'-3"	No
West side of floor	Not Applicable	25'-3"	4'-3"	No
Floor	Not Applicable	50'-2"	1'-4"	Yes
Floor	Not Applicable	76'-5"	2'-0"	No
Reactor Building				
Fuel Storage and Handling Area (Spent Fuel Pit, New Fuel Pit, Cask Pit, Cask Washdown Pit, Fuel Inspection Pit)				
Column Line AR wall	From 1R to 2aR	From -26'-4" to 3'-7"	3'-4"	Yes
Column Line AR wall	From 2aR to 4R	From -26'-4" to -8'-7"	4'-0"	Yes

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 3 of 15)

Wall or Section Description	Column Lines(1)	Floor Elevation or Elevation Range(1)	Concrete Thickness(2)	Applicable Radiation Shielding Wall (Yes/No)
Column Line AR wall	From 2aR to 4R	From -8’-7” to 3’-7”	3’-8”	Yes
Column Line AR wall	From 4R to 13’-2” east of 6aR	From -26’-4” to 3’-7”	3’-8”	Yes
Column Line AR wall	From 13’-2” east of 6aR to 8R	From -26’-4” to 3’-7”	3’-4”	Yes
Column Line AR wall	From 8R to 6’-8” east of 8aR	From -26’-4” to 3’-7”	4’-0”	Yes
Column Line AR wall	From 6’-8” east of 8aR to 11R	From -26’-4” to 3’-7”	3’-4”	Yes
Column Line AR wall	From 1R to 2aR	From 3’-7” to 25’-3”	3’-4”	Yes
Column Line AR wall	From 2aR to 4R	From 3’-7” to 25’-3”	3’-8”	Yes
Column Line AR wall	From 4R to 9’-4” east of 6aR	From 3’-7” to 25’-3”	7’-9”	Yes
Column Line AR wall	From 9’-4” east of 6aR to 11R	From 3’-7” to 25’-3”	3’-4”	Yes
Column Line AR wall	From 1R to 2aR	From 25’-3” to 50’-2”	3’-4”	Yes
Column Line AR wall	From 2aR to 4R	From 25’-3” to 50’-2”	5’-9”	Yes
Column Line AR wall	From 4R to 5aR	From 30’-1” to 76’-5”	7’-9”	Yes
Column Line AR wall	From 6R to 9’-4” east of 6aR	From 27’-4” to 76’-5”	7’-9”	Yes
Column Line AR wall	From 9’-4” east of 6aR to 11R	From 25’-3” to 50’-2”	3’-4”	Yes
Column Line AR wall	From 1R to 8’-3” east of 2bR	From 50’-2” to 76’-5”	3’-4”	Yes

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 4 of 15)

Wall or Section Description	Column Lines(1)	Floor Elevation or Elevation Range(1)	Concrete Thickness(2)	Applicable Radiation Shielding Wall (Yes/No)
Column Line AR wall	From 5aR to 6R	From 50’-2” to 76’-5”	7’-9”	Yes
Column Line AR wall	From 9’-4” east of 6aR to 6’-8” east of 8R	From 48’-3” to 76’-5”	6’-10”	Yes
Column Line AR wall	From 6’-8” east of 8R to 11R	From 50’-2” to 76’-5”	3’-4”	Yes
Column Line AR wall	From 1R to 7’-1” east of 2bR	From 76’-5” to 101’-0”	3’-4”	Yes
Column Line AR wall	From 7’-1” east of 2bR to 11R	From 76’-5” to 154’-6”	1’-9”	Yes
Column Line 1R wall	From AR to CR	From -26’-4” to 50’-2”	3’-4”	Yes
Column Line 1R wall	From AR to CR	From 50’-2” to 76’-5”	2’-8”	Yes
Column Line 1R wall	From AR to CR	From 76’-5” to 101’-0”	2’-4”	Yes
Column Line 11R wall	From AR to CR	From -26’-4” to 3’-7”	3’-4”	Yes
Column Line 11R wall	From A2R to CR	From 3’-7” to 25’-3”	3’-4”	Yes
Column Line 11R wall	From AR to CR	From 25’-3” to 50’-2”	3’-4”	Yes
Column Line 11R wall	From AR to CR	From 50’-2” to 76’-5”	3’-4”	Yes
Column Line 11R wall	From AR to CR	From 76’-5” to 125’-8”	3’-4”	Yes
Column Line 11R wall	From AR to CR	From 125’-8” to 154’-6”	2’-0”	Yes
Floor	From AR to CR and 1R to 11R	-26’-4”	9’-11”	No

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 5 of 15)

Wall or Section Description	Column Lines(1)	Floor Elevation or Elevation Range(1)	Concrete Thickness(2)	Applicable Radiation Shielding Wall (Yes/No)
Safety System Pumps Areas				
Column Line CR wall	From 1R to 2R	From -26’-4” to -8’-7”	3’-4”	No
Column Line CR wall	From 2R to 4bR	From -26’-4” to 3’-7”	3’-4”	Yes
Column Line CR wall	From 8R to 10R	From -26’-4” to 3’-7”	3’-4”	Yes
Column Line CR wall	From 10R to 11R	From -26’-4” to -8’-7”	3’-4”	No
Column Line CR wall	From 2R to 3’-4” east of 4aR	From 3’-7” to 15’-9”	3’-10”	Yes
Column Line CR wall	From 2R to 3’-4” east of 4aR	From 15’-9” to 25’-3”	3’-2”	Yes
Column Line CR wall	From 3’-4” east of 4aR to 10’-1” east of 8R	From 3’-7” to 25’-3”	3’-2”	Yes
Column Line CR wall	From 10’-1” east of 8R to 11R	From 3’-7” to 25’-3”	3’-10”	Yes
Column Line CR wall	From 1R to 4bR	From 25’-3” to 50’-2”	3’-2”	Yes
Column Line CR wall	From 4bR to 10’-5” east of 4bR	From 25’-3” to 50’-2”	3’-4”	Yes
Column Line CR wall	From 10’-5” east of 4bR to 6aR	From 25’-3” to 50’-2”	3’-10”	Yes
Column Line CR wall	From 6aR to 7aR	From 25’-3” to 50’-2”	3’-8”	Yes
Column Line CR wall	From 7aR to 2’-4” east of 8aR	From 25’-3” to 50’-2”	3’-2”	No
Column Line CR wall	From 2’-4” east of 8aR to 11R	From 25’-3” to 50’-2”	2’-0”	Yes

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 6 of 15)

Wall or Section Description	Column Lines(1)	Floor Elevation or Elevation Range(1)	Concrete Thickness(2)	Applicable Radiation Shielding Wall (Yes/No)
Column Line CR wall	From 1R to 8’-3” east of 2bR	From 50’-2” to 76’-5”	2’-6”	Yes
Column Line CR wall	From 1R to 2R	From 76’-5” to 101’-0”	2’-8”	No
Column Line CR wall	From 3’-9” east of 2bR to 4bR	From 76’-5” to 101’-0”	2’-8”	Yes
Column Line CR wall	From 3’-9” east of 2bR to 4bR	From 101’-0” to 154’-6”	1’-9”	Yes
Column Line CR wall	From 4bR to 11R	From 76’-5” to 154’-6”	1’-9”	Yes
Column Line JR wall	From 1R to 5R	From -26’-4” to 3’-7”	3’-8”	Yes
Column Line JR wall	From 7R to 11R	From -26’-4” to 3’-7”	3’-8”	Yes
Column Line JR wall	From 1R to 11R	From 3’-7” to 26’-11”	3’-8”	Yes
Column Line JR wall	From 1R to 11R	From 26’-11” to 50’-2”	3’-4”	Yes
Column Line JR wall	From 1R to 5R	From 50’-2” to 76’-5”	3’-4”	No
Column Line JR wall	From 5R to 7R	From 50’-2” to 65’-0”	3’-4”	No
Column Line JR wall	From 7R to 11R	From 50’-2” to 76’-5”	3’-4”	No
Column Line JR wall	From 1R to 5R	From 76’-5” to 101’-0”	3’-4”	No
Column Line JR wall	From 7R to 11R	From 76’-5” to 101’-0”	3’-4”	No
Column Line 1R wall	From CR to JR	From -26’-4” to 3’-7”	3’-4”	Yes

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 7 of 15)

Wall or Section Description	Column Lines(1)	Floor Elevation or Elevation Range(1)	Concrete Thickness(2)	Applicable Radiation Shielding Wall (Yes/No)
Column Line 1R wall	From CR to 12’-7” south of D2R	From 3’-7” to 25’-3”	3’-4”	Yes
Column Line 1R wall	From 12’-7” south of D2R to 10’-8” south of GR	From 3’-7” to 17’-8”	3’-4”	Yes
Column Line 1R wall	From 12’-7” south of D2R to 10’-8” south of GR	From 17’-8” to 25’-3”	4’-2”	Yes
Column Line 1R wall	From 10’-8” south of GR to JR	From 3’-7” to 25’-3”	3’-4”	Yes
Column Line 1R wall	From CR to 11’-11” south of D2R	From 25’-3” to 50’-2”	3’-4”	Yes
Column Line 1R wall	From 11’-11” south of D2R to 11’-4” south of GR	From 25’-3” to 42’-4”	3’-4”	Yes
Column Line 1R wall	From 11’-11” south of D2R to 11’-4” south of GR	From 42’-4” to 50’-2”	4’-2”	Yes
Column Line 1R wall	From 10’-8” south of GR to JR	From 25’-3” to 50’-2”	3’-4”	Yes
Column Line 1R wall	From CR to 15’-7” south of HR	From 50’-2” to 76’-5”	2’-8”	Yes
Column Line 1R wall	From 15’-7” south of HR to JR	From 50’-2” to 76’-5”	3’-4”	No
Column Line 1R wall	From CR to JR	From 76’-5” to 101’-0”	2’-4”	Yes
Column Line 2R wall	From CR to 8’-7” south of CR	From -26’-4” to -8’-7”	3’-4”	Yes
Column Line 2R wall	From 17’-7” south of CR to 6’-10” south of D2R	From -26’-4” to -8’-7”	2’-8”	Yes
Column Line 2R wall	From 16’-5” south of GR to 15’-7” south of HR	From -26’-4” to -8’-7”	2’-8”	Yes

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 8 of 15)

Wall or Section Description	Column Lines[(1)]	Floor Elevation or Elevation Range[(1)]	Concrete Thickness[(2)]	Applicable Radiation Shielding Wall (Yes/No)
Column Line 2R wall	From 4'-1" south of H1R to JR	From -26'-4" to 3'-7"	5'-0"	Yes
Column Line 2R wall	From CR to 6'-10" south of D2R	From -8'-7" to 3'-7"	3'-4"	Yes
Column Line 2R wall	From 16'-5" south of GR to 4'-1" south of H1R	From -8'-7" to 3'-7"	3'-4"	Yes
Column Line 2R wall	From CR to DR	From 3'-7" to 25'-3"	3'-10"	Yes
Column Line 2R wall	From DR to ER	From 3'-7" to 25'-3"	3'-6"	Yes
Column Line 2R wall	From ER to GR	From 3'-7" to 17'-8"	2'-8"	Yes
Column Line 2R wall	From ER to GR	From 17'-8" to 25'-3"	4'-2"	Yes
Column Line 2R wall	From GR to HR	From 3'-7" to 25'-3"	3'-6"	Yes
Column Line 2R wall	From HR to JR	From 3'-7" to 25'-3"	3'-10"	Yes
Column Line 2R wall	From CR to DR	From 25'-3" to 50'-2"	3'-2"	Yes
Column Line 2R wall	From DR to ER	From 25'-3" to 50'-2"	3'-10"	Yes
Column Line 2R wall	From ER to GR	From 25'-3" to 50'-2"	2'-8"	Yes
Column Line 2R wall	From GR to HR	From 25'-3" to 50'-2"	3'-10"	Yes
Column Line 2R wall	From HR to H1R	From 25'-3" to 50'-2"	2'-8"	No
Column Line 2R wall	From CR to H1R	From 50'-2" to 76'-5"	2'-8"	Yes

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 9 of 15)

Wall or Section Description	Column Lines(1)	Floor Elevation or Elevation Range(1)	Concrete Thickness(2)	Applicable Radiation Shielding Wall (Yes/No)
Column Line 2R wall	From CR to DR	From 76’-5” to 101’-0”	2’-8”	No
Column Line 2R wall	From DR to ER	From 76’-5” to 101’-0”	3’-8”	Yes
Column Line 2R wall	From ER to 9’-5” south of G1R	From 76’-5” to 101’-0”	2’-8”	Yes
Column Line 10R wall	From CR to 8’-7” south of CR	From -26’-4” to -8’-7”	3’-4”	Yes
Column Line 10R wall	From 5-9” south of C1R to 11’-3” south of D1R	From -26’-4” to -8’-7”	2’-8”	Yes
Column Line 10R wall	From 16’-5” south of GR to 13’-7” south of HR	From -26’-4” to -8’-7”	2’-8”	Yes
Column Line 10R wall	From 4’-1“ south of H1R to JR	From -26’-4” to 3’-7”	5’-0”	Yes
Column Line 10R wall	From CR to 11’-3” south of D1R	From -8’-7” to 3’-7”	3’-4”	Yes
Column Line 10R wall	From 16’-5” south of GR to 4’-1” south of H1R	From -8’-7” to 3’-7”	3’-4”	Yes
Column Line 10R wall	From CR to DR	From 3’-7” to 25’-3”	3’-10”	Yes
Column Line 10R wall	From DR to ER	From 3’-7” to 25’-3”	3’-6”	Yes
Column Line 10R wall	From ER to GR	From 3’-7” to 17’-8”	2’-8”	Yes
Column Line 10R wall	From ER to GR	From 17’-8” to 25’-3”	4’-2”	Yes
Column Line 10R wall	From GR to HR	From 3’-7” to 25’-3”	3’-6”	Yes
Column Line 10R wall	From HR to JR	From 3’-7” to 25’-3”	3’-10”	Yes

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 10 of 15)

Wall or Section Description	Column Lines[(1)]	Floor Elevation or Elevation Range[(1)]	Concrete Thickness[(2)]	Applicable Radiation Shielding Wall (Yes/No)
Column Line 10R wall	From CR to DR	From 25'-3" to 50'-2"	2'-8"	No
Column Line 10R wall	From DR to ER	From 25'-3" to 50'-2"	3'-10"	Yes
Column Line 10R wall	From ER to GR	From 25'-3" to 50'-2"	2'-8"	Yes
Column Line 10R wall	From GR to HR	From 25'-3" to 50'-2"	3'-10"	Yes
Column Line 10R wall	From HR to H1R	From 25'-3" to 50'-2"	2'-8"	No
Column Line 10R wall	From CR to H1R	From 50'-2" to 76'-5"	2'-8"	Yes
Column Line 10R wall	From D1R to ER	From 76'-5" to 112'-0"	2'-8"	No
Column Line 10R wall	From ER to GR	From 76'-5" to 101'-0"	2'-8"	Yes
Column Line 10R wall	From GR to H1R	From 76'-5" to 101'-0"	3'-8"	Yes
Column Line 11R wall	From CR to JR	From -26'-4" to 3'-7"	3'-4"	Yes
Column Line 11R wall	From CR to 17'-0" south of D1R	From 3'-7" to 25'-3"	3'-4"	Yes
Column Line 11R wall	From 17'-0" south of D1R to 10'-8" south of GR	From 3'-7" to 17'-8"	3'-4"	Yes
Column Line 11R wall	From 17'-0" south of D1R to 10'-8" south of GR	From 17'-8" to 25'-3"	4'-2"	Yes
Column Line 11R wall	From 10'-8" south of GR to HR	From 3'-7" to 25'-3"	3'-4"	Yes
Column Line 11R wall	From HR to JR	From 3'-7" to 76'-5"	5'-0"	Yes

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 11 of 15)

Wall or Section Description	Column Lines(1)	Floor Elevation or Elevation Range(1)	Concrete Thickness(2)	Applicable Radiation Shielding Wall (Yes/No)
Column Line 11R wall	From CR to 16’-4” south of D1R	From 25’-3” to 50’-2”	3’-4”	Yes
Column Line 11R wall	From 16’-4” south of D1R to 11-4” south of GR	From 25’-3” to 42’-4”	3’-4”	Yes
Column Line 11R wall	From 16’-4” south of D1R to 11-4” south of GR	From 42’-4” to 50’-2”	4’-2”	Yes
Column Line 11R wall	From 11’-4” south of GR to HR	From 25’-3” to 50’-2”	3’-4”	Yes
Column Line 11R wall	From CR to HR	From 50’-2” to 76’-5”	2’-8”	Yes
Column Line 11R wall	From D1R to ER	From 76’-5” to 112’-0”	2’-4”	Yes
Column Line 11R wall	From ER to HR	From 76’-5” to 101’-0”	2’-4”	Yes
Column Line 11R wall	From HR to JR	From 76’-5” to 101’-0”	5’-0”	No
Floor	From CR to JR and 1R to 2R	-26’-4”	9’-11”	No
Floor	From CR to JR and 10R to 11R	-26’-4”	9’-11”	No
Floor	From CR to JR and 1R to 2R	3’-7”	2’-8”	No
Floor	From CR to JR and 10R to 11R	3’-7”	2’-8”	No
Floor	From ER to GR and 1R to 2R	25’-3”	3’-10”	Yes
Floor	From ER to GR and 10R to 11R	25’-3”	3’-10”	Yes
Floor	From ER to GR and 1R to 2R	50’-2”	3’-10”	Yes

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 12 of 15)

Wall or Section Description	Column Lines(1)	Floor Elevation or Elevation Range(1)	Concrete Thickness(2)	Applicable Radiation Shielding Wall (Yes/No)
Floor	From ER to GR and 10R to 11R	50’-2”	3’-10”	Yes
Floor	From CR to GR and 1R to 2R	76’-5”	2’-4”	No
Floor	From GR to HR and 1R to 2R	76’-5”	2’-8”	Yes
Floor	From CR to HR and 10R to 11R	76’-5”	3’-4”	Yes
Floor	From CR to GR and 1R to 2R	101’-0”	1’-3”	Yes
Floor	From 4’-0” south of CR to ER and 10R to 11R	112’-0”	1’-3”	Yes
Non-Radiological Control Area				
Column Line LR wall	From 1R to 11R	From -26’-4” to 3’-7”	3’-8”	No
Column Line LR wall	From 1R to 3aR	From 3’-7” to 26’-11”	3’-8”	No
Column Line LR wall	From 3aR to 8bR	From 3’-7” to 25’-3”	3’-8”	No
Column Line LR wall	From 8bR to 11R	From 3’-7” to 26’-11”	3’-8”	No
Column Line LR wall	From 1R to 3aR	From 26’-11” to 50’-2”	3’-4”	No
Column Line LR wall	From 3aR to 8bR	From 25’-3” to 50’-2”	3’-4”	Yes
Column Line LR wall	From 8bR to 11R	From 26’-11” to 50’-2”	3’-4”	No
Column Line LR wall	From 1R to 5R	From 50’-2” to 76’-5”	3’-4”	No

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 13 of 15)

Wall or Section Description	Column Lines[(1)]	Floor Elevation or Elevation Range[(1)]	Concrete Thickness[(2)]	Applicable Radiation Shielding Wall (Yes/No)
Column Line LR wall	From 5R to 7R	From 50’-2” to 65’-0”	3’-4”	No
Column Line LR wall	From 7R to 11R	From 50’-2” to 76’-5”	3’-4”	No
Column Line LR wall	From 1R to 5R	From 76’-5” to 115’-6”	3’-4”	No
Column Line LR wall	From 5R to 7R	From 65’-0” to 115’-6”	4’-4”	No
Column Line LR wall	From 7R to 11R	From 76’-5” to 115’-6”	3’-4”	No
Column Line 1R wall	From JR to KR	From -26’-4” to 101’-0”	3’-4”	No
Column Line 1R wall	From KR to LR	From -26’-4” to 115’-6”	3’-4”	No
Column Line 11R wall	From JR to KR	From -26’-4” to 101’-0”	3’-4”	No
Column Line 11R wall	From KR to LR	From -26’-4” to 115’-6”	3’-4”	No
Floor	From JR to LR and 1R to 11R	-26’-4”	9’-11”	No
Floor	From JR to LR and 1R to 11R	3’-7”	4’-0”	No
Floor	From JR to LR and 1R to 3R	26’-11”	2’-4”	No
Floor	From JR to LR and 5R to 7R	25’-3”	3’-4”	Yes
Floor	From JR to LR and 9R to 11R	26’-11”	2’-4”	No
Floor	From JR to LR and 1R to 5R	50’-2”	2’-4”	No

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 14 of 15)

Wall or Section Description	Column Lines(1)	Floor Elevation or Elevation Range(1)	Concrete Thickness(2)	Applicable Radiation Shielding Wall (Yes/No)
Floor	From JR to LR and 5R to 7R	50’-2”	3’-4”	Yes
Floor	From JR to LR and 7R to 11R	50’-2”	2’-4”	No
Floor	From JR to KR and 1R to 5R	76’-5”	2’-4”	No
Floor	From KR to LR and 1R to 5R	76’-5”	4’-4”	No
Floor	From JR to KR and 7R to 11R	76’-5”	2’-4”	No
Floor	From KR to LR and 7R to 11R	76’-5”	4’-4”	No
Floor	From JR to KR and 1R to 5R	101’-0”	2’-4”	No
Floor	From JR to KR and 7R to 11R	101’-0”	2’-4”	No

Table 2.2-2 Definition of Wall Thicknesses for Safety-Related Structures: Pre-stressed Concrete Containment Vessel, Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 15 of 15)

Wall or Section Description	Column Lines[1]	Floor Elevation or Elevation Range[1]	Concrete Thickness[2]	Applicable Radiation Shielding Wall (Yes/No)
Power Source Buildings				
Column Line AP wall	From 1P to 5P	From -26’-4” to 3’-7”	2’-8”	No
Column Line CP wall	From 1P to 5P	From -26’-4” to 3’-7”	2’-8”	No
Column Line 1P wall	From AP to CP	From -26’-4” to 3’-7”	2’-8”	No
Column Line 5P wall	From AP to CP	From -26’-4” to 3’-7”	2’-8”	No
Column Line AP wall	From 1P to 5P	From 3’-7” to 39’-6”	1’-9”	No
Column Line CP wall	From 1P to 5P	From 3’-7” to 39’-6”	1’-9”	No
Column Line 1P wall	From AP to CP	From 3’-7” to 39’-6”	1’-9”	No
Column Line 5P wall	From AP to CP	From 3’-7” to 39’-6”	2’-8”	No
Floor	From AP to CP and 1P to 5P	-26’-4”	9’-11”	No
Floor	From AP to CP and 1P to 2P	3’-7”	3’-4”	No
Floor	From AP to CP and 2P to 5P	3’-7”	2’-8”	No
Floor	From AP to CP and 1P to 5P	39’-6”	1’-3”	No

NOTES:

1. The column lines and floor elevations are identified and included on Figures 2.2-3 through 2.2-14.
2. These wall thicknesses have a construction tolerance of ± 1 inch, except for exterior walls below grade where the tolerance is +12 inches, - 1 inch.
3. For walls that are part of structural modules, the concrete thickness also includes the steel face plates.

Table 2.2-3 Main Components Protected against External Floods, Internal Floods and Internal Fires

Safe Shutdown Function	Main Component
Reactivity Control	Safety injection pump
	Emergency letdown line isolation valve
	Safety depressurization valve
RCS Pressure Control	Pressurizer backup heater
	Safety depressurization valve
Decay Heat Removal and RCS Cooling	Emergency feedwater pump
	Main steam depressurization valve
	Containment spray/Residual heat removal pump
	Containment spray/Residual heat removal heat exchanger
	Component cooling water pump
	Essential service water pump
RCS Inventory Control	Safety injection pump

Table 2.2-4 Structural and Systems Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The structural configurations of the R/B and each PS/B are as described in Table 2.2-2, and as shown on Figures 2.2-1 through 2.2-13.	1. Inspections of the as-built structural configurations of the R/B and each PS/B will be performed.	1. The as-built R/B and each PS/B conform to the structural configurations as described in Table 2.2-2, and as shown on Figures 2.2-1 through 2.2-13.
2. The ASME Code Section III components and piping retain their pressure boundary integrity at their design pressure.	2. A hydrostatic test and preoperational NDE will be performed in conjunction with Section III of the ASME Code.	2. The results of the hydrostatic test and preoperational NDE of the as-built components and piping conform to the requirements of the ASME Code, Section III.
3. The PCCV retains structural integrity at the design pressures of 68 psig.	3. A structural integrity test (SIT) will be performed in accordance with the ASME code, Section III.	3. The result of the structural integrity test (SIT) of the as-built PCCV exists and verifies that the PCCV maintains its structural integrity at a test pressure of 115% of the design pressure of 68 psig in accordance with the requirements of ASME Code, Section III.
4.a The integrated containment system barrier prevents release of fission products to the atmosphere.	4.a A containment integrated leak rate test will be performed in accordance with 10 CFR 50, Appendix J, Type A testing.	4.a The containment integrated leak rate test verifies that the leak rate is less than the allowable leakage rate specified in 10 CFR 50, Appendix J, Type A testing.
4.b The containment system barrier primary reactor containment penetrations prevent release of fission products to the atmosphere.	4.b A leak rate test will be performed for all Type B containment penetrations in accordance with 10 CFR 50, Appendix J, Type B tests.	4.b The containment penetration leak rate tests verifies that the leak rate is less than the allowable leakage rate specified in 10 CFR 50, Appendix J, Type B tests.
5. The PCCV is designed based on the structural design-basis loads.	5. An analysis will be performed to verify that the as-built PCCV structural design-basis loads are reconciled.	5. ASME design report exists for the as-built PCCV, and concludes the PCCV is designed based on the structural design-basis loads.
6. The safety-related standard plant buildings other than the PCCV are designed based on the structural design-basis loads.	6. An analysis will be performed to verify that the as-built safety-related standard plant structures, other than the PCCV, structural design-basis loads are reconciled.	6. Design reports exist for the as-built safety-related standard plant buildings other than the PCCV, and conclude the safety-related standard plant buildings are designed in accordance with structural design-basis loads.
7. The ASME Code, Section III, Class 1 piping systems and components are designed to retain their pressure integrity and functional capability under internal design and operating pressures and design-basis loads.	7. Refer to Table 2.3-2 ITAAC #1.	7. Refer to Table 2.3-2 ITAAC #1.

Table 2.2-4 Structural and Systems Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8. The ASME Code, Section III, Class 2 or 3 piping systems and components are designed to retain their pressure integrity and functional capability under internal design and operating pressures and design-basis loads.	8. Refer to Table 2.3-2 ITAAC #3.	8. Refer to Table 2.3-2 ITAAC #3.
9. Divisional flood barriers are provided in the R/B and each PS/B to protect against the internal and external flooding.	9. An inspection will be performed to verify that the as-built divisional flood barriers exist in the R/B and each PS/B.	9. The as-built divisional flood barriers exist at the appropriate locations in the R/B and each PS/B against the internal and external flooding.
10. Water-tight doors are provided in the R/B to protect against the internal and external flooding.	10. An inspection of the as-built water- tight doors will be performed.	10. The as-built water-tight doors exist at the appropriate locations in the R/B against the internal and external flooding.
11. Penetrations in the divisional walls of the R/B and each PS/B, except for water-tight doors, are provided appropriately against the internal and external flooding.	11. An inspection of the as-built penetrations will be performed.	11. The as-built penetrations in the divisional walls of the R/B and each PS/B are installed at an acceptable level above the floor, and are sealed up to the internal and external design flood levels.
12. Safety-related electrical, instrumentation, and control equipment are located in the R/B and each PS/B to protect them from the design flood.	12. An inspection of the as-built safety-related electrical, instrumentation, and control equipment in the R/B and each PS/B will be performed.	12. The as-built safety-related electrical, instrumentation, and control equipment in the R/B and each PS/B are located at sufficient height above the floor surface to protect them against the design flood.
13. For the R/B and each PS/B, external wall thicknesses below flood level are a minimum of two feet thick to protect against water seepage.	13. An inspection of the as-built external wall thickness for the R/B and each PS/B will be performed.	13. For the R/B and each PS/B, the as-built external walls below flood level are a minimum of two feet thick to protect against water seepage.
14. Flood barriers of the R/B and each PS/B are installed up to the finished plant grade level to protect against water seepage.	14. Inspections of the as-built flood barriers will be performed.	14. The as-built flood barriers are installed up to the finished plant grade level for the R/B and each PS/B to protect against water seepage.

Table 2.2-4 Structural and Systems Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
15. Flood doors and flood barrier penetrations of the R/B and each PS/B are provided with flood protection features.	15. Inspections of the as-built flood doors and flood barrier penetrations will be performed.	15. For the R/B and each PS/B, the as-built flood doors and flood barrier penetrations are provided with flood protection features to protect against water seepage.
16. Penetrations in the external walls of the R/B and each PS/B are provided with flood protection features below flood level.	16. An inspection will be performed to verify that the flood protection features of the as-built penetrations in the external walls of the R/B and each PS/B exist below flood level.	16. The as-built penetrations in the external walls of the R/B and each PS/B are provided with flood protection features below flood level.
17. Redundant safe shutdown components and associated electrical divisions outside the containment and the control room complex are separated by 3-hour rated fire barriers to preserve the capability to safely shutdown the plant following a fire. The 3-hour rated fire barriers are placed as required by the FHA.	17. An inspection of the as-built fire barriers will be performed.	17. The 3-hour rated as-built fire barriers are placed as required by the FHA for separation of redundant safe shutdown components and associated electrical divisions outside the containment and the control room complex, and to preserve the capability to safely shutdown the plant following a fire.
18. All penetrations and openings through the fire barriers are protected against fire.	18. An inspection will be performed to verify that the as-built components are provided to protect the penetrations and openings through fire barriers.	18. All as-built penetrations and openings are protected with rated components (i.e., fire doors in door openings, fire dampers in ventilation duct openings, and penetration seals) consistent with the fire resistance rating of the associated barrier.
19. Safety-related SSCs are designed to withstand the dynamic effects of pipe breaks.	19. Refer to Table 2.3-2 ITAAC #4.	19. Refer to Table 2.3-2 ITAAC #4.
20. The key dimensions of the RV conform with the licensed design and are documented in an as-built report.	20. Refer to Section 2.4.1 ITAAC #5	20. Refer to Section 2.4.1 ITAAC #5

Table 2.2-4 Structural and Systems Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
21. Safety-related SSCs are protected from any credible internal missile sources inside and outside the containment.	21. An inspection will be performed to verify as-built locations of safety-related SSCs are protected from potential impact by credible internal missiles.	21. Primary missile protection is provided by locating missile sources behind concrete walls and floors, and/or locating safety-related SSCs outside the zones of credible missile strikes.
22. Special modular construction techniques adequately address the fabrication, shipping, handling, and installation of the SC modules and reconcile the as-built configuration of the plant with the structural design basis of the licensed facility.	22. An inspection will be performed to verify special modular construction techniques adequately address the fabrication, shipping, handling, and installation of the SC modules and reconcile the as-built configuration of the plant with the structural design basis of the licensed facility.	22. Fabrication, shipping, handling, and installation of the SC modules are in accordance with governing programs, codes and specifications.
23. Failure of non-seismic and seismic Category II structures will not impair the ability of near-by safety-related SSCs to perform their safety-related functions (II/I interactions).	23. An inspection will be performed to verify failure of non-seismic and seismic Category II structures will not impair the ability of near-by safety-related SSCs to perform their safety-related functions (II/I interactions).	23. The inspection of design criteria and as-built plant configuration for non-seismic and seismic Category II structures verify the acceptability of II/I interactions.
24. SSCs that require evaluation in the seismic fragilities task of a seismic margin analysis have sufficient seismic margin.	24.i Analysis will be performed on the SSCs to confirm the seismic margin using plant specific in-structure response and the results of stress analyses.	24.i Reports exist and conclude that the high confidence of low probability of failuer (HCLPF) values for the SSCs have sufficient seismic margin.
	24.ii Inspection will be performed on the as-built SSCs.	24.ii The as-built SSCs retain the sufficient seismic margin.

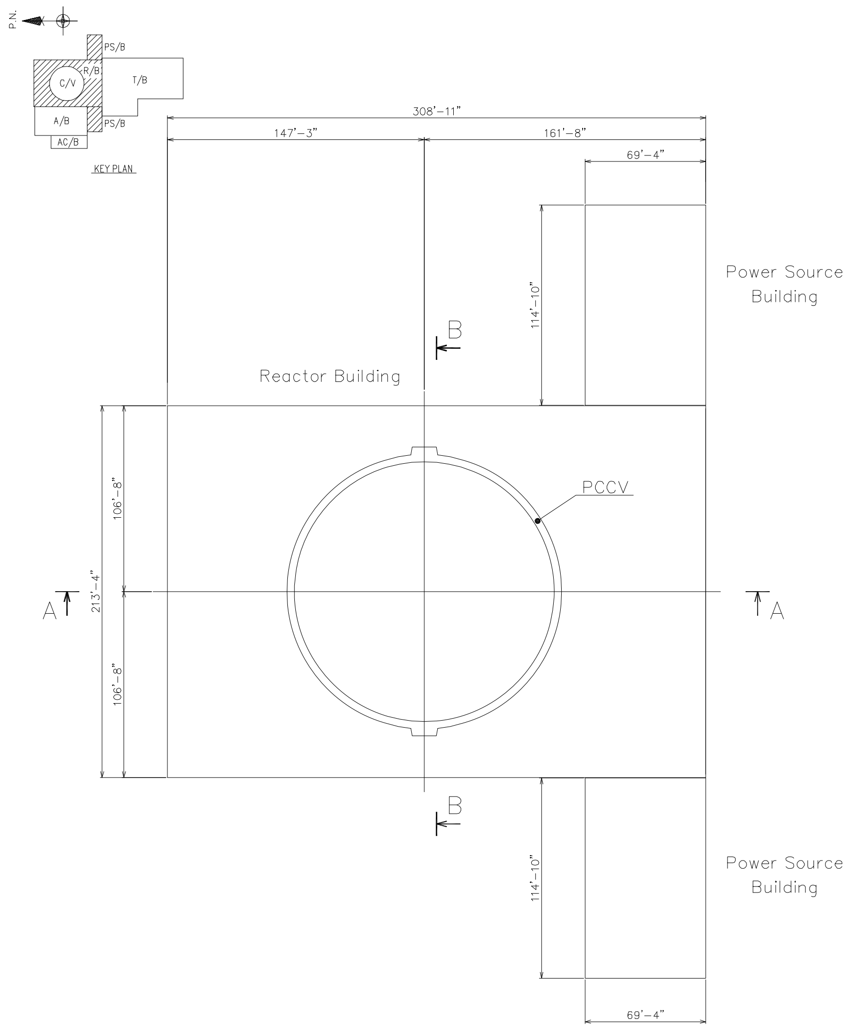
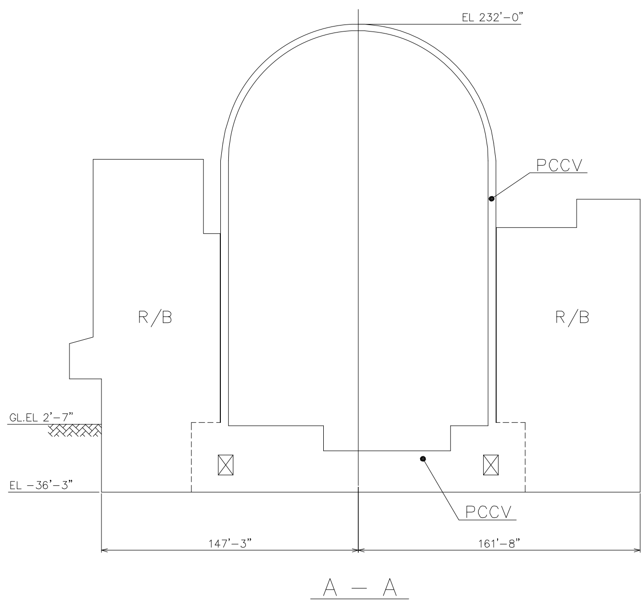


Figure 2.2-1 Critical Building Dimensions of US-APWR (Plan View)



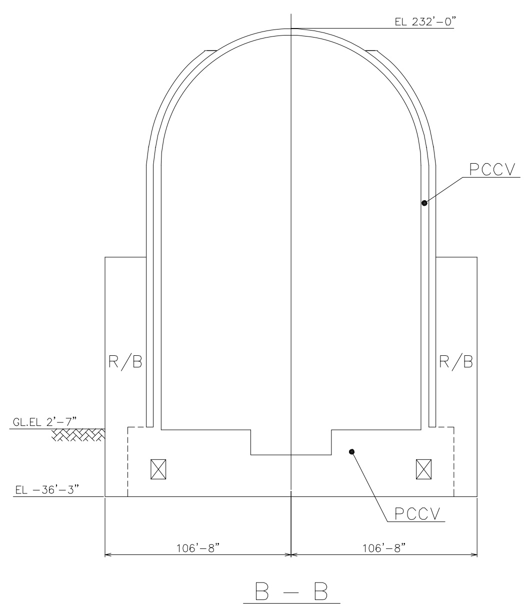


Figure 2.2-2 Critical Building Dimensions of US-APWR (Section Views)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 2.2-3 US-APWR Building Architectural Layout R/B Plan View Elevation -26’-4”

Security-Related Information – Withheld Under 10 CFR 2.390

Figure 2.2-4 US-APWR Building Architectural Layout R/B Plan View Elevation 3'-7"

Security-Related Information – Withheld Under 10 CFR 2.390

Figure 2.2-5 US-APWR Building Architectural Layout R/B Plan View Elevation 25’-8”

Security-Related Information – Withheld Under 10 CFR 2.390

Figure 2.2-6 US-APWR Building Architectural Layout R/B Plan View Elevation 50’-2”

Security-Related Information – Withheld Under 10 CFR 2.390

Figure 2.2-7 US-APWR Building Architectural Layout R/B Plan View Elevation 76'-5"

Security-Related Information – Withheld Under 10 CFR 2.390

Figure 2.2-8 US-APWR Building Architectural Layout R/B Plan View Elevation 101'-0"

Security-Related Information – Withheld Under 10 CFR 2.390

Figure 2.2-9 US-APWR Building Architectural Layout R/B Plan View Elevation 115’-6”

Security-Related Information – Withheld Under 10 CFR 2.390

Figure 2.2-10 US-APWR Building Architectural Layout R/B Section View Section "A-A"

Security-Related Information – Withheld Under 10 CFR 2.390

Figure 2.2-11 US-APWR Building Architectural Layout R/B Section View Section "B-B"

Security-Related Information – Withheld Under 10 CFR 2.390

Figure 2.2-12 US-APWR Building Architectural Layout PS/Bs Plan View Elevation -26'-4",3'-7",39'-6"

Security-Related Information – Withheld Under 10 CFR 2.390

Figure 2.2-13 US-APWR Building Architectural Layout PS/B Section View Section “A-A”

2.3 PIPING SYSTEMS AND COMPONENTS

2.3.1 Design Description

This design description addresses four areas related to piping systems and components: (1) piping stress analysis, (2) protection against the dynamic effects of pipe rupture, (3) the leak before break (LBB) aspects of the design of piping systems, and (4) component stress analysis.

Piping Stress Analysis

Piping and piping supports are analyzed and designed to the requirements of the ASME Code Section III, based on Code classification and ASME Service Level. The requirements of the ASME Code Section III, Subsections NB (Class 1), NC (Class 2), or ND (Class 3) are used in the piping stress qualification.

The following are considered in piping system analysis.

Piping modeling technique

- Branch lines and instrument connections are decoupled from the analysis model of larger run piping provided that either the ratio of the branch pipe mean diameter to the run pipe mean diameter (D_b/D_r) is less than or equal to 1/3, or the ratio of the moments of inertia of the two lines (I_b/I_r) is less than or equal to 1/25.
- In the decoupled piping stress analysis where support is modeled as a restraint versus the integrated analysis, supports are modeled with either calculated actual stiffness of the support structure, or an arbitrarily chosen rigid stiffness.

Piping stress analysis criteria

- The internal design pressure, P, is used in the design and analysis of ASME Code Section III, Class 1, 2 and 3 piping.
- The weight of the piping system, its contents, any insulation and in-line equipment, and any other sustained loads identified in the design specification are considered in the piping analysis.
- The effect of linear thermal expansion range during various operating modes is considered along with thermal movements of terminal equipment nozzles, anchors, or restraints (thermal anchor movements) corresponding to the operating modes.
- The effects of inertial loads and anchor movements due to SSE are considered as service level D loads in the design of piping and piping supports.
- The effect of relief/safety valve thrust loads, for open or closed systems, are considered in the design of piping and piping supports.
- The water hammer phenomenon is set in motion by the rapid actuation of valves or the sudden start or trip of a pump or turbine, and it is analyzed using dynamic analysis methods.

- Design-basis pipe break (DBPB) loads include the impact of the reactor coolant pressure boundary (RCPB) piping break, main steam and feedwater line breaks except for pipe breaks that meet the LBB criteria (see Subsection 3.6.3) or are located inside the pipe break exclusion area.
- ASME Code Section III, Class 1 piping is evaluated for the effects of fatigue caused by various thermal and pressure transients and other cyclic events, including earthquakes and thermal stratifications. The fatigue evaluations consider both air and reactor coolant environments.
- ASME Code Section III, Class 2 and 3 piping are not explicitly analyzed for calculation of cumulative usage factors. ASME Code Section III, Class 2 and 3 piping are evaluated for the requirements of Section III NC/ND, which allows the reduction of allowable stress for thermal expansion stress ranges based on the number of transient load cycles.

Protection Against the Dynamic Effects of Piping Rupture

The plant is designed for protection against piping failure inside or outside the containment to assure that such a failure would not compromise the functional capability of safety-related systems to restore the plant in the safe shutdown condition and maintain it in that condition in the event of such failure. The design includes consideration of high-energy and moderate-energy fluid system piping located inside and outside of the containment. The habitability of the MCR is also protected. In addition, containment penetrations and associated isolation valves are also protected.

In order to assure successful protection against the dynamic effects of pipe rupture, the following requirements are satisfied:

- Pipe breaks (circumferential and longitudinal) are evaluated for the entire range of effects, including dynamic effects (i.e., pipe whip, jet impingement, jet thrust forces, internal forces due to system decompression, sub-compartment pressurization), environmental conditions, spray wetting, and flooding. When LBB criteria are successfully applied, evaluation of dynamic effects is not required.
- Leakage cracks are evaluated for spray wetting, flooding and environmental effects. The dynamic effects of these cracks are not evaluated.
- Circumferential and longitudinal breaks and leakage cracks are not postulated in the break exclusion zones, but the effects of flooding, spray wetting, and sub-compartment pressurization are evaluated for a postulated 1.0 square foot break for the main steam and feedwater lines at a location that has the greatest effect on essential equipment.
- Each postulated piping failure event (pipe break or crack) is considered and analyzed as a single initial event during normal plant operation. For systems not analyzed for seismic conditions, it is considered that SSE event will cause pressure boundary failure at any location.

- The sub-compartment pressurization loads on structures and components are evaluated for postulated circumferential breaks and longitudinal breaks in piping that cannot be qualified for LBB application.

Table 2.3-1 provides a list of high and moderate energy piping system considered for protection of essential systems.

Leak-Before-Break (LBB)

For applicable high-energy piping, a LBB evaluation is performed for RCPB piping so that the dynamic effect of pipe rupture is eliminated. Additionally the main steam supply system (MSS) piping is evaluated using LBB criteria.

In order to assure successful application of LBB, the following requirements are satisfied:

- Materials of adequate toughness are used.
- Leak detection systems inside the containment meet the requirements of RG 1.45.
- 100% pre-service inspection of all welds is performed.
- In-service inspection and testing of snubbers is performed to assure low snubber failure rate.
- The LBB evaluations demonstrate that for piping meeting the criteria, sudden catastrophic failure of the pipe is not credible. This is demonstrated by plant design, operating experience, tests, or analyses that breaks are less likely to occur under the effects of thinning by erosion or corrosion, stress corrosion cracks, water hammer, fatigue (thermal or mechanical), thermal aging, thermal stratification, creep fatigue, indirect factors, and cleavage.
- The LBB analysis combines normal and abnormal (including seismic) loads to determine a critical crack size for a postulated through–wall crack. The critical crack size is compared to the size of a leakage crack for which detection is certain. If the leakage crack size is significantly smaller than the critical crack size, the LBB requirement is satisfied.
- The exclusion of dynamic effects associated with pipe rupture is allowed when analyses demonstrate that the probability of pipe rupture is extremely low for the applied loading resulting from normal conditions, anticipated transients and a postulated SSE.
- For piping systems where design drawings are used to perform the LBB evaluation, the as-built conditions are verified to assure that the design checked for LBB is consistent with the final as-built configuration. The as-built verification includes, but is not limited to, the following:
  - Material and material specification
  - Pipe geometry

- Support locations and their characteristics
- Locations and weights of components such as valves

Each of the as-built lines identified below is designed to meet the LBB criteria or an evaluation is performed of the dynamic effects of a rupture of the line.

- Reactor coolant loop (RCL) Piping
- RCL branch piping with nominal diameter of 6 inches or larger, except for steam within the piping for the pressurizer safety valve and power operated relief valve
- Main steam pipe in PCCV

Component Stress Analysis

Components, component supports, and core support structures are analyzed and designed to the requirements of the ASME Code Section III, based on Code classification and ASME Service Level. The requirements of the ASME Code Section III, Subsections NB (Class 1), NC (Class 2), or ND (Class 3) code are used in component stress qualification. Component supports and their attachments for essential Code Class 1, 2, and 3 components are designed in accordance with ASME Code Section III, Subsection NF up to the interface of the building structure, with jurisdictional boundaries as defined by Subsection NF. The requirements of the ASME Code Section III, Subsection NG are used in core support structure stress qualification. In addition, the design and installation criteria applicable to over-pressure protection components are included along with the requirements for operability assurance related to maintaining structural and leak tight integrity, pressure retaining capability, and required functionality of pumps and valves.

In order to assure required component stress and functionality are met, the following requirements are satisfied:

- In order to assure that ASME components meet the service level stress requirements and functionality requirements, the ASME Code Section III, NCA-2000 requires that a design specification be prepared for ASME Code Section III, Class 1, 2, and 3 components. The specification requires that the ASME Code Section III, Class 1 stress analyses for components and core support structures consider sustained loads (including dead load, pressure, and thermal expansion), system operational transient loads (thermal and fluid pressure transients), seismic loads, and pipe rupture loads (design pipe breaks, unless modified by LBB evaluations, LOCA). Additionally, ASME Code Section III, Class 1 pressure boundary components are subject to fatigue usage evaluations over the 60-year plant life.
- The basis of the ASME component design acceptance for applicable loading combinations involves comparison of calculated stress and fatigue demand levels to acceptable stress and fatigue capacity allowables specified by ASME Code Section III. The ASME Code acceptance standards differ depending on whether a component is classified as ASME Code Section III, Class 1, 2, or 3.

- In addition to the ASME classification, plant operational modes and frequency of system operating and/or transient events are used to define which ASME service limit (Level A [Normal], Level B [Upset], Level C [Emergency], Level D [Faulted], and Test) applies. The design specifications for ASME Code Section III, Class 1, 2 and 3 components, supports, and appurtenances are prepared under administrative procedures that meet or exceed the ASME Code requirements. These specifications conform to and are certified to the requirements of ASME Code Section III depending on the component classification. The Code also requires a design report for safety-related components, to demonstrate that component design meets the requirements of the relevant ASME design specification and the applicable ASME Code.

2.3.2 Generic Design and Specific-System ITAAC

The piping systems and components ITAAC are divided into generic design ITAAC and the system specific ITAAC. The high-energy and moderate-energy piping systems are listed in Tables 2.3-1. The ITAAC for generic piping systems and component design are located in Table 2.3-2. The ITAAC for specific piping systems and components, other than design ITAAC, are located in their respective fluid system sections, such as Section 2.4, Reactor Systems, Section 2.7, Plant Systems, and Section 2.11, Containment Systems.

Table 2.3-1 High and Moderate Energy Piping System Considered for Protection of Essential Systems(1)

System	High-Energy	Moderate-Energy
Reactor coolant system (RCS)	X	–
Chemical and volume control system (CVCS)	X	–
Safety injection system (SIS)	X	–
Residual heat removal system (RHRS(2))	–	X
Emergency feedwater system (EFWS)(2)	–	X
Feedwater system (FWS)	X	–
Main steam supply system (MSS)	X	–
Containment spray system (CSS)	–	X
Component cooling water system (CCWS)	–	X
Spent fuel pit cooling and purification system (SFPCS)	–	X
Essential service water system (ESWS)	–	X
Gaseous waste management system (GWMS)	–	X
Liquid waste management system (LWMS)	–	X
Solid waste management system (SWMS)	–	X
Sampling system	X	–
Steam generator blowdown system (SGBDS)	X	–
Refueling water storage system (RWS)	–	X
Primary wakeup water system (PMWS)	–	X
Auxiliary steam supply system (ASSS)	X	–
Instrument air system (IAS)	–	X
Fire protection water supply system (FSS)	–	X
Station service air system (SSAS)	–	X
Chilled water system (VWS)	–	X

NOTES:

1. High-energy piping includes those systems or portions of systems in which the maximum normal operating temperature exceeds 200°F or the maximum normal operating pressure exceeds 275 psig. Piping systems or portions of systems pressurized above atmospheric pressure during normal plant conditions and not identified as high-energy are considered as moderate-energy. Piping systems that exceed 200°F or 275 psig for 2% or less of the time during which the system is in operation are considered moderate-energy.
2. The RHRS and EFWS lines are classified as moderate-energy based on the 2% rule. These lines experience high-energy conditions for less than 2% of the system operation time. The portions of the RHRS from the connections to the RCS to the first closed valve in each line are high-energy.

Table 2.3-2 Piping Systems and Components Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a The ASME Code Section III, Class 1 piping systems and components (PSC) are designed to retain their pressure integrity and functional capability under internal design and operating pressures and design basis loads.	1.a An inspection of the stress report for the ASME Code, Section III, Class 1 PSC will be performed.	1.a The stress report(s) exist and conclude that the design of the ASME Code Section III Class 1 PSC comply with the requirements of the ASME Code Section III.
1.b The usage factors for ASME Code Section III Class 1 piping systems are evaluated for both air and reactor coolant environments.	1.b An analysis of the ASME Code, Section III, Class 1 piping systems will be performed.	1.b Report(s) exist and conclude that the usage factors for ASME Code Section III Class 1 piping systems are evaluated for air and reactor coolant environments.
2. RCPB and MSS piping systems are designed in accordance with the LBB method.	2. A LBB analysis using the LBB method will be performed for each RCPB and MSS piping system.	2. The results of the LBB analysis conclude that the stress values conform to the LBB acceptance criteria using the LBB assumptions.
3. The ASME Code Section III, Class 2 and 3 piping systems and components (PSC) are designed to retain their pressure integrity and functional capability under internal design and operating pressures and design basis loads.	3.i An inspection of the stress report for the risk-significant ASME Code, Section III, Class 2 and 3 PSC will be performed	3.i The stress report(s) exist and conclude that the design of the risk-significant ASME Code Section III Class 2 and 3 PSC comply with the requirements of ASME Code Section III.
	3.ii An inspection of the stress report for low risk ASME Code Section III, Class 2 and 3 PSC will be performed.	3.ii The stress report(s) exist and conclude that the design of low risk ASME Code Section III Class 2 and 3 PSC comply with the requirements of ASME Code Section III.

Table 2.3-2 Piping Systems and Components Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4. Safety-related SSCs have adequate high-energy pipe break mitigation features.	4. A pipe break analysis of the as-built high-energy line will be performed.	4. The reconciliation of the as-built configuration of high-energy pipe lines concludes that, for each postulated piping failure, the reactor can be shut down safely and maintained in a safe, cold shutdown condition without offsite power. For postulated pipe breaks, the report confirms whether (A) piping stresses in the containment penetration area are within allowable stress limits, (B) pipe whip restraints and jet shield designs can mitigate pipe break loads, (C) loads on safety-related SSCs are within design load limits and (D) SSCs are protected or qualified to withstand the environmental effects of postulated failures.

2.4 REACTOR SYSTEMS

2.4.1 Reactor System

2.4.1.1 Design Description

System Purpose and Functions

The primary purposes and functions of the reactor system are to:

- Generate heat by controlled nuclear fission and transfer the heat generated to the reactor coolant,
- Provide the primary means for controlling reactivity and shutting down the reactor, and,
- Provide barriers to contain radioactivity associated with reactor operation.

The reactor system is a safety-related system. Its significant safety functions include shutting down the reactor and containing radioactivity associated with reactor operation.

Location and Functional Arrangement

All of the reactor system is located within the containment. The reactor system includes the reactor internals, the fuel assemblies, the control rods, the reactor vessel, and the control rod drive mechanisms (CRDMs). Figure 2.4.1-1 illustrates the reactor general assembly, showing the arrangement of the reactor system components. Figure 2.4.1-2 and Figure 2.4.1-3 show the arrangement of the fuel assemblies and rod cluster control assemblies and the arrangement of the reactor vessel, respectively.

Key Design Features

The reactor core contains 257 fuel assemblies. Each fuel assembly is composed of fuel rods, which contain fuel pellets. The fuel assembly is designed so that it would not be damaged in normal operation or during anticipated operational occurrences.

The core reactivity control is provided by 69 rod cluster control assemblies and by the soluble boron in the primary coolant. The CRDMs are magnetically operated.

The signals of ex-core detectors are used as input to the reactor protection system. The in-core instrumentation system consists of thermocouples and in-core neutron detectors. These neutron detectors are used to measure core power distribution and to calibrate the ex-core detectors.

The core support structures support and align the fuel assemblies. The reactor internals distribute coolant flow. The reactor internals consist of two major assemblies, the lower reactor internal assembly, and the upper reactor internal assembly. The core cavity is formed by a stainless steel neutron reflector. The flow induced vibration response of the reactor internals should be acceptably low in comparison with stress limit of high cycle fatigue. The major reactor internals are illustrated in Figure 2.4.1-1.

The cylindrical reactor vessel measures approximately 435.1 inches from the bottom of its hemispherical bottom head dome to the top of the vessel flange mating surface, with an inside diameter of approximately 202.8 inches. Eight nozzles, located above the fuel, are attached to four coolant loops. No penetrations are located below the top of the reactor core. It is supported by eight steel support pads which are integral with the nozzles. The closure head is held in place with 58 preloaded closure stud assemblies.

The reactor vessel water level is measured using probes that determine reactor coolant liquid inventory above the upper core plate using discrete heated junction thermocouple sensors.

Seismic and ASME Code Classifications

The reactor system is designed and fabricated to meet seismic Category I standards so it withstands a design-basis earthquake and retains its safety functions, as indicated in Table 2.4.1-1.

The reactor system components identified in Table 2.4.1-1 are designed and fabricated to ASME Code Section III requirements. Pressure boundary welds in the ASME Code Section III components identified in Table 2.4.1-1 meet ASME Code Section III requirements and the welding materials used are qualified to these requirements. Information on materials and weld quality are as follows.

The reactor vessel is fabricated of low alloy steel with stainless steel cladding on the inside surfaces. The low alloy steel materials used to the reactor vessel pressure boundary satisfy the fracture toughness requirements of 10 CFR 50 Appendix G and ASME Code Section III. Surveillance capsules located in irradiation specimen guide attached to the outside of the core barrel provide data that can be related to reactor vessel material condition after irradiation. The surveillance program for the capsules complies with 10 CFR 50 Appendix H.

The CRDM pressure housings are made of austenitic stainless steel. The reactor internals are made of corrosion resistant materials such as stainless steel and nickel-chrome-iron alloy.

The reactor system is fabricated and welded in accordance with applicable U.S. standards, including Section III of the ASME Code. Compliance with these standards ensures that the reactor system maintains pressure boundary integrity at design pressure.

System Operation

Normal modes of operation include startup, power operation, shutdown, and refueling. Reactor startup initiates the controlled nuclear fission process. During normal power operation, controlled fission in the reactor system produces heat that is transferred to the circulating reactor coolant. Following reactor trip, loss of electrical power to the CRDM coils unlatches the drive rod, so gravity drops the rod cluster control assembly to the fully inserted position.

Displays

The equipment so identified in Table 2.4.1-1 has safety-related displays in the main control room.

Logic

A reactor trip signal triggers insertion of the RCCAs, as well as in case of loss of electrical power.

Interlocks

There are no interlocks needed for direct safety functions related to the reactor system.

Class 1E Electrical Power Sources and Divisions

The equipment so identified in Table 2.4.1-1 is powered from their respective Class 1E division. Separation is provided between these Class 1E divisions and between Class 1E divisions and non-Class 1E divisions.

Equipment to be Qualified for Harsh Environments

The equipment so identified in Table 2.4.1-1 is qualified for a harsh environment to ensure they can maintain functional operability under all service conditions, including the design basis accident.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

2.4.1.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4.1-2 describes the ITAAC for the reactor system.

Table 2.4.1-1 Equipment Key Attributes

Equipment[1]	Tag #	ASME Section III Class	Seismic Category	Class 1E/ Qual. for Harsh Envir	S-VDU
Fuel assemblies (257)	—	None	I	No	No
Rod cluster control assemblies (69)	—	None	I	No	No
Core support structures	—	CS	I	No	No
RCCA guide thimbles	—	None	I	No	No
Reactor vessel, including all nozzles	—	1	I	No	No
Reactor vessel head	—	1	I	No	No
Reactor vessel head stud bolt assemblies	—	1	I	No	No
CRDM housings (69)	—	1	I	No	No
In-core thermocouples	ICT-TE-001 thru ICT-TE-026	—	I	Yes/Yes	Yes
Reactor vessel water level instruments (2)	RCS-LE-181 RCS-LE-182	—	I	Yes/Yes	Yes
Source Range Neutron Flux (2)	NIS-NE-031, 032	—	I	Yes/Yes[2]	Yes
Intermediate Range Neutron Flux (2)	NIS-NE-035, 036	—	I	Yes/Yes[2]	No
Power Range Neutron Flux (4)	NIS-NE-041, 042, 043, 044	—	I	Yes/Yes[2]	No
Wide Range Neutron Flux (2)	NIS-NE-033, 034	—	I	Yes/Yes	Yes

Legend: S-VDU = safety visual display unit (VDU)

Notes:

1. Figures 2.4.1-1, 2.4.1-2, and 2.4.1-3 show many of these components.
2. Qualification for harsh environment is not required for post-accident environmental condition.

Table 2.4.1-2 Reactor System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. Deleted	1. Deleted	1. Deleted
2. Deleted	2. Deleted	2. Deleted
3. The functional arrangement of the reactor vessel is as shown in Figure 2.4.1-3 and as described in this subsection.	3. Inspections of the as-built system will be performed.	3. The as-built reactor vessel functional arrangement conforms to Figure 2.4.1-3 and the description in Subsection 2.4.1.1
4.a The materials of construction of the ASME Code Section III components identified in Table 2.4.1-1 are in accordance with ASME Code requirements.	4.a Inspection of the certified material test reports will be performed.	4.a The materials of construction of the ASME Code Section III components identified in Table 2.4.1-1 are in accordance with ASME Code requirements.
4.b The low alloy steel materials of construction used for the reactor vessel pressure boundary satisfy the fracture toughness requirements of 10 CFR 50 Appendix G and ASME Code Section III.	4.b Tests and/or analyses of the materials of construction will be performed.	4.b The low alloy steel materials of construction used for the reactor vessel pressure boundary satisfy the fracture toughness requirements of 10 CFR 50 Appendix G and ASME Code Section III.
5.a The ASME Code Section III components of the reactor system identified in Table 2.4.1-1 are fabricated, installed and inspected in accordance with ASME Code Section III requirements.	5.a An inspection of the as-built ASME Code Section III components of the reactor system will be performed.	5.a The ASME Code Section III data reports (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the reactor system identified in Table 2.4.1-1 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

Table 2.4.1-2 Reactor System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5.b The ASME Code Section III components of the reactor system identified in Table 2.4.1-1 are reconciled with the design requirements.	5.b A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	5.b The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the reactor system identified in Table 2.4.1-1 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.
6. Pressure boundary welds in ASME Code Section III components, identified in Table 2.4.1-1, meet ASME Code Section III requirements for non-destructive examination of welds.	6. Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	6. The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
7. The ASME Code Section III components, identified in Table 2.4.1-1, retain their pressure boundary integrity at their design pressure.	7. A hydrostatic test will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	7. The results of the hydrostatic test of the as-built components identified in Table 2.4.1-1 as ASME Code Section III class 1 conform with the requirements of the ASME Code Section III.
8. The seismic Category I equipment, identified in Table 2.4.1-1, is designed to withstand seismic design basis loads without loss of safety function.	8.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.4.1-1 is located in the containment.	8.i The seismic Category I as-built equipment identified in Table 2.4.1-1 is located in the containment.
	8.ii Type tests and/or analyses of the seismic Category I equipment will be performed.	8.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	8.iii An inspection will be performed on the as-built equipment including anchorage.	8.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.

Table 2.4.1-2 Reactor System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9. The reactor internals withstand flow-induced vibration.	9. The flow-induced vibration test will be performed to measure the vibration response in the pre-operational test on the first US-APWR unit, with associated pre-test and post-test inspections.	9. The results of the flow-induced vibration test show that the alternative stress is acceptably low in comparison with the limit for high cycle fatigue in the ASME code. No structural damage or change is observed in post-test inspections.
10. The Class 1E equipment identified in Table 2.4.1-1 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	10.i Type tests and/or analyses will be performed on Class 1E equipment located in a harsh environment.	10.i The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.4.1-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	10.ii Inspections will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	10.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.4.1-1 as being qualified for a harsh environment are bounded by type tests and/or analyses.
11. The Class 1E equipment, identified in Table 2.4.1-1, is powered from their respective Class 1E division.	11. A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	11. The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.4.1-1 under test.
12. Separation is provided between the Class 1E divisions for the equipment identified in Table 2.4.1-1 as Class 1E/qualified and non-Class 1E divisions.	12. Inspections of the as-built Class 1E divisional cables will be performed.	12. Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.

Table 2.4.1-2 Reactor System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
13. Displays of the parameters identified in Table-2.4.1-1 can be retrieved in the MCR.	13. Inspections will be performed for retrievability of the reactor system parameters in the as-built MCR.	13. The displays identified in Table 2.4.1-1 can be retrieved in the as-built MCR.
14. Irradiation specimen guides are attached to the core barrel to hold capsules with material surveillance specimens.	14. Inspection of the as-built core barrel will be performed for attachment of the irradiation specimen guides and existence of surveillance capsules.	14. Irradiation specimen guides are attached to the as-built core barrel and a minimum of three as-built surveillance capsules are provided.

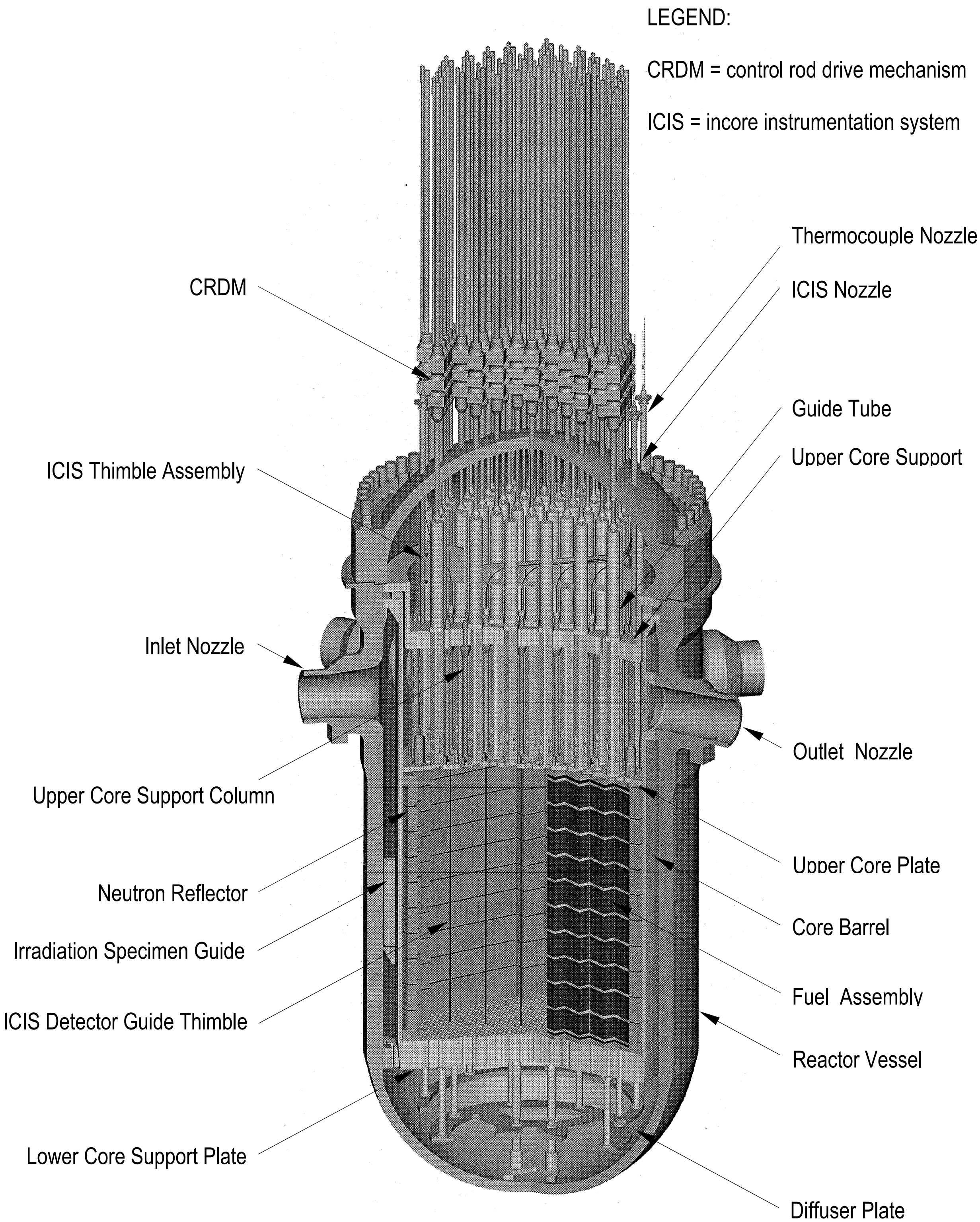


Figure 2.4.1-1 Reactor General Assembly

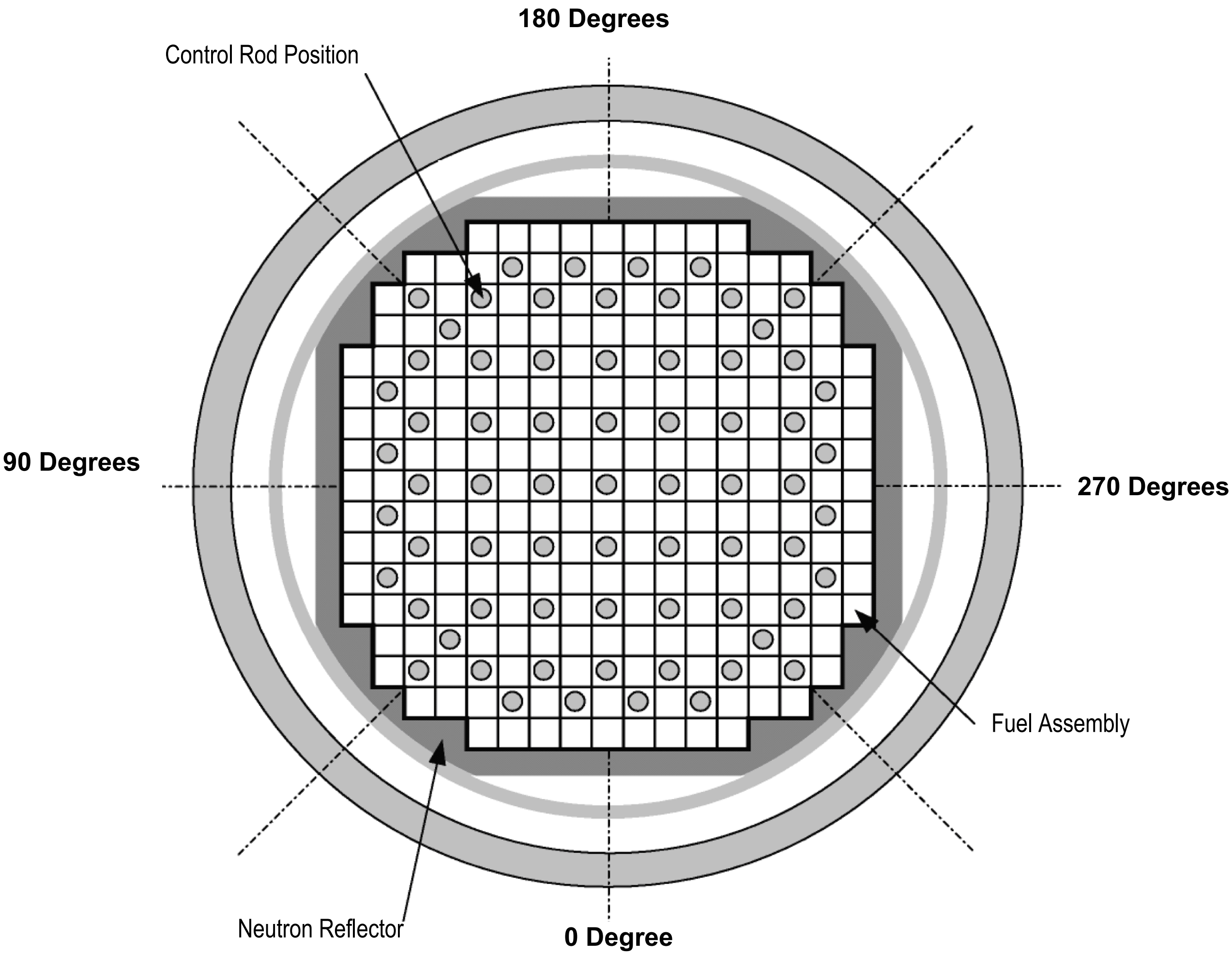


Figure 2.4.1-2 Arrangement of Fuel and Rod Cluster Control Assemblies

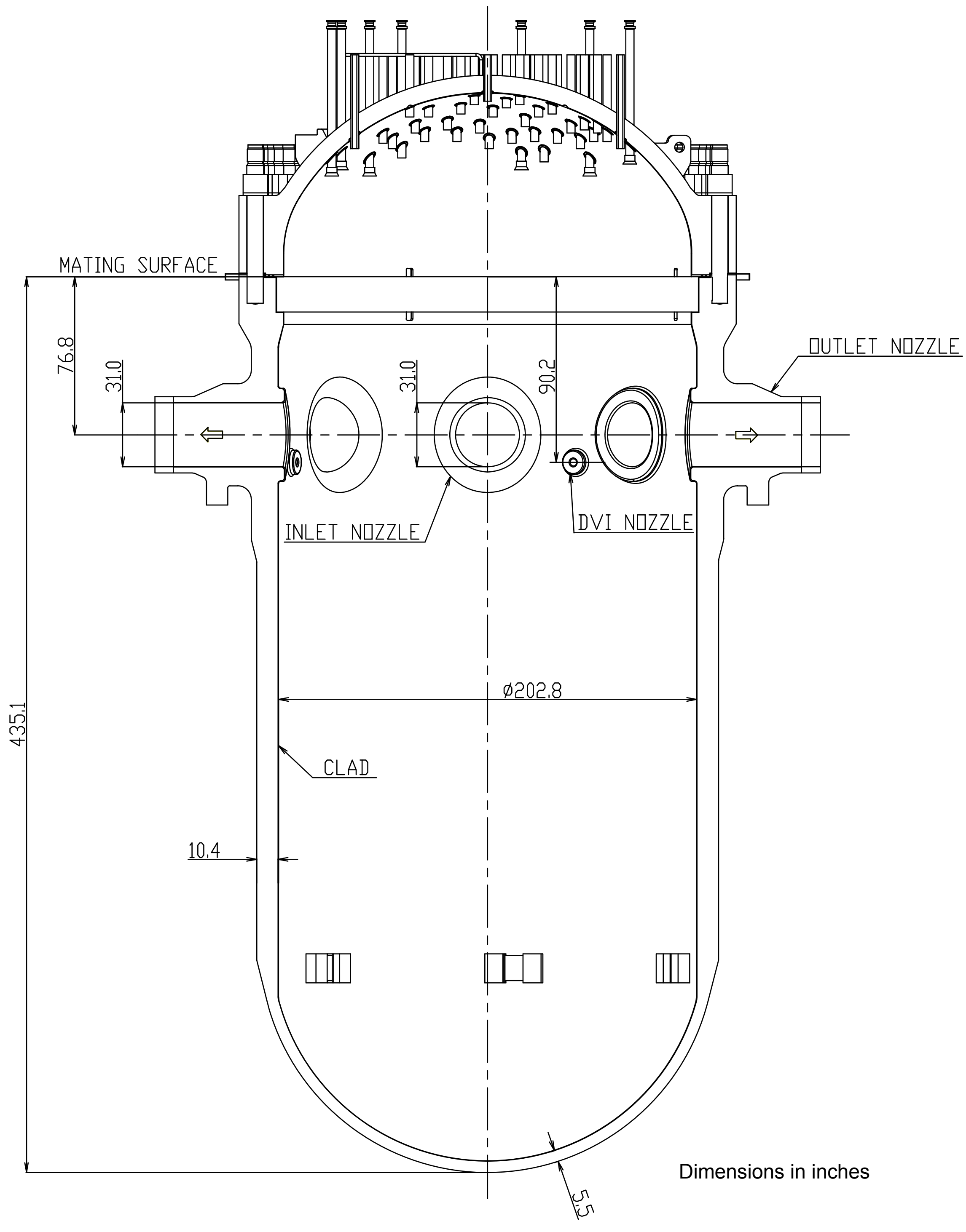


Figure 2.4.1-3 Reactor Vessel

2.4.2 Reactor Coolant System

2.4.2.1 Design Description

System Purpose and Functions

The purpose and primary function of the reactor coolant system (RCS) are to provide reactor cooling by transferring the heat generated in the reactor core to the secondary side of steam generators (SGs).

The RCS is a safety-related system. Besides cooling the reactor core, the RCS' significant safety functions include the following;

- Forming the reactor coolant pressure boundary
- The pressurizer safety valves provide overpressure protection
- The RCS provides depressurization during a design bases event
- RCPs have a rotating inertia to provide coastdown flow
- The RCP flywheel can withstand a design overspeed condition
- The RCS provides the containment isolation function, as described in Subsection 2.11.2 of the piping that penetrates the containment.

Location and Functional Arrangement

Figure 2.4.2-1 and Figure 2.4.2-2 show the functional arrangement of the system. The locations of the major RCS components and piping are specified in Table 2.4.2-1.

As shown in the figures, the major components of the RCS are four SGs, four RCPs, one pressurizer, and the reactor coolant piping and valves. (Note that the reactor vessel is addressed in Subsection 2.4.1.)

Tables 2.4.2-2 and 2.4.2-3 provide information on design characteristics of system components and system piping, respectively.

Key Design Features

The key design features of the RCS are as follows.

The SGs are vertical shell U-tube evaporators with integral moisture separating equipment. Reactor coolant enters the channel head via the coolant inlet nozzle, flows through the inverted U-tubes, transferring heat from the primary side to the secondary side, and leaves from the channel head via the coolant outlet nozzle. Feedwater enters the steam generator at an elevation above the top of the U-tubes through a feedwater nozzle. Steam generated on the secondary side, flows upward, and exits through the outlet nozzle at the top of the vessel.

The RCPs are vertical mixed flow type pumps driven by a three-phase induction motor mounted above the pump. A flywheel attached to the motor provides additional inertia, thereby preventing a rapid reduction in reactor coolant flow during loss of power. The pump suction is located at the bottom of the pump and the discharge is on the side.

The pressurizer, a vertically-oriented cylindrical vessel with hemispherical top and bottom heads, maintains liquid and vapor in equilibrium under saturated conditions for pressure control. Electrical immersion heaters are installed vertically through the bottom head of the vessel while the nozzles such as spray nozzle and safety valve nozzle are located in the top head of the vessel. The surge line, which is attached to the bottom of the pressurizer, connects to the hot leg of a reactor coolant loop.

Pressurizer safety valves provide overpressure protection for the RCS.

The reactor vessel head vent valves, the safety depressurization valve and depressurization valves could be used for high point vents.

The RCS is designed to provide containment isolation of the piping penetrating the containment.

Seismic and ASME Code Classifications

System components meet the seismic category requirements identified in Table 2.4.2-2. System components are designed and constructed to ASME Code Section III requirements identified in this table.

System piping meets the seismic category requirements identified in Table 2.4.2-3. System piping is designed and constructed to ASME Code Section III requirements identified in this table.

Pressure boundary welds in ASME Code Section III components and piping meet ASME Code Section III requirements.

The materials of construction for RCS components and piping are as follows:

- Major components of the SGs are made of low-alloy steel, with the inner surfaces exposed to reactor coolant clad with stainless steel or nickel-chrome-iron alloy. The tube material is alloy 690 thermally treated.

- All parts of RCPs in contact with reactor coolant are stainless steel, except for seals, bearings, and special parts.

- The pressurizer is constructed of low-alloy steel with stainless steel cladding on all surfaces exposed to reactor coolant.

- The reactor coolant piping (hot leg, cold leg and cross-over leg) is stainless steel. Other RCS piping such as the pressurizer surge line, pressurizer spray lines and connecting lines to other systems are also stainless steel.

System Operation

There is no realignment of RCS except for containment isolation valves (CIVs) following an actuation signal.

Alarms, Displays, and Controls

Table 2.4.2-4 identifies alarms, displays, and controls associated with the RCS that are located in the MCR and on the remote shutdown console (RSC).

Logic

RCPs trip in response to an emergency core cooling system (ECCS) actuation signal coincident with a reactor trip (P-4) signal.

Interlocks

There are no interlocks needed for direct safety functions related to the RCS.

Class 1E Electrical Power Sources and Divisions

The RCS equipment identified in Table 2.4.2-2 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

The equipment identified in Table 2.4.2-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITAAC acceptance criteria in Table 2.4.2-5.

2.4.2.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4.2-5 describes the ITAAC for the RCS.

The ITAAC associated with the RCS equipment, components, and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.4.2-1 Reactor Coolant System Location of Equipment and Piping

System and Components	Location
Pressurizer	Containment
Steam generators	Containment
Reactor coolant pumps	Containment
Pressurizer piping upstream of and including the pressurizer safety valves RCS-SRV-120,121,122,123, safety depressurization valves RCS-MOV-117A,B, and depressurization valves RCS-MOV-119	Containment
Reactor vessel head vent piping upstream of and including the reactor vessel head vent valves RCS-MOV-003A,B	Containment
Pressurizer piping downstream of and excluding pressurizer safety valves	Containment
Pressurizer piping downstream of and excluding safety depressurization valves	Containment
Pressurizer piping downstream of and excluding depressurization valves	Containment
Reactor vessel head vent line piping downstream of and excluding the reactor vessel head vent valves	Containment
Reactor coolant piping drain piping upstream of and including the second drain stop valve RCS-VLV-023A,B,C,D	Containment
Reactor coolant piping	Containment
Pressurizer surge line piping	Containment
Pressurizer spray line piping	Containment

Table 2.4.2-2 Reactor Coolant System Equipment Characteristics (Sheet 1 of 4)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. for Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Reactor coolant pumps	RCS-MPP-001 A, B, C, D	1	Yes	—	No/No	ECCS Actuation coincident with RT (P-4)	Stop	—
Pressurizer	RCS-MTK-002	1	Yes	—	—/—	—	—	—
SG (primary side)	RCS-MHX-001 A, B, C, D	1	Yes	—	—/—	—	—	—
SG (secondary side)		2				—		—
Pressurizer safety valves	RCS-SRV-120,121,122,123	1	Yes	—	—/—	—	Transfer Open/ Transfer Closed	—
Safety depressurization valves	RCS-MOV-117 A, B	1	Yes	Yes	Yes/Yes	Remote Manual	Transfer Open/ Transfer Closed	As Is
SDV block Valves	RCS-MOV-116 A, B	1	Yes	Yes	Yes/Yes	Remote Manual	Transfer Open/ Transfer Closed	As Is
Depressurization valves	RCS-MOV-118	1	Yes	Yes	Yes/Yes	—	—	As Is
Depressurization valves	RCS-MOV-119	1	Yes	Yes	Yes/Yes	—	—	As Is

Table 2.4.2-2 Reactor Coolant System Equipment Characteristics (Sheet 2 of 4)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. for Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Pressurizer spray valves	RCS-PCV-061 A, B	1	Yes	Yes	No/No	—	—	Closed
Pressurizer spray block valves	RCS-MOV-111 A, B	1	Yes	Yes	No/No	—	—	As Is
Pressurizer spray bypass valves	RCS-VLV-112 A, B	1	Yes	No	—/—	—	—	—
Letdown line stop valve	RCS-VLV-021	1	Yes	No	—/—	—	—	—
Reactor Coolant Piping First Drain Stop Valves	RCS-VLV-022 A, B, C, D	1	Yes	No	—/—	—	—	—
Reactor Coolant Piping Second Drain Stop Valves	RCS-VLV-023 A, B, C, D	1	Yes	No	—/—	—	—	—
Cavity/RCS water level meter line stop valve	RCS-VLV-024, 025	1	Yes	No	—/—	—	—	—
Reactor Vessel Head Vent First Valves	RCS-MOV-002 A, B,	1	Yes	Yes	Yes/Yes	Remote Manual	Transfer Open/ Transfer Closed	As Is
Reactor Vessel Head Vent Second Valves	RCS-MOV-003 A, B	1	Yes	Yes	Yes/Yes	Remote Manual	Transfer Open/ Transfer Closed	As Is
Reactor Coolant Flow	RCS-FT-022, 023, 024, 025, 032, 033, 034, 035, 042, 043, 044, 045, 052, 053, 054, 055	—	Yes	—	Yes/Yes(1)	—	—	—

Table 2.4.2-2 Reactor Coolant System Equipment Characteristics (Sheet 3 of 4)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. for Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Pressurizer Water Level	RCS-LT-061, 062, 063, 064	—	Yes	—	Yes/Yes	—	—	—
Reactor Coolant Pressure	RCS-PT-020, 030, 040, 050	—	Yes	—	Yes/Yes	—	—	—
Pressurizer Pressure	RCS-PT-061, 062, 063, 064	—	Yes	—	Yes/Yes	—	—	—
Reactor Coolant Hot Leg Temperature (Wide Range)	RCS-TE-020, 030, 040, 050	—	Yes	—	Yes/Yes	—	—	—
Reactor Coolant Cold Leg Temperature (Wide Range)	RCS-TE-025, 035, 045, 055	—	Yes	—	Yes/Yes	—	—	—
Reactor Coolant Hot Leg Temperature (Narrow Range)	RCS-TE-021A, 021B, 021C, 031A, 031B, 031C, 041A, 041B, 041C, 051A, 051B, 051C	—	Yes	—	Yes/Yes	—	—	—
Reactor Coolant Hot Leg Temperature (Narrow Range) (spare)	RCS-TE-023A, 023B, 023C, 033A, 033B, 033C, 043A, 043B, 043C, 053A, 053B, 053C	—	Yes	—	Yes/Yes	—	—	—
Reactor Coolant Cold Leg Temperature (Narrow Range)	RCS-TE-021D, 031D, 041D, 051D	—	Yes	—	Yes/Yes	—	—	—

Table 2.4.2-2 Reactor Coolant System Equipment Characteristics (Sheet 4 of 4)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. for Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Reactor Coolant Cold Leg Temperature (Narrow Range) (spare)	RCS-TE-023D, 033D, 043D, 053D	—	Yes	—	Yes/Yes	—	—	—
Reactor Coolant Pump Speed	RCS-SE-028A, 038A, 048A, 058A	—	Yes	—	Yes/Yes(1)	—	—	—
Reactor Coolant Pump Speed (spare)	RCS-SE-028B, 038B, 048B, 058B	—	Yes	—	Yes/Yes(1)	—	—	—

NOTE:

Dash (-) indicates not applicable

1. Qualification for harsh environment is not required for post-accident environmental condition.

Table 2.4.2-3 Reactor Coolant System Piping Characteristics

Pipe Line Name	ASME Code Section III Class	Leak Before Break	Seismic Category I
Pressurizer piping upstream of and including the pressurizer safety valves RCS-SRV-120,121,122,123, safety depressurization valves RCS-MOV-117A,B, and depressurization valves RCS-MOV-119	1	No	Yes
Reactor vessel head vent piping upstream of and including the reactor vessel head vent valves RCS-MOV-003A,B	1	No	Yes
Pressurizer piping downstream of and excluding pressurizer safety valves RCS-SRV-120,121,122,123	—	No	No
Pressurizer piping downstream of and excluding safety depressurization valves RCS-MOV-117A,B	—	No	No
Pressurizer piping downstream of and excluding depressurization valves RCS-MOV-119	—	No	No
Reactor vessel head vent line piping downstream of and excluding the reactor vessel head vent valves RCS-MOV-003A,B	—	No	No
Reactor coolant piping drain piping upstream of and including the second drain stop valve RCS-VLV-023A,B,C,D	1	No	Yes
Reactor coolant piping	1	Yes	Yes
Pressurizer surge line piping	1	Yes	Yes
Pressurizer spray line piping	1	No	Yes

Note: Dash (-) indicates not applicable

Table 2.4.2-4 Reactor Coolant System Equipment Alarms, Displays, and Control Functions

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Reactor Coolant Pump	No	Yes	Yes	Yes
Pressurizer Heaters	No	Yes	Yes	Yes
Pressurizer Safety Valve	No	Yes	No	Yes
Safety Depressurization Valve	No	Yes	Yes	Yes
SDV block valve	No	Yes	Yes	Yes
Depressurization Valve	No	Yes	Yes	Yes
Reactor Vessel Head Vent Valve	No	Yes	Yes	Yes
Reactor Coolant Flow RCS-FT-022,023,024,025, 032,033,034,035, 042,043,044,045, 052,053,054,055	Yes	No	No	No
Reactor Coolant Pump Speed RCS-SE-028A, 038A, 048A, 058A	Yes	No	No	No
Reactor Coolant Pump Speed (spare) RCS-SE-028B, 038B, 048B, 058B	—	—	—	—
Pressurizer Pressure RCS-PT-061,062,063,064	Yes	Yes	No	Yes
Pressurizer Water Level RCS-LT-061,062,063,064	Yes	Yes	No	Yes
Reactor Coolant Hot Leg Temperature (Wide Range) RCS-TE-020, 030, 040, 050	No	Yes	No	Yes
Reactor Coolant Cold Leg Temperature (Wide Range) RCS-TE-025, 035, 045, 055	No	Yes	No	Yes
Reactor Coolant Hot Leg Temperature (Narrow Range) RCS-TE-021A,B,C, 031A,B,C, 041A,B,C, 051A,B,C	—	—	—	—
Reactor Coolant Hot Leg Temperature (Narrow Range) (spare) RCS-TE-023A,B,C, 033A,B,C, 043A,B,C, 053A,B,C	—	—	—	—
Reactor Coolant Cold Leg Temperature (Narrow Range) RCS-TE-021D, 031D, 041D, 051D	—	—	—	—
Reactor Coolant Cold Leg Temperature (Narrow Range) (spare) RCS-TE-023D, 033D, 043D, 053D	—	—	—	—
Reactor Coolant Pressure RCS-PT-020, 030, 040, 050	No	Yes	No	Yes
Reactor Vessel Water Level RCS-LE-181,182	No	Yes	No	Yes

Note: Dash (-) indicates not applicable

Table 2.4.2-5 Reactor Coolant System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1a. Deleted	1a. Deleted	1a. Deleted
1b. Deleted	1b. Deleted	1b. Deleted
2. The functional arrangement of the RCS is as described in the Design Description of Subsection 2.4.2.1 and as shown on Figure 2.4.2-1.	2. An inspection of the as-built RCS will be performed.	2. The as-built RCS conforms to the functional arrangement as described in the Design Description of this Subsection 2.4.2.1 and as shown in Figure 2.4.2-1.
3a. The materials of construction of the ASME Code Section III components identified in Table 2.4.2-2 are in accordance with ASME Code requirements.	3a. Inspections of the certified material test reports will be performed.	3a. The materials of construction of the ASME Code components identified in Table 2.4.2-2 are in accordance with ASME Code requirements.
3b. The materials of construction of the ASME Code Section III piping identified in Table 2.4.2-3 are in accordance with ASME Code requirements.	3b. Inspections of the certified material test reports will be performed.	3b. The materials of construction of the ASME Code piping identified in Table 2.4.2-3 are in accordance with ASME Code requirements.
4.a.i The ASME Code Section III components of the RCS, identified in Table 2.4.2-2, are fabricated, installed and inspected in accordance with ASME Code Section III requirements.	4.a.i An inspection of the as-built ASME Code Section III components of the RCS will be performed.	4.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the RCS identified in Table 2.4.2-2 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
4.a.ii The ASME Code Section III components of the RCS identified in Table 2.4.2-2 are reconciled with the design requirements.	4.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	4.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the RCS identified in Table 2.4.2-2 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.

Table 2.4.2-5 Reactor Coolant System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4.b.i The ASME Code Section III piping of the RCS, including supports, identified in Table 2.4.2-3, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	4.b.i An inspection of the as-built ASME Code piping of the RCS, including supports, will be performed .	4.b.i The ASME Code Section III data report(s) (certified when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the RCS, including supports, identified in Table 2.4.2-3 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
4.b.ii The ASME Code Section III piping of the RCS, including supports, identified in Table 2.4.2-3 are reconciled with the design requirements.	4.b.ii A reconciliation analysis of the piping of the RCS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	4.b.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the RCS, including supports, identified in Table 2.4.2-3 is reconciled with the design requirements. The report documents the results of the reconciliation analysis.
5.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.4.2-2, meet ASME Code Section III requirements for non-destructive examination of welds.	5.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	5.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
5.b Pressure boundary welds in ASME Code Section III piping, identified in Table 2.4.2-3, meet ASME Code Section III requirements for non-destructive examination of welds.	5.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	5.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.

Table 2.4.2-5 Reactor Coolant System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6.a The ASME Code Section III components, identified in Table 2.4.2-2, retain their pressure boundary integrity at their design pressure.	6.a A hydrostatic test will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	6.a The results of the hydrostatic test of the as-built components identified in Table 2.4.2-2 as ASME Code Section III conform with the requirements of the ASME Code Section III.
6.b The ASME Code Section III piping, identified in Table 2.4.2-3, retains its pressure boundary integrity at its design pressure.	6.b A hydrostatic test will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	6.b The results of the hydrostatic test of the as-built piping identified in Table 2.4.2-3 as ASME Code Section III conform to the requirements of the ASME Code Section III.
7.a The seismic Category I equipment, identified in Table 2.4.2-2, is designed to withstand seismic design basis loads without loss of safety function.	7.a.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.4.2-2 is located in the containment.	7.a.i The seismic Category I as-built equipment identified in Table 2.4.2-2 is located in the containment.
	7.a.ii Type tests and/or analyses of seismic Category I equipment will be performed.	7.a.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	7.a.iii Inspections will be performed on the as-built equipment including anchorage.	7.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.
8.i Each of the seismic Category I piping, including supports, identified in Table 2.4.2-3 is designed to withstand combined normal and seismic design basis loads without a loss of its safety function.	8.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table 2.4.2-3 are supported by a seismic Category I structure(s).	8.i Reports(s) document that each of the as-built seismic Category I piping, including supports, identified in Table 2.4.2-3 is supported by a seismic Category I structure(s).
	8.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, identified in Table 2.4.2-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.	8.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, identified in Table 2.4.2-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.

Table 2.4.2-5 Reactor Coolant System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9.a The Class 1E equipment identified in Table 2.4.2-2 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	9.a.i Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	9.a.i The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.4.2-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	9.a.ii Inspections will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	9.a.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.4.2-2 as being qualified for a harsh environment are bounded by type tests and/or analyses.
9.b The Class 1E equipment, identified in Table 2.4.2-2, is powered from their respective Class 1E division.	9.b A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	9.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.4.2-2 under test.
9.c Separation is provided between RCS Class 1E divisions, and between Class 1E divisions and non-Class 1E cables.	9.c Inspections of the as-built Class 1E divisional cables will be performed	9.c Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.

Table 2.4.2-5 Reactor Coolant System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10.a The pressurizer safety valves provide overpressure protection in accordance with the ASME Code Section III.	10.a.i Inspections will be conducted to confirm that the value of the vendor code plate rating is greater than or equal to system relief requirements.	10.a.i The sum of the rated capacities recorded on the valve ASME Code plates of the as-built safety valves exceeds 1.728×10^6 lb/hr.
	10.a.ii Tests and analyses in accordance with ASME Code Section III will be performed to confirm set pressure.	10.a.ii The result of test and analysis conforms with the following as-built safety valves set pressure; $\geq$ 2435 psig and $\leq$ 2485 psig
10.b Each RCP flywheel assembly can withstand a design overspeed condition.	10.b Tests of each as-built RCP flywheel assembly will be performed at overspeed conditions.	10.b A report exists and concludes that each as-built RCP flywheel assembly can withstand an overspeed condition of no less than 125% of operating speed.
10.c RCPs have a rotating inertia to provide RCS flow coastdown on loss of power to the pumps.	10.c Tests and/or analyses will be performed on the as-built RCP.	10.c The rotating inertia of each as-built RCP is no less than 115,330 lb-ft^2.
10.d The RCS provides circulation of coolant to remove heat from the reactor core.	10.d Tests and analyses to measure RCS flow with the as-built four reactor coolant pumps operating at no-load RCS pressure and temperature conditions will be performed. Analyses will be performed to convert the measured pre-fuel load flow to post-fuel load flow with 10% steam generator tube plugging.	10.d The calculated reactor coolant flow rate per loop with 10% steam generator plugging is at least 112,000 gallons per minute.
10.e The RCS provides the means to control system pressure.	10.e Inspections will be performed to verify the rated capacity of the as-built pressurizer heater backup groups A, B, C, and D	10.e The as-built pressurizer heater backup groups A, B, C, and D each has a rated capacity of at least 120 kW.
11.a Controls exist in the MCR to open and close the remotely operated valves identified in Table 2.4.2-2.	11.a Tests will be performed on the as-built remotely operated valves listed in Table 2.4.2-2 using controls in the as-built MCR.	11.a Controls exist in the as-built MCR to open and close the as-built remotely operated valves listed in Table 2.4.2-2.

Table 2.4.2-5 Reactor Coolant System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
11.b The valves identified in Table 2.4.2-2 as having PSMS control perform an active safety function after receiving a signal from PSMS.	11.b Tests will be performed on the as-built remotely operated valves listed in Table 2.4.2-2 using simulated signals.	11.b The as-built remotely operated valves identified in Table 2.4.2-2 as having PSMS control perform the active function identified in the table after receiving a simulated signal.
12.a The motor-operated valves, identified in Table 2.4.2-2, perform an active safety function to change position as indicated in the table.	12.a.i Tests or type tests of the motor-operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	12.a.i Each motor-operated valve changes position as indicated in Table 2.4.2-2 under design conditions.
	12.a.ii Tests of the as-built motor-operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	12.a.ii Each as-built motor operated valve changes position as indicated in Table 2.7.1.2-2 under preoperational test conditions.
12.b After loss of motive power, the remotely operated valves, identified in Table 2.4.2-2, assume the indicated loss of motive power position.	12.b Tests of the as-built valves will be performed under the conditions of loss of motive power.	12.b Upon loss of motive power, each as-built remotely operated valve identified in Table 2.4.2-2 assumes the indicated loss of motive power position.
13.a Controls exist in the MCR to start and stop the pumps identified in Table 2.4.2-4	13.a Tests will be performed on the as-built pumps in Table 2.4.2-4 using controls in the as-built MCR.	13.a Controls exist in the as-built MCR to start and stop the as-built pumps listed in Table 2.4.2-4.
13.b The pumps identified in Table 2.4.2-2 as having PSMS control perform an active safety function after receiving a signal from PSMS.	13.b Tests will be performed on the as-built pumps listed in Table 2.4.2-2 using simulated signals.	13.b The as-built pumps identified in Table 2.4.2-2 as having PSMS control perform the active function identified in the table after receiving a simulated signal.
14. MCR alarms and displays of the parameters identified in Table 2.4.2-4 can be retrieved in the MCR.	14. Inspections will be performed for retrievability of the RCS parameters in the as-built MCR.	14. MCR alarms and displays identified in Table 2.4.2-4 can be retrieved in the as-built MCR.

Table 2.4.2-5 Reactor Coolant System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 7 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
15. RSC alarms displays and controls are identified in Table 2.4.2-4.	15. Inspections of the as-built RSC alarms, displays and controls will be performed.	15. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.4.2-4.
16. Each of the as-built piping identified in Table 2.4.2-3 as designed for LBB meets the LBB criteria, or an evaluation is performed of the protection from the dynamic effects of a rupture of the piping.	16. Inspections of the as-built piping will be performed based on the evaluation report for LBB or the protection from dynamic effects of a pipe break, as specified in Section 2.3.	16. The LBB acceptance criteria are met by the as-built piping and piping materials, or the protection is provided for the dynamic effects of the piping break.
17. Controls exist in the MCR to start and stop the pressurizer heaters identified in Table 2.4.2-4.	17. Tests will be performed on the as-built pressurizer heaters listed in Table 2.4.2-4 using controls in the as-built MCR.	17. Controls exist in the as-built MCR to start and stop the as-built pressurizer heaters identified in Table 2.4.2-4.

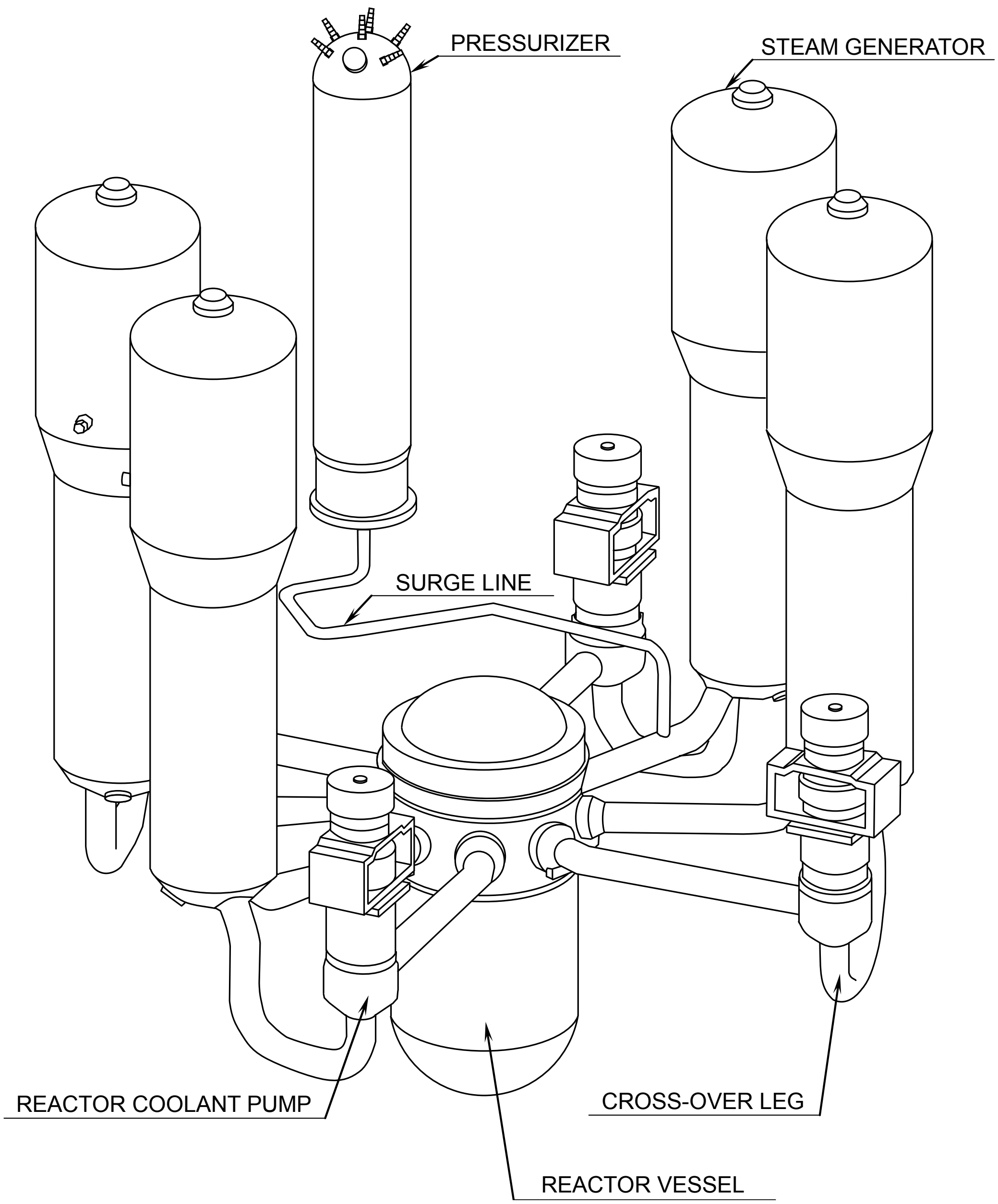


Figure 2.4.2-1 Isometric View of the Reactor Coolant System

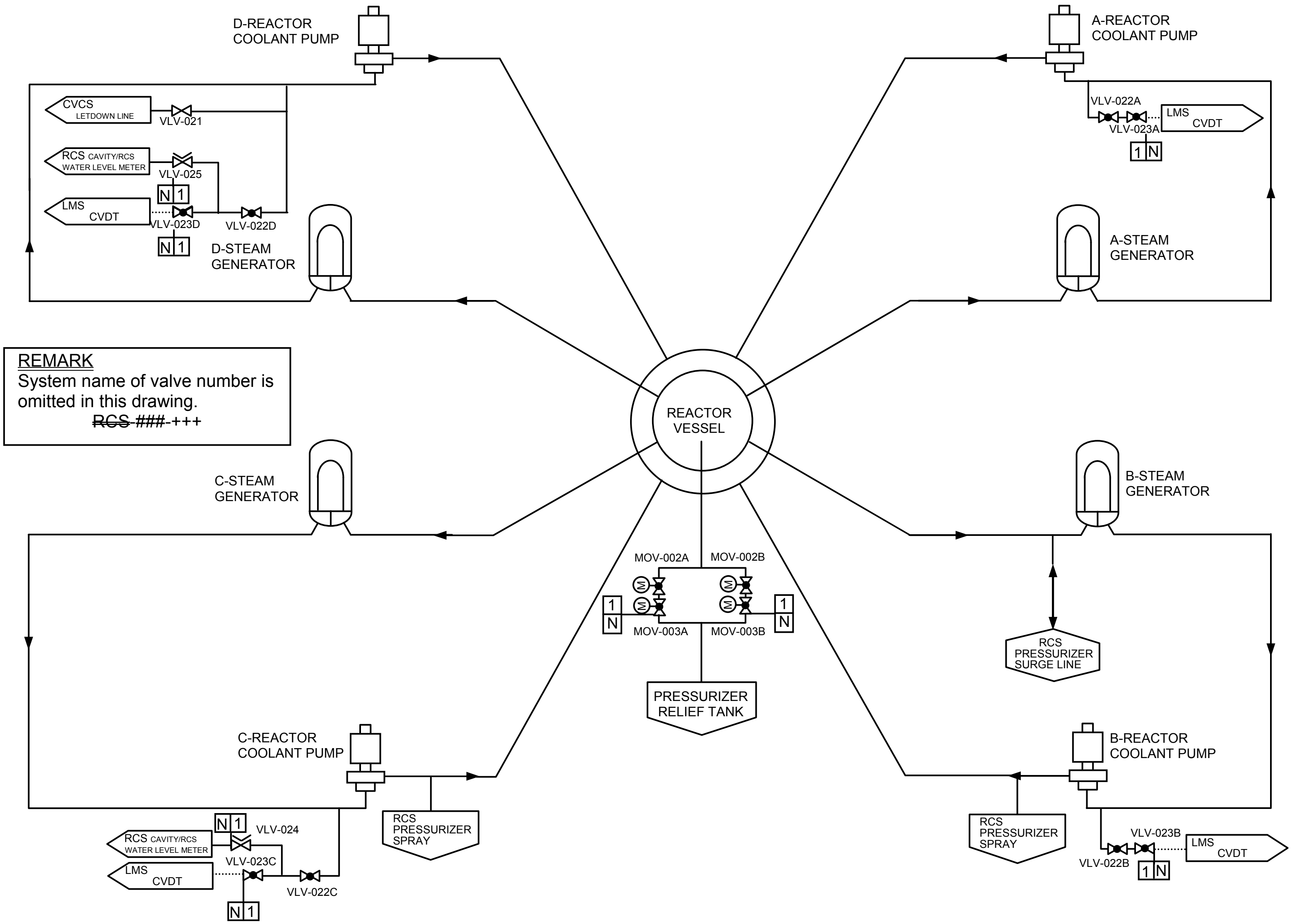


Figure 2.4.2-2 Reactor Coolant System (Sheet 1 of 2)

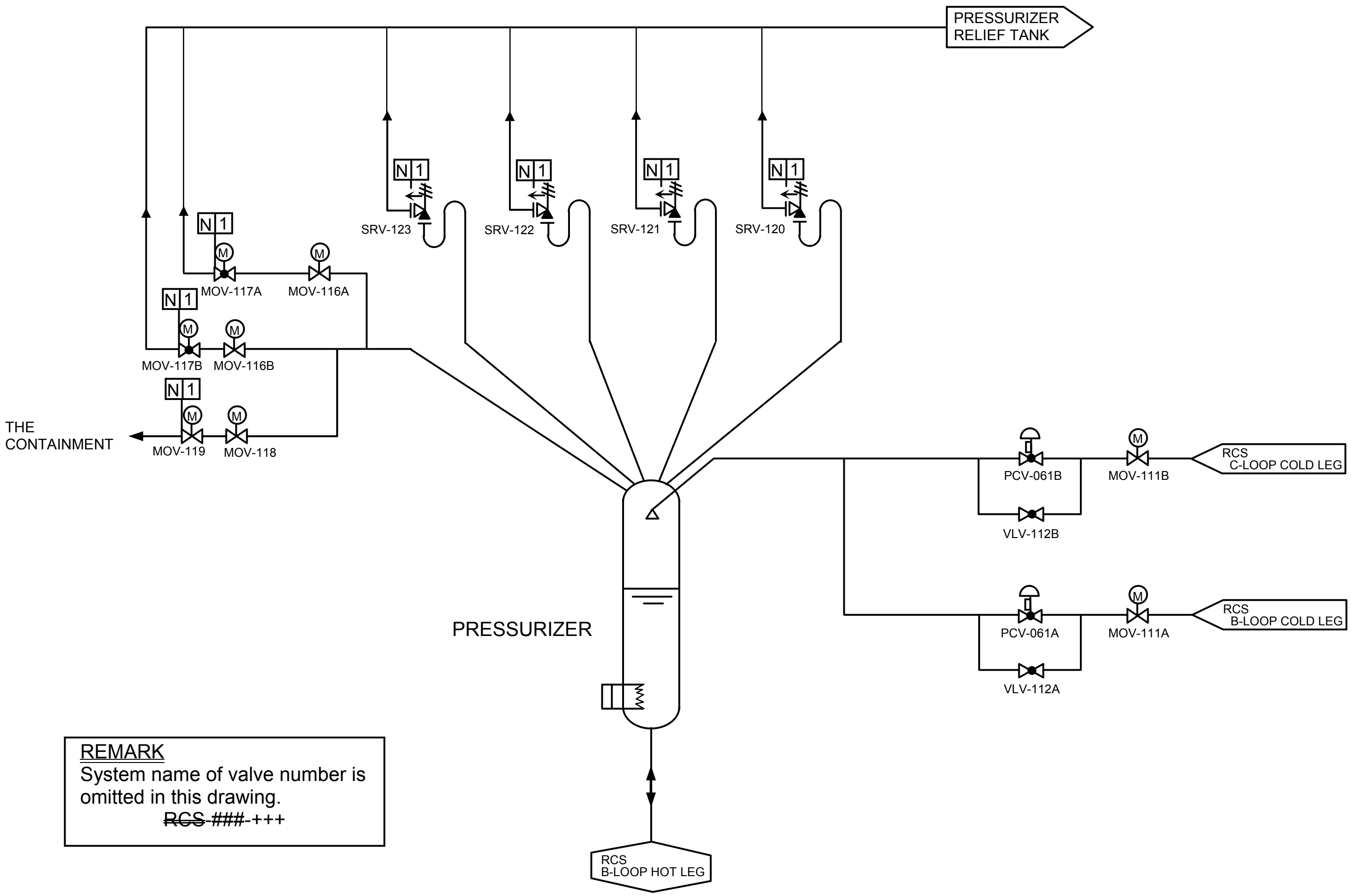


Figure 2.4.2-2 Reactor Coolant System (Sheet 2 of 2)

2.4.3 Loose Parts Monitoring System

2.4.3.1 Design Description

System Purpose and Functions

The purpose and function of the loose parts monitoring system (LPMS) is to detect loose metallic parts in the RCS before damage occurs. This system has non safety-related functions.

Location and Functional Arrangement

The LPMS is located within the containment, with its alarms and displays located in the MCR. The system sensors are installed at fixed positions on the reactor coolant system where loose parts are likely to gather. These areas include the upper and lower head plenums of the reactor vessel and the inlet plenum of each steam generator.

Key Design Features

Each LPMS instrumentation channel consists of a sensor, signal conditioning, and processing equipment and signal recorder. LPMS equipment inside the containment is designed to remain functional through an earthquake of a magnitude equal to half of the calculated SSE. The system activates and operates automatically. Data obtained from the loose parts monitoring sensors can be retrieved in the MCR. The LPMS actuates audible and visual alarms in the MCR if a signal exceeds the preset alarm level.

2.4.3.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4.3-1 describes the ITAAC for the LPMS.

Table 2.4.3-1 Loose Parts Monitoring System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the LPMS is as described in the Design Description of Subsection 2.4.3.1.	1. Inspections of the as-built system will be performed.	1. The as-built LPMS conforms to the functional arrangement described in the Design Description of Subsection 2.4.3.1.
2. MCR alarms and displays provided for the LPMS are defined in Subsection 2.4.3.1	2. Inspections will be performed on the MCR alarms and displays for the as-built LPMS.	2. The as-built alarms and displays exist or can be retrieved in the as-built MCR as defined in Subsection 2.4.3.1.

2.4.4 Emergency Core Cooling System

2.4.4.1 Design Description

System Purpose and Functions

The primary purpose of the ECCS is to remove stored and fission product decay heat from the reactor core following an accident. Four important functions of this safety-related system are to ensure that (1) fuel cladding temperature, oxidation and hydrogen production limits are not exceeded, (2) "coolable" core geometry is maintained, (3) long-term core cooling is available, and (4) the ECCS is capable of providing the containment isolation function, as described in Section 2.11.2, for piping penetrating the containment.

The ECCS has the following functions:

Accumulator injection - The accumulator system stores borated water under pressure and automatically injects it into the RCS if the reactor coolant pressure decreases below the accumulator pressure.

High head injection - The high-head injection system takes suction from the RWSP and delivers borated water to the safety injection nozzles on the reactor vessel or to the hot legs of the RCS.

Emergency letdown - The emergency letdown system can be utilized to achieve a cold shutdown boration level in the RCS by directing reactor coolant to the RWSP and providing borated water from the RWSP to the RCS via the safety injection pumps.

Containment pH control - Sodium tetraborate decahydrate (NaTB) contained in baskets provides adjustment of the pH of the water in the containment following an accident. The pH adjustment maintains the desired post-accident pH conditions in the containment water, to enhance the iodine retention capacity in the containment and to avoid stress corrosion cracking of the austenitic stainless steel components.

Location and Functional Arrangement

The location and functional arrangement of ECCS equipment and piping is shown on Figure 2.4.4-1. Table 2.4.4-1 also provides a tabulation of the location of ECCS equipment. The equipment, piping and valves of ECCS are located within the containment or reactor building.

Figure 2.4.4-1 shows the functional arrangement of the ECCS, which is further described below. Tables 2.4.4-2 and 2.4.4-3 provide information on design characteristics of system components and system piping, respectively. Information in these tables is discussed below.

Key Design Features

The key design features of the ECCS are reflected in the system design bases, which include:

In combination with control rod insertion, the ECCS is designed to shut down and cool the reactor during the following accidents:

- LOCAs,
- Ejection of a control rod cluster assembly,
- Secondary steam system piping failure,
- Inadvertent operating of main steam relief or safety valve, and
- Steam generator tube failure.

- The ECCS includes four 50%-capacity safety injection pump divisions, assuming one is out of service for maintenance and one becomes inoperative due to a single failure upon initiation of the ECCS.
- The emergency power sources supply electrical power to the essential components of the ECCS, so the safety functions can be maintained during a loss of offsite power.
- The ECCS is automatically initiated by an ECCS actuation signal.
- The ECCS design permits periodical tests and inspections to verify integrity and operability.
- The ECCS provides containment isolation of ECCS lines penetrating the containment.
- Each mechanical division of the ECCS is physically separated from the other divisions by a structural barrier, which also serves as a fire barrier. The piping and components inside the containment are exceptions.

The key design features of the ECCS are as follows:

Accumulator injection - The accumulator system consists of four accumulators and the associated valves and piping, one for each RCS loop. The system is connected to the cold legs of the reactor coolant piping. The accumulators incorporate internal passive flow damper which function to inject a large flow to refill the reactor vessel in the first stage of injection, and then reduce the flow as the water level in the accumulator drop. The accumulators have a design pressure of 700 psig, and when the RCS pressure falls below approximately 640 psig, the accumulators begin to inject borated water into the RCS cold legs.

When the water level is above the top of the standpipe, water enters the vortex chamber through both inlets at the top of the standpipe and at the side of the vortex chamber and thus it injects water with a large flow rate. When the water level drops below the top of the standpipe, the water enters the vortex chamber only through the side inlet and thus it injects water with a relatively low flow rate. The accumulators perform the large flow injection to refill the reactor vessel and the following small flow injection during core re-flooding in association with the safety injection pumps. The combined performance of the accumulator system and the high-head injection system eliminate the need for a conventional low-head injection system.

High-Head Injection - The high head injection system consists of four independent divisions, each containing a safety injection pump and the associated valves, and piping. The safety injection pumps start automatically upon receipt of the ECCS actuation signal. Each safety injection pump receives power from the associated independent safety electrical bus.

The safety injection pumps are aligned to take suction from the RWSP and to deliver borated water to the safety injection nozzles on the reactor vessel. Two safety injection divisions are capable of meeting the design cooling function for a large break LOCA, assuming a single failure in one train and another train out of service for maintenance.

The RWSP in the containment provides a continuous borated water source for the safety injection pumps thus eliminating the conventional realignment from the refueling water storage tank to the containment sump.

Emergency Letdown - The emergency letdown system consists of two emergency letdown lines from the RCS hot legs to the refueling water storage pit. In the event that the normal CVCS letdown and boration capability is not available, the feed and bleed emergency letdown and boration operation can be utilized to achieve a cold shutdown boration level in the reactor coolant prior to the safe shutdown operation. The emergency letdown directs reactor coolant to the refueling water storage pit. The safety injection pumps provide borated coolant to the RCS from the refueling water storage pit.

Containment pH control - Twenty three NaTB baskets containing NaTB as a buffer agent are located inside three NaTB basket containers at an elevation that is below the lowest spray ring. NaTB in basks is dissolved in spray water in the containers. The solution containing NaTB is discharged from each container to the RWSP through NaTB solution transfer pipe.

RWSP ECC/CS suction strainers – Each quadrant of the RWSP is equipped with an ECC/CS suction strainer with the following design features:

- protection from the dynamic effects of high-energy line breaks
- strainer corrosion resistance
- strainer surface area
- strainer perforated plate maximum hole diameter

- strainer location at lower elevations in containment to maintain submergence during a design basis accident

The four suction strainers are designed to maintain adequate NPSH and minimize downstream effects to support ECC/CS functions, maintaining the reactor core in a long- term coolable geometry and supporting decay heat removal following a design basis accident.

Insulation and coatings inside containment are consistent with the design basis evaluations of ECC/CS suction strainer performance.

RWSP replenishment function - The RWSP is equipped with transfer piping and refueling cavity drain piping to serve to the replenishment functions necessary for the ECCS to perform its safety function.

Seismic and ASME Code Classifications

The seismic classification of ECCS components is identified in Table 2.4.4-2. System components so identified in Table 2.4.4-2 are designed and constructed to ASME Code Section III requirements.

All surfaces of the ECCS components and piping in contact with borated reactor coolant are austenitic stainless steel. The accumulator vessels are formed of carbon steel with stainless steel cladding on their internal surfaces. The pressure boundary welds in ASME Code Section III components and piping meet ASME Code Section III requirements.

System Operation

Accumulator and high head injection system operation following an accident is addressed under key design features, as is the operation of the emergency letdown system to achieve a cold shutdown RCS boron level.

Alarms, Displays, and Controls

Table 2.4.4-4 identifies alarms, displays, and controls associated with the ECCS that are located in the main control room.

Logic

Each four safety injection pump automatically starts on receipt of an ECCS actuation signal.

Interlocks

A confirmatory-open interlock is provided to automatically open the accumulator discharge valves upon the receipt of an ECCS actuation or an above low pressureizer pressure (P11) setpoint signal to ensure that the valves are opened.

Class 1E Electrical Power Sources and Divisions

The ECCS equipment identified in Table 2.4.4-2 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

The Class 1E equipment identified in Table 2.4.4-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITAAC acceptance criteria in Table 2.4.4-5. Key parameters of the ECCS design that are used in the safety analysis and which are included in the Table 2.4.4-5 are activation of the ECCS and its ability to deliver water to cool the reactor.

2.4.4.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4.4-5 describes the ITAAC for the ECCS.

The ITAAC associated with the ECCS equipment, components, and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.4.4-1 Emergency Core Cooling System Location of Equipment and Piping

System and Components	Location
ECC/CS Suction Strainers	Containment
Safety injection pumps	Reactor Building
Accumulators	Containment
Refueling Water Storage Pit	Containment
NaTB Baskets	Containment
NaTB Basket Containers	Containment
Safety injection piping and valves between the direct vessel injection penetration and including the check valve SIS-VLV-012 A, B, C, D upstream of the direct vessel injection penetration	Containment
Safety injection piping and valves upstream of and excluding the check valve SIS-VLV-012A,B,C,D upstream of the direct vessel injection penetration	Containment and Reactor Building
Hot leg injection piping downstream of and including the motor operated valves SIS-MOV-014 A ,B, C, D	Containment
Hot leg injection piping upstream of but excluding the motor operated valves SIS-MOV-014 A, B, C, D	Containment
Accumulator piping and valves on the RCS side of and including the check valves SIS-VLV-102 A, B, C, D	Containment
Accumulator piping and valves on the accumulator side of but excluding the check valves SIS-VLV-102 A, B, C, D	Containment
Emergency letdown isolation valves SIS-MOV-031B, 031D, 032B, 032D and piping between valves	Containment
Accumulator nitrogen vent piping up and including valves SIS-VLV-114, SIS-MOV-121A,B	Containment and Reactor Building
NaTB solution transfer piping	Containment
RWSP transfer piping	Containment
Refueling cavity drain piping	Containment

Table 2.4.4-2 Emergency Core Cooling System Equipment Characteristics (Sheet 1 of 4)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
ECC/CS Strainers	SIS-SST-001 A, B, C, D	-	Yes	-	-/-	-	-	-
Safety Injection Pumps	SIS-MPP-001 A, B, C, D	2	Yes	-	Yes/No	ECCS Actuation	Start	-
Accumulators	SIS-MTK-001 A, B, C, D	2	Yes	-	-	-	-	-
Refueling Storage Water Pit	RWS-MCT-001	-	Yes	-	-	-	-	-
NaTB Baskets	PHS-MEQ-001A~Y	-	Yes	-	-	-	-	-
NaTB Basket Containers	PHS-MTK-001A,B,C	2	Yes	-	-	-	-	-
Safety Injection Pump Suction Isolation Valves	SIS-MOV-001 A, B, C, D	2	Yes	Yes	Yes/ Yes	Remote Manual	Transfer Closed	As Is
Safety Injection Pump Discharge Containment Isolation Valves	SIS-MOV-009 A, B, C, D	2	Yes	Yes	Yes/ No	Remote Manual	Transfer Closed	As Is
Safety Injection Pump Discharge Containment Isolation Check Valves	SIS-VLV-010 A, B, C, D	2	Yes	-	-/-	-	Transfer Open/ Transfer Closed	-

Table 2.4.4-2 Emergency Core Cooling System Equipment Characteristics (Sheet 2 of 4)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Direct Vessel Safety Injection Line Isolation Valves	SIS-MOV-011 A, B, C, D	2	Yes	Yes	Yes/ Yes	Remote Manual	Transfer Closed	As Is
Hot Leg Injection Isolation Valves	SIS-MOV-014 A, B, C, D	1	Yes	Yes	Yes/ Yes	Remote Manual	Transfer Open	As Is
Hot Leg Injection Check Valves	SIS-VLV-015 A, B, C, D	1	Yes	-	-/-	-	Transfer Open	-
Accumulator Discharge Valves	SIS-MOV-101 A, B, C, D	2	Yes	Yes	Yes/ Yes	ECCS Actuation, Above Low Pressureizer Pressure (P11) Setpoint	Transfer Open	As Is
						Remote Manual	Transfer Closed	
Accumulator Nitrogen Supply Line Isolation Valves	SIS-MOV-125 A, B, C, D	2	Yes	Yes	Yes/ Yes	Remote Manual	Transfer Open	As Is
Accumulator Nitrogen Discharge Valves	SIS-MOV-121 A, B	2	Yes	Yes	Yes/ Yes	Remote Manual	Transfer Open	As Is
Accumulator Nitrogen Supply Containment Isolation Valve	SIS-AOV-114	2	Yes	Yes	Yes/No	Containment Isolation	Transfer Closed	Closed

Table 2.4.4-2 Emergency Core Cooling System Equipment Characteristics (Sheet 3 of 4)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Accumulator Nitrogen Supply Containment Isolation Check Valve	SIS-VLV-115	2	Yes	-	-/-	-	Transfer Closed	-
Accumulator Injection Line 1st Check Valves	SIS-VLV-102 A, B, C, D	1	Yes	No	-	-	Transfer Open	-
Accumulator Injection Line 2nd Check Valves	SIS-VLV-103 A, B, C, D	1	Yes	No	-	-	Transfer Open	-
Direct Vessel Injection Line 1st Check Valves	SIS-VLV-012 A, B, C, D	1	Yes	No	-	-	Transfer Open	-
Direct Vessel Injection Line 2nd Check Valves	SIS-VLV-013 A, B, C, D	1	Yes	No	-	-	Transfer Open	-
Emergency Letdown Line 1st Isolation Valves	SIS-MOV-031 A, D	1	Yes	Yes	Yes/ Yes	Remote Manual	Transfer Open/ Transfer Closed	As Is
Emergency Letdown Line 2nd Isolation Valves	SIS-MOV-032 A, D	1	Yes	Yes	Yes/ Yes	Remote Manual	Transfer Open/ Transfer Closed	As Is

Table 2.4.4-2 Emergency Core Cooling System Equipment Characteristics (Sheet 4 of 4)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Safety Injection Pump Discharge Check Valves	SIS-VLV-004 A,B,C,D	2	Yes	No	—	—	Transfer Open	—
Safety Injection Pump Minimum Flow	SIS-FT-072, 073, 074, 075	—	Yes	—	Yes/No	—	—	—
Accumulator Water Level	SIS-LT-010, 020, 030,040	—	Yes	—	Yes/Yes	—	—	—
Accumulator Pressure	SIS-PT-010, 020, 030, 040	—	Yes	—	Yes/Yes	—	—	—
Safety Injection Pump Suction Pressure	SIS-PT-060, 061, 062, 063	—	Yes	—	Yes/No	—	—	—
Safety Injection Pump Discharge Pressure	SIS-PT-064, 065, 066, 067	—	Yes	—	Yes/No	—	—	—
Refueling Water Storage Pit Water Level	RWS-LT-010, 011, 012, 013	—	Yes	—	Yes/Yes	—	—	—
Safety Injection Pump Discharge Flow	SIS-FT-062, 063, 064, 065	—	Yes	—	Yes/No	—	—	—

NOTE:
Dash (-) indicates not applicable

Table 2.4.4-3 Emergency Core Cooling System Piping Characteristics

Pipe Line Name	ASME Code Section III Class	Leak Before Break	Seismic Category I
SI piping and valves between the DVI penetration and including the check valve SIS-VLV-012 A, B, C, D upstream of the DVI penetration	1	No	Yes
SI piping and valves upstream of and excluding the check valve SIS-VLV-012 A, B, C, D upstream of the DVI penetration	2	No	Yes
Hot leg injection piping downstream of and including the 4 motor operated valves SIS-MOV-014 A, B, C, D	1	No	Yes
Hot leg injection piping upstream of but excluding the 4 motor operated valves SIS-MOV-014 A, B, C, D	2	No	Yes
Accumulator piping and valves on the RCS side of and including the check valves SIS-VLV-102 A, B, C, D	1	Yes	Yes
Accumulator piping and valves on the accumulator side of but excluding the check valves SIS-VLV-102 A, B, C, D	2	No	Yes
Emergency letdown isolation valves SIS-MOV-031A, 031D, 032A, 032D and piping between valves	1	No	Yes
Accumulator nitrogen vent piping up and including valves SIS-AOV-114, SIS-MOV-121A,B	2	No	Yes
NaTB solution transfer piping	2	No	Yes
RWSP transfer piping	2	No	Yes
Refueling cavity drain piping	2	No	Yes

Table 2.4.4-4 Emergency Core Cooling System Equipment, Alarms, Displays and Control Functions (Sheet 1 of 2)

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Safety Injection Pumps (SIS-MPP-001A,B,C,D)	No	Yes	Yes	Yes
Safety Injection Pump Suction Isolation Valves (SIS-MOV-001A,B,C,D)	No	Yes	Yes	Yes
Safety Injection Pump Discharge Containment Isolation Valves (SIS-MOV-009A,B,C,D)	No	Yes	Yes	Yes
Direct Vessel Safety Injection Line Isolation Valves (SIS-MOV-011A,B,C,D)	No	Yes	Yes	Yes
Hot Leg Injection Isolation Valves (SIS-MOV-014A,B,C,D)	No	Yes	Yes	Yes
Emergency Letdown Line 1st, 2nd Isolation Valves (SIS-MOV-031A,D and 032A,D)	No	Yes	Yes	Yes
Accumulator Discharge Valves (SIS-MOV-101A,B,C,D)	Yes	Yes	Yes	Yes
Accumulator Nitrogen Supply Line Isolation Valves (SIS-MOV-125A,B,C,D)	No	Yes	Yes	Yes
Accumulator Nitrogen Discharge Valves (SIS-MOV-121A,B,C,D)	No	Yes	Yes	Yes
Safety Injection Pump Discharge Flow (SIS-FT-062,063,064,065)	No	Yes	No	Yes
Safety Injection Pump Minimum Flow (SIS-FT-072,073,074,075)	No	Yes	No	Yes
Safety Injection Pump Discharge pressure (SIS-PT-064,065,066,067)	No	Yes	No	Yes
Safety Injection Pump Suction pressure (SIS-PT-060,061,062,063)	No	Yes	No	Yes

Table 2.4.4-4 Emergency Core Cooling System Equipment, Alarms, Displays and Control Functions (Sheet 2 of 2)

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Accumulator Pressure (SIS-PT-010, 020,030,040)	Yes	Yes	No	Yes
Accumulator Water Level (SIS-LT-010,020,030,040)	Yes	Yes	No	Yes
Refueling Water Storage Pit Water Level (RWS-LT-010,011,012,013)	Yes(1)	Yes	No	Yes
Accumulator Nitrogen Supply Containment Isolation valve (SIS-AOV-114)	No	Yes	Yes	Yes

NOTE:
1. Alarm function is not required for “RWS-LT-010” and “RWS-LT-012”.

Table 2.4.4-5 Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 10)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a The functional arrangement of the ECCS is as described in Subsection 2.4.4.1 Design Description and as shown in Figure 2.4.4-1.	1.a An Inspection of the as-built system will be performed.	1.a The as-built ECCS conforms to the functional arrangement as described in the Design Description of this Subsection 2.4.4.1 and as shown in Figure 2.4.4-1.
1.b Each mechanical division of the ECCS (Divisions A, B, C & D) is physically separated from the other divisions with the exception of inside the containment.	1.b Inspections of the as-built ECCS will be performed.	1.b Each mechanical division of the as-built ECCS is physically separated from other mechanical divisions of the system by structural barriers with the exception of inside the containment.
2.a.i The ASME Code Section III components of the ECCS, identified in Table 2.4.4-2 are fabricated, installed and inspected in accordance with ASME Code Section III requirements.	2.a.i An inspection of the as-built ASME Code Section III components of the ECCS will be performed.	2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the ECCS identified in Table 2.4.4-2 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.a.ii The ASME Code Section III components of the ECCS identified in Table 2.4.4-2 are reconciled with the design requirements.	2.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the ECCS identified in Table 2.4.4-2 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.

Table 2.4.4-5 Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 10)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.b.i The ASME Code Section III piping of the ECCS, including supports, identified in Table 2.4.4-3, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.b.i An inspection of the as-built ASME Code Section III piping of the ECCS, including supports, will be performed.	2.b.i The ASME Code Section III data report(s) (certified when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the ECCS, including supports, identified in Table 2.4.4-3 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.b.ii The ASME Code Section III piping of the ECCS, including supports, identified in Table 2.4.4-3 are reconciled with the design requirements.	2.b.ii A reconciliation analysis of the piping of the ECCS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.b.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the ECCS, including supports, identified in Table 2.4.4-3 is reconciled with the design requirements. The report documents the results of the reconciliation analysis.

Table 2.4.4-5 Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 10)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.4.4-2, meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
3.b Pressure boundary welds in ASME Code Section III piping, identified in Table 2.4.4-3, meet ASME Code Section III requirements for non-destructive examination of welds.	3.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of as-built pressure boundary welds.
4.a The ASME Code Section III components, identified in Table 2.4.4-2, retain their pressure boundary integrity at their design pressure.	4.a A hydrostatic test will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	4.a The results of the hydrostatic test of the as-built components identified in Table 2.4.4-2 as ASME Code Section III conform with the requirements of the ASME Code Section III.
4.b The ASME Code Section III piping, identified in Table 2.4.4-3, retains its pressure boundary integrity at its design pressure.	4.b A hydrostatic test will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the hydrostatic test of the as-built piping identified in Table 2.4.4-3 as ASME Code Section III conform with the requirements of the ASME Code Section III.
5.a The seismic Category I equipment, identified in Table 2.4.4-2, is designed to withstand seismic design basis loads without loss of safety function.	5.a.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.4.4-2 is located in the containment and reactor building.	5.a.i The seismic Category I as-built equipment identified in Table 2.4.4-2 is located in the containment and reactor building.
	5.a.ii Type tests and/or analyses of seismic Category I equipment will be performed.	5.a.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.a.iii Inspections will be performed on the as-built equipment including anchorage.	5.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.

Table 2.4.4-5 Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 10)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5.b Each of the seismic Category I piping, including supports, identified in Table 2.4.4-3 is designed to withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table 2.4.4-3 are supported by a seismic Category I structure(s).	5.b.i Reports(s) document that each of the as-built seismic Category I piping, including supports, identified in Table 2.4.4-3 is supported by a seismic Category I structure(s).
	5.b.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, identified in Table 2.4.4-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, identified in Table 2.4.4-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.
6.a The Class 1E equipment identified in Table 2.4.4-2 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.a.i Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	6.a.i The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.4.4-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	6.a.ii Inspections will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.4.4-2 as being qualified for a harsh environment are bounded by type tests and/or analyses.

Table 2.4.4-5 Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 10)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6.b The Class 1E equipment, identified in Table 2.4.4-2, is powered from their respective Class 1E division.	6.b A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.4.4-2 under test.
6.c Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	6.c Inspections of the as-built Class 1E divisional cables will be performed.	6.c Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.
7.a Deleted.	7.a Deleted.	7.a Deleted.
7.b The ECCS provides RCS makeup, boration, and safety injection during design basis events.	7.b.i.a Injection test with low tank pressure condition for each as-built accumulator will be conducted. The test will be initiated by opening isolation valve(s) in the piping being tested. Each as-built accumulator will be partially filled with water and pressurized with nitrogen. All valves in these lines will be open during the test.	7.b.i.a The total water volume injected from each as-built accumulator into reactor vessel is ≥2126 ft^3. The water volume injected from each accumulator into reactor vessel at large flow rate (prior to flow switching to small flow rate) is ≥1326.8 ft^3.
	7.b.i.b An analysis will be performed to calculate the resistance coefficients of the as-built accumulator system.	7.b.i.b The calculated resistance coefficients of the as-built accumulator system (based on a cross-section area of 0.6827 ft^2) meet the requirements shown in Table 2.4.4-6.
	7.b.ii The as-built safety injection pump injection test will be performed. Analysis will be performed to convert the test results from the test conditions to the design condition.	7.b.ii Each as-built safety injection pump has a pump differential head of no less than 3937 ft and no more 4527 ft at the minimum flow, and injects no less than 1259 gpm and no more than 1462 gpm of RWSP water into the reactor vessel at atmospheric pressure.

Table 2.4.4-5 Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 10)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7.b The ECCS provides RCS makeup, boration, and safety injection during design basis events.	7.b.iii Inspections of each as-built accumulator and the RWSP will be conducted.	7.b.iii The volume of each is as follows: Each as-built accumulator: at least 3,180 ft^3 As-built RWSP: at least 81,230 ft^3
	7.b.iv An inspection for the existence of a report for the as-built ECC/CS suction strainers will be conducted.	7.b.iv A report exists and concludes that each of the four as-built ECC/CS suction strainers have the following features: stainless steel materials of construction for corrosion resistance; a minimum strainer surface area of 3510 square feet; perforated plate with maximum hole diameter of 0.066 inches; remains submerged under design basis; accident conditions minimizes head loss consistent with design basis NPSH evaluations for ECC/CS; minimizes downstream effects to maintain the reactor core in a long term coolable geometry and support decay heat removal following a design basis accident.
	7.b.v An inspection for the existence of a report for the as-built coatings used in the containment will be conducted.	7.b.v A report exists and concludes the as-built coatings used in the containment are DBA-qualified and are consistent with the ECC/CS suction strainer debris generation, debris transport and downstream effects evaluations.

Table 2.4.4-5 Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 7 of 10)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7.b The ECCS provides RCS makeup, boration, and safety injection during design basis events.	7.b.vi An inspection for the existence of a report for the as-built insulation used in the containment will be conducted	7.b.vi A report exists and concludes that the as-built insulation in containment meets the following criteria: Reflective metal insulation (RMI) is used for the as-built reactor coolant loop (RCL) piping and main steam / feedwater (MS/FW) piping inside containment, and is consistent with design basis evaluations of suction strainer performance and downstream effects. Fibrous insulation is minimized and is consistent with design basis evaluations of suction strainer performance and downstream effects.

Table 2.4.4-5 Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 8 of 10)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7.c The ECCS provides pH adjustment of water flooding the containment following design basis accidents.	7.c Inspections of the as-built NaTB baskets will be conducted.	7.c The as-built NaTB baskets exist, with a total calculated weight of NaTB of 44,100 pounds. The as-built NaTB baskets are located below plant elevation 131 ft, 6 in.
7.d The safety injection pumps have sufficient net positive suction head (NPSH).	7.d Tests to measure the as-built safety injection pump suction pressure will be performed. Inspections and analysis to determine NPSH available to each safety injection pump will be performed. The analysis will consider the effects of: - pressure losses for pump inlet piping and components, - pressure losses for pump suction strainers due to debris blockage, - suction from the RWSP water level at the minimum value, - vendor test results of required NPSH.	7.d The as-built system meets the design, and the analysis confirms that the NPSH available is at least 21.9 feet at 1540 gpm.
8. Controls exist in the MCR to open and close the remotely operated valves identified in Table 2.4.4-2.	8. Tests will be performed on the as-built remotely operated valves listed in Table 2.4.4-2 using controls in the as-built MCR.	8. Controls exist in the as-built MCR to open and close the as-built remotely operated valves listed in Table 2.4.4-2.

Table 2.4.4-5 Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 9 of 10)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9.a The motor-operated, air-operated and check valves, identified in Table 2.4.4-2, perform an active safety function to change position as indicated in the table.	9.a.i Tests or type tests of motor-operated and air operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	9.a.i Each motor-operated and air operated valve changes position as indicated in Table 2.4.4-2 under design conditions.
	9.a.ii Tests of the as-built motor-operated and air operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	9.a.ii Each as-built motor-operated and air operated valve changes position as indicated in Table 2.4.4-2 under pre-operational test conditions.
	9.a.iii Tests of the as-built check valves with active safety functions identified in Table 2.4.4-2 will be performed under pre-operational test pressure, temperature, and fluid flow conditions.	9.a.iii Each as-built check valve changes position as indicated in Table 2.4.4-2.
9.b After loss of motive power, the remotely operated valves, identified in Table 2.4.4-2, assume the indicated loss of motive power position.	9.b. Tests of the as-built valves will be performed under the conditions of loss of motive power.	9.b Upon loss of motive power, each as-built remotely operated valve identified in Table 2.4.4-2 assumes the indicated loss of motive power position.
10.a Controls exist in the MCR to start and stop the pumps identified in Table 2.4.4-4.	10.a Tests will be performed on the as-built pumps in Table 2.4.4-4 using controls in the as-built MCR.	10.a Controls exist in the as-built MCR to start and stop the as-built pumps listed in Table 2.4.4-4.
10.b The pumps identified in Table 2.4.4-4 start after receiving an ECCS actuation signal.	10.b Tests will be performed using a simulated signal.	10.b The as-built pumps identified in Table 2.4.4-4 start after receiving a simulated signal.
10.c A confirmatory-open interlock is provided to automatically open the accumulator discharge valve upon the receipt of an ECCS actuation signal or an above low pressureizer pressure (P11) setpoint signal.	10.b Tests will be performed using simulated signal.	10.b The as-built accumulator discharge valve automatically opens upon the receipt of simulated signal.

Table 2.4.4-5 Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 10 of 10)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
11. MCR alarms and displays of the parameters identified in Table 2.4.4-4 can be retrieved in the MCR.	11. Inspections will be performed for retrievability of the ECCS parameters in the as-built MCR.	11. MCR alarms and displays identified in Table 2.4.4-4 can be retrieved in the as-built MCR.
12. RSC alarms, displays and controls are identified in Table 2.4.4-4.	12. Inspections of the as-built RSC alarms, displays and controls will be performed.	12. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.4.4-4.
13. Each of the as-built piping identified in Table 2.4.4-3 as designed for LBB meets the LBB criteria, or an evaluation is performed of the protection from the dynamic effects of a rupture of the line.	13. Inspections of the as-built piping will be performed based on the evaluation report for LBB or the protection from dynamic effects of a pipe break, as specified in Section 2.3.	13. The LBB acceptance criteria are met by the as-built piping and pipe materials, or the protection is provided for the dynamic effects of the piping break.
14.a The materials of construction of the ASME Code Section III, Class 1 components, identified in Table 2.4.4-2, are in accordance with ASME Code requirements.	14.a Inspection of the certified material test reports will be performed.	14.a The materials of construction of the ASME Code Section III, Class 1 components identified in Table 2.4.4-2 conform to the requirements of the ASME Code.
14.b The materials of construction of the ASME Code Section III, Class 1 piping, identified in Table 2.4.4-3, are in accordance with ASME Code requirements.	14.b Inspection of the certified material test reports will be performed.	14.b The materials of construction of the ASME Code Section III, Class 1 piping identified in Table 2.4.4-3 conform to the requirements of the ASME Code.

Table 2.4.4-6 Requirement for Accumulator System Resistance Coefficient

Operation mode	Resistance coefficient (based on a cross-section area of 0.6827 ft^2)
Large flow injection	$\geq \frac{1}{[x\{0.7787 - 0.6889\exp(-0.5238\sigma_V)\}]^2} + 461.7f + 1.99$ $\leq \frac{1}{[y\{0.7787 - 0.6889\exp(-0.5238\sigma_V)\}]^2} + 564.3f + 2.21$ Where σ_V :cavitation factor $x = 1 + \frac{\text{uncertaity}(\%)}{100}$ $y = 1 - \frac{\text{uncertaity}(\%)}{100}$ f : friction factor of piping
Small flow injection	$\geq \frac{1}{[x\{0.07197 - 0.01904\exp(-6.818\sigma_V)\}]^2} + 461.7f + 1.99$ $\leq \frac{1}{[y\{0.07197 - 0.01904\exp(-6.818\sigma_V)\}]^2} + 564.3f + 2.21$ Where σ_V :cavitation factor $x = 1 + \frac{\text{uncertaity}(\%)}{100}$ $x = 1 - \frac{\text{uncertaity}(\%)}{100}$ f : friction factor of piping

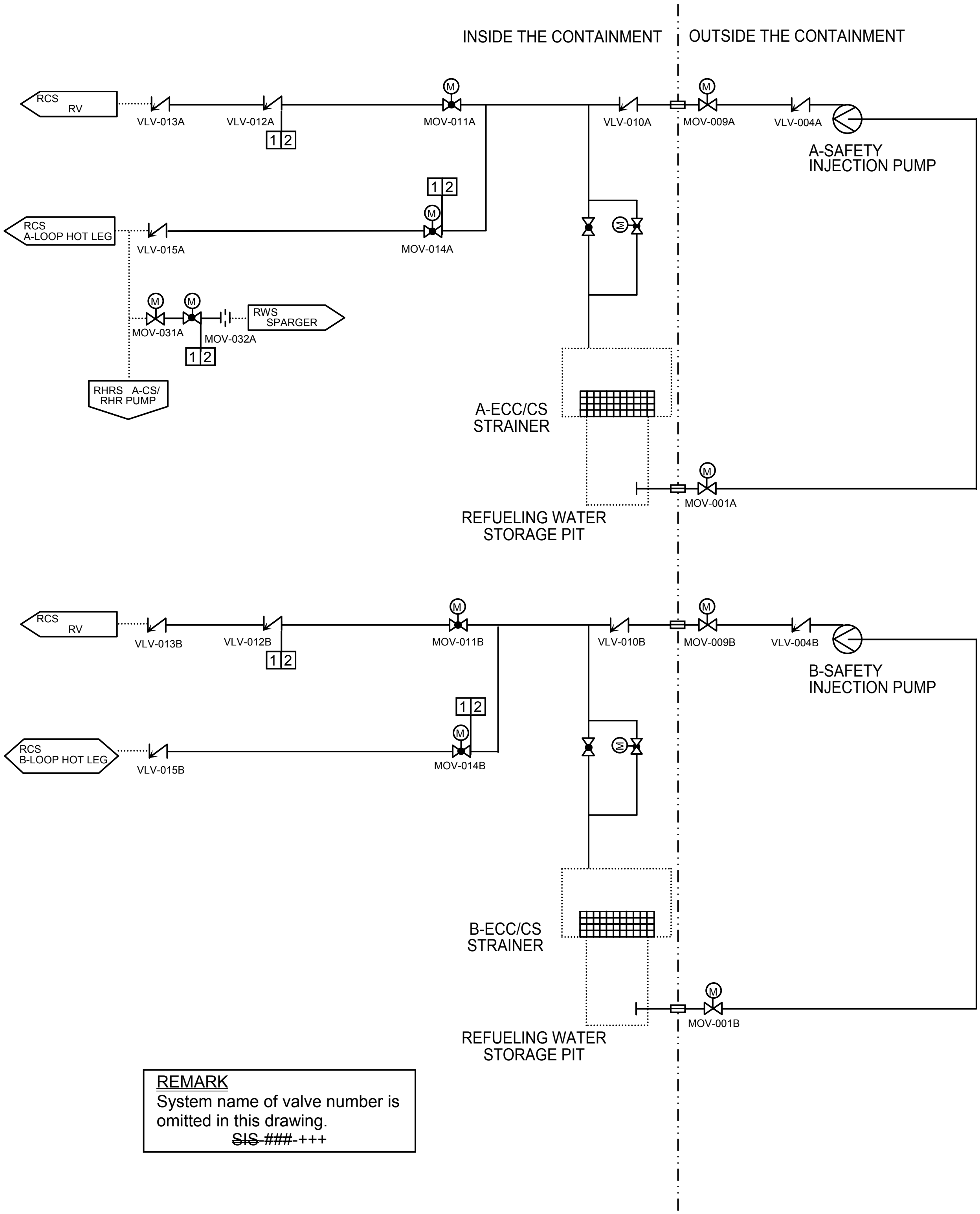


Figure 2.4.4-1 Emergency Core Cooling System (Sheet 1 of 4)

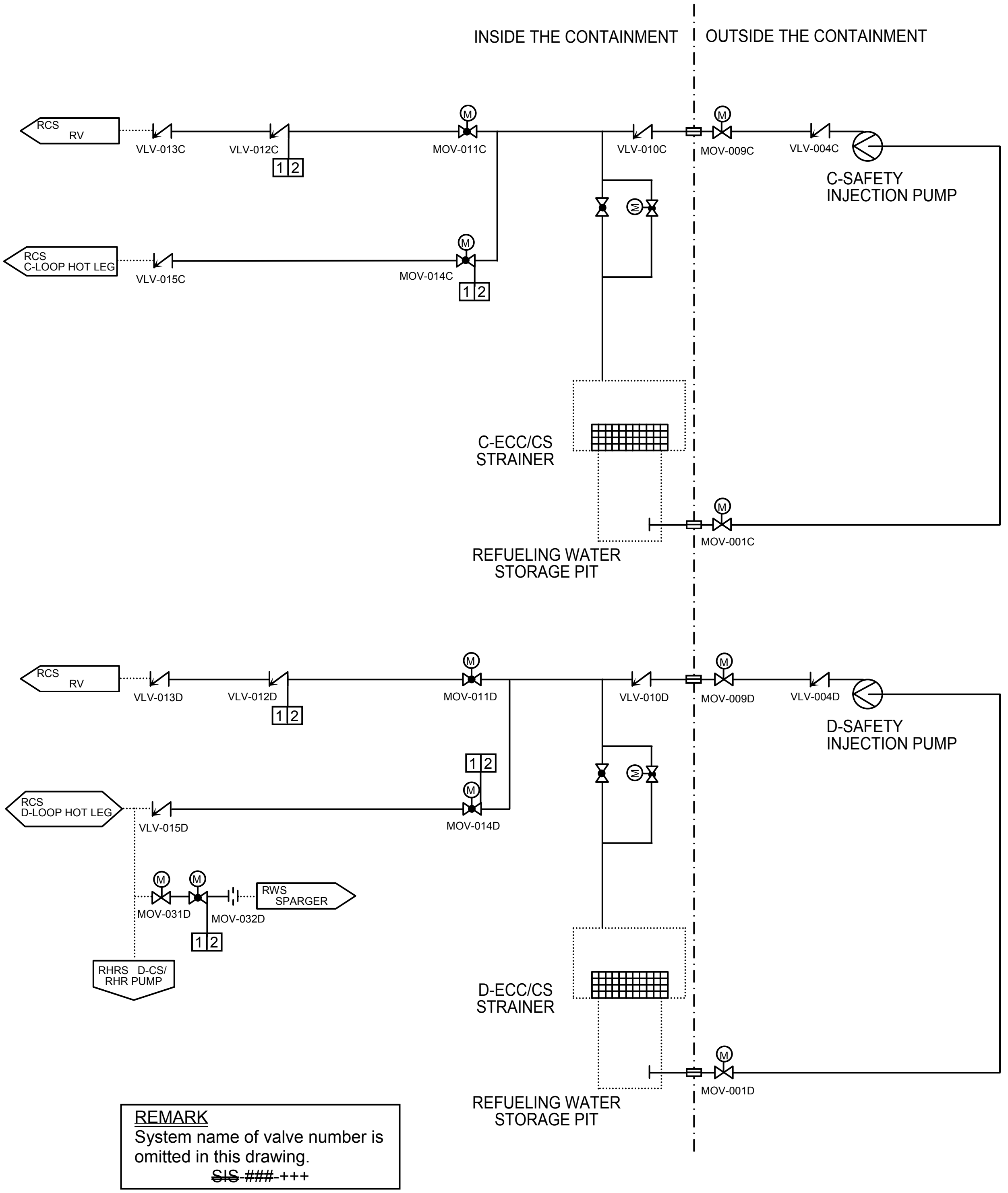


Figure 2.4.4-1 Emergency Core Cooling System (Sheet 2 of 4)

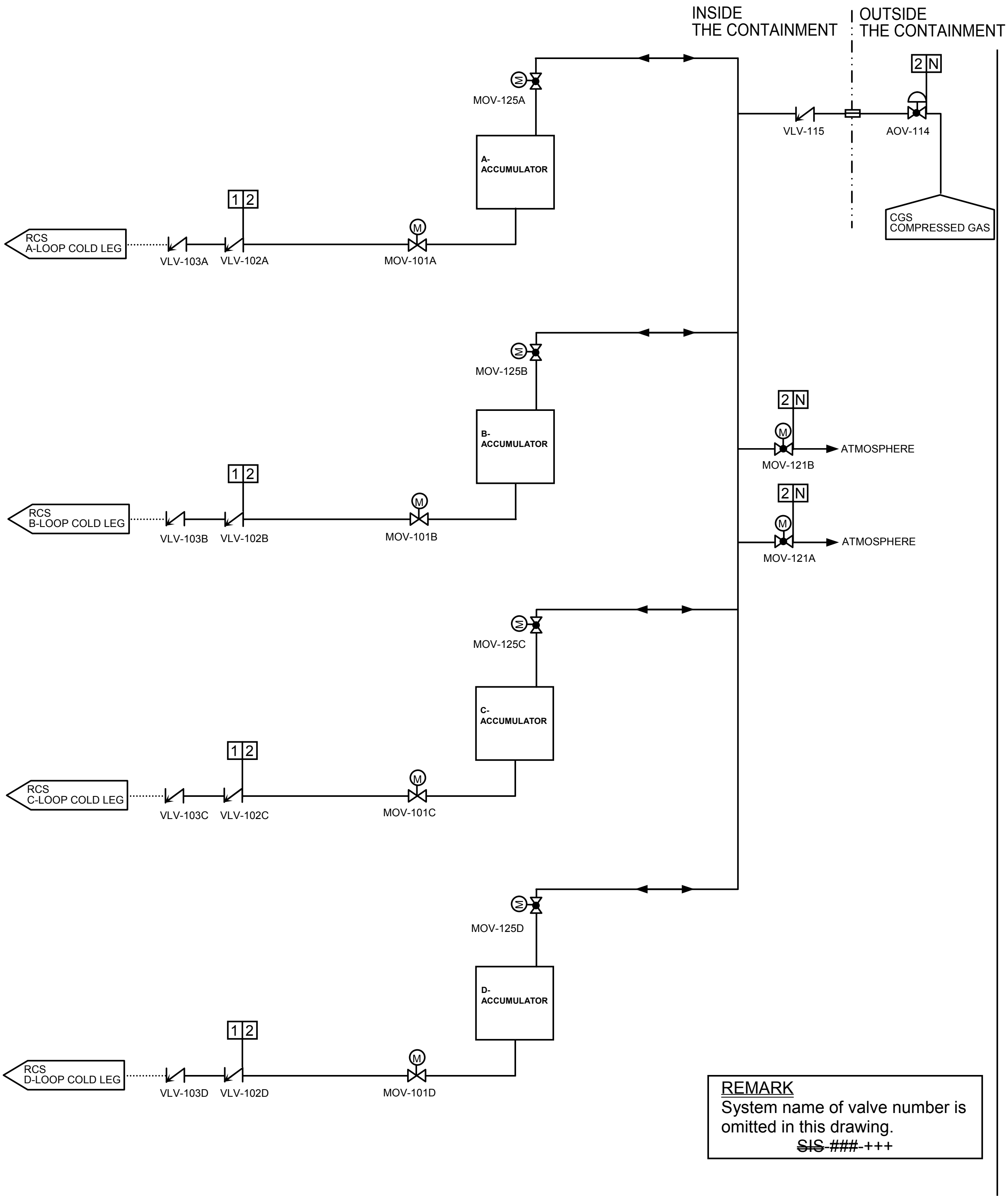


Figure 2.4.4-1 Emergency Core Cooling System (Sheet 3 of 4)

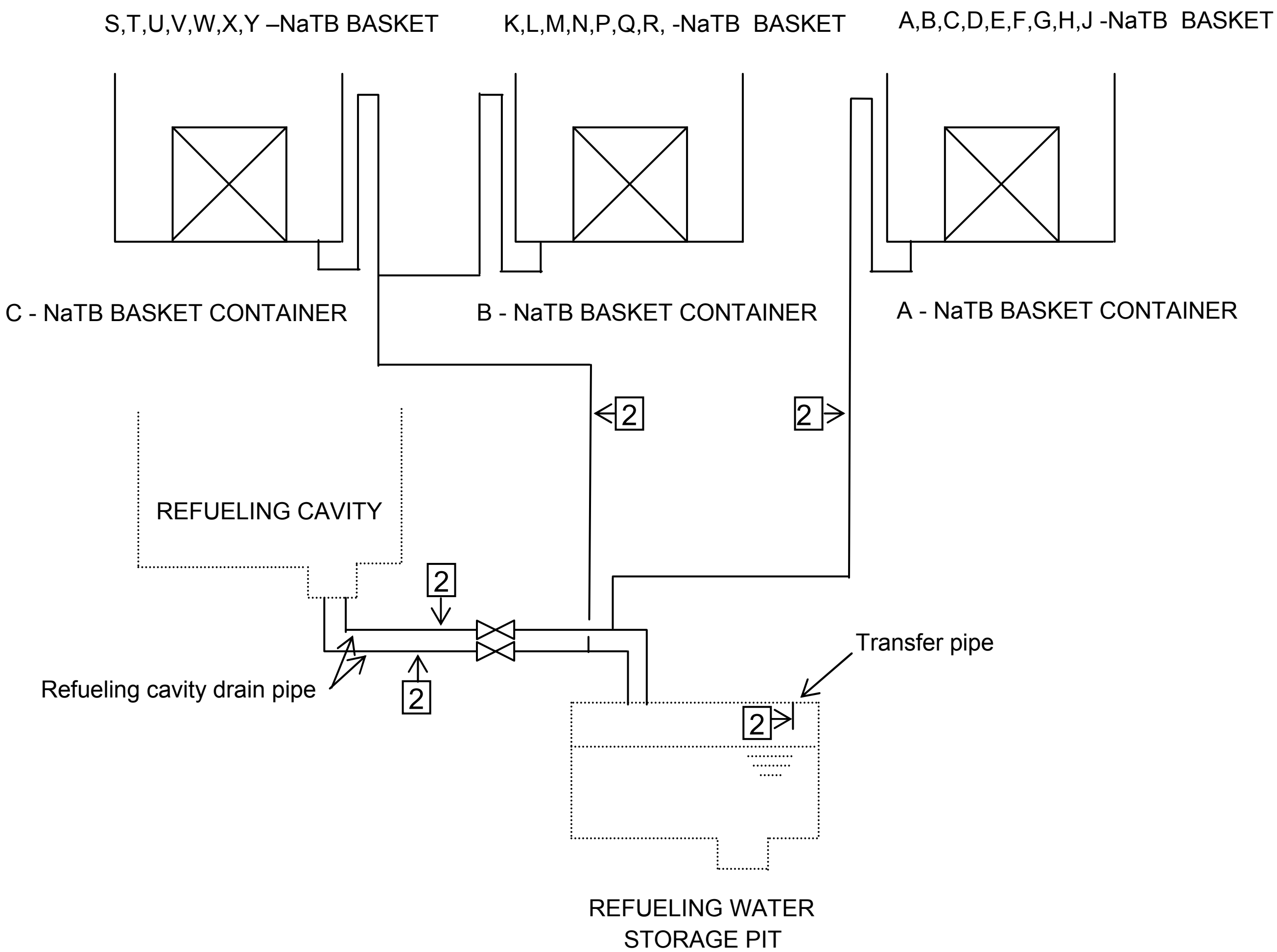


Figure 2.4.4-1 Emergency Core Cooling System (Sheet 4 of 4)

2.4.5 Residual Heat Removal System

2.4.5.1 Design Description

System Purpose and Functions

The RHRS is designed to cool the reactor by removing decay heat and other residual heat from the reactor core and the RCS during the plant shutdown and cooldown condition via the CCWS.

The RHRS is a safety-related system. Portions of the RHRS (i.e., heat exchangers and pumps) are shared with the containment spray system (CSS).

The RHRS has the following safety functions:

- The RHRS is designed to cool the reactor by removing fission product decay heat and other residual heat from the reactor core and the RCS after the initial phase of the normal plant shutdown and cooldown. During the initial phase of cooldown, the heat is transferred from the RCS through the steam generators (SGs).

- The RHRS is designed to ensure that the reactor core decay heat and other residual heat are safely removed from the reactor with four independent subsystems. Any two of the four subsystems have a 100% capability for safe shutdown.

- Each containment spray/residual heat removal (CS/RHR) pump receives electrical power from safety buses so that the RHRS safety functions are maintained during a loss of offsite power.

- Each CS/RHR pump and isolation valve of one division is connected independent from other electrical divisions so that the RHRS safety functions are maintained during a single failure of an electrical division. This design prevents the loss of two or more trains during an electrical failure.

- The RHRS provides the containment isolation function, as described in Section 2.11.2, for the piping that penetrates the containment.

RHRS non-safety functions are identified below under key design features.

Location and Functional Arrangement

The location and functional arrangement of RHRS equipment and piping is shown on Figure 2.4.5-1. Table 2.4.5-1 also provides a tabulation of the location of RHRS equipment. All major equipment of the RHRS are located within the reactor building, while the piping and valves of the RHRS are located within both the reactor building and the containment.

As shown in Figure 2.4.5-1, the RHRS consists of four independent subsystems, with each CS/RHR pump taking suction from one of the RCS hot legs by a separate suction line. The pumps then discharge the reactor coolant through the CS/RHR heat exchangers, which transfers heat from the hot reactor coolant fluid to the CCWS circulating through the shell side of the CS/RHR heat exchangers. The cooled reactor coolant is then returned to the RCS cold legs.

Key Design Features

The key design features of the RHRS are reflected in the system design bases, which include:

- The RHRS is designed to provide a portion of the RCS flow to the CVCS during normal plant startup and cooldown operations to control RCS pressure.

- The RHRS is designed to transfer borated water from the RWSP to the refueling cavity at the beginning of a refueling operation.

- The RHRS is designed to provide cooling for the in-containment RWSP during normal plant operations when required. The system is manually initiated by the operator. The RHRS limits the in-containment RWSP water temperature to not greater than 120° F during normal operation.

- The RHRS is designed and equipped with pressure relief valves to prevent RCS low temperature over-pressurization transients condition, loss of equipment and possible operator error, during plant startup, shutdown, and cold shutdown decay heat-removal.

- The RHRS is designed for a single nuclear power unit and is not shared between units.

- The RHRS divisions are supplied by separate Class 1E electrical divisions thereby being operationally independent of the each other

- The RHRS is designed to be fully operable by the control room operator.

- The RHRS is designed to be operated during mid-loop or drain down operation to allow maintenance or inspection of the reactor head, SG, and reactor coolant pump seals.

- There are no motor-operated valves in the RHRS that are subject to flooding following a secondary side break or a LOCA.

- The CS/RHR pumps are protected from overheating and loss of suction flow against shutoff operation by minimum flow lines that ensure flow to the pump suction.

- The RHRS is designed for protection against missiles, protection against dynamic effects associated with the postulated rupture of piping and pipe whipping, discharging fluids inside and outside the containment, fires, loss-of-coolant accidents loads, and seismic effects.
- The RHRS is designed to provide containment isolation of the piping penetrating the containment.
- Each mechanical division of the RHRS is physically separated from the other divisions by a structural barrier, which also serves as a fire barrier. The piping and components inside the containment are exceptions.
- The RHRS is used as an alternate core cooling / injection in case all safety injection system fails.

Seismic and ASME Code Classifications

The seismic classifications for system components are identified in Table 2.4.5-2. The ASME Code Section III requirements for system components are also identified in Table 2.4.5-2. Table 2.4.5-3 provides this information for system piping.

The materials used in the RCPB conform to the applicable ASME code rules. The welding materials used for joining RCPB materials conform to the requirements of the ASME Code Section III. Pressure boundary welds in ASME Code Section III components and piping meet ASME Code Section III requirements.

System Operation

As described under system purpose and functions and key design features, the RHRS is designed to operate during plant startup, normal power operation, plant shutdown and cooldown, and at the beginning of a refueling operation.

Alarms, Displays, and Controls

Table 2.4.5-4 identifies alarms, displays, and controls associated with the RHRS that are located in the main control room.

Logic

The RHRS is provided with isolation valves in each suction line with interlock capabilities to prevent them from being opened to the RCS above the pressure setpoint.

To prevent loss of RCS inventory during mid-loop operation, the low-pressure letdown line isolation valves are automatically closed and the CVCS is isolated from the RHRS, after receiving a RCS loop low-level signal.

Interlocks

The RHRS is provided with isolation valves in each pump suction and discharge line with interlock capabilities to prevent them from being opened to the RCS above the pressure setpoint. A second RHRS interlock is provided to preclude the simultaneous opening of both the RHRS and CSS discharge line valves.

Class 1E Electrical Power Sources and Divisions

The RHRS equipment identified in Table 2.4.5-2 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

The equipment identified in Table 2.4.5-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITAAC acceptance criteria in Table 2.4.5-5.

2.4.5.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4.5-5 describes the ITAAC for the RHRS. The ITAAC associated with those components shared with the CSS performing their containment spray functions are provided in Subsection 2.11.3.

The ITAAC associated with the RHRS equipment, components, and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.4.5-1 Residual Heat Removal System Location of Equipment and Piping

Equipment and Piping Name	Location
CS/RHR pumps	Reactor Building
CS/RHR heat exchangers	Reactor Building
RHRS suction piping and valves on the RCS side between the hot legs, up to and including the second motor operated valves	Containment
RHRS discharge piping and valves on the RCS side between the cold legs, up to and including the second check valves	Containment
RHRS piping and valves on the RHR side from and excluding the second motor operated valves to and excluding the second check valves	Containment and Reactor Building
All RHRS piping and valves not mentioned above up to and including the valves interfacing with systems of a lower classification.	Containment and Reactor Building

Table 2.4.5-2 Residual Heat Removal System Equipment Characteristics (Sheet 1 of 2)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
CS/RHR Pumps	RHS-MPP-001 A, B, C, D	2	Yes	-	Yes/-	Containment Spray Actuation	Start	-
CS/RHR Heat Exchangers - tube side	RHS-MHX-001 A, B, C, D	2	Yes	-	-/-	-	-	-
CS/RHR Heat Exchangers - CCW side		3	Yes	-	-/-	-	-	-
1st CS/RHR Pump Hot Leg Isolation Valves	RHS-MOV-001A, B, C, D	1	Yes	Yes	Yes/Yes	-	Transfer Closed/ Transfer Open	As Is
2nd CS/RHR Pump Hot Leg Isolation Valves	RHS-MOV-002A, B, C, D	1	Yes	Yes	Yes/Yes	-	Transfer Closed/ Transfer Open	As Is
CS/RHR Pump Suction Relief Valves	RHS-SRV-003A, B, C, D	2	Yes	No	-/-	-	-	-
CS/RHR Pump Suction Check Valves	RHS-VLV-004A, B, C, D	2	Yes	No	-/-	-	Transfer Open	-
RHR Discharge Line Containment Isolation Valves outside containment	RHS-MOV-021A, B, C, D	2	Yes	Yes	Yes/No	Remote Manual	Transfer Closed/ Transfer Open	As Is
RHR Discharge Line Containment Isolation Valves inside containment	RHS-VLV-022A, B, C, D	2	Yes	No	-/-	-	Transfer Open/ Transfer Closed	-

Table 2.4.5-2 Residual Heat Removal System Equipment Characteristics(Sheet 2 of 2)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
CS/RHR Pump Full-Flow Test Line Stop Valves	RHS-MOV-025A, B, C, D	2	Yes	Yes	Yes/Yes	Remote Manual	Transfer Open	As Is
RHR Flow Control Valves	RHS-MOV-026A, B, C, D	2	Yes	Yes	Yes/Yes	Remote Manual	Transfer Open	As Is
2nd RHR Discharge Line Check Valves	RHS-VLV-027A, B, C, D	1	Yes	No	-/-	-	Transfer Open	-
1st RHR Discharge Line Check Valves	RHS-VLV-028A, B, C, D	1	Yes	No	-/-	-	Transfer Open	-
Containment Spray / Residual Heat Removal Pump Discharge Flow	RHS-FT-011, 021, 031, 041	—	Yes	—	Yes/No	-	—	—
Containment Spray / Residual Heat Removal Pump Minimum Flow	RHS-FT-014, 024, 034, 044	—	Yes	—	Yes/No	-	—	—
Containment Spray / Residual Heat Removal Pump Suction Pressure	RHS-PT-010, 020, 030, 040	—	Yes	—	Yes/No	-	—	—
Containment Spray / Residual Heat Removal Pump Discharge Pressure	RHS-PT-011, 021, 031, 041	—	Yes	—	Yes/No	-	—	—
Containment Spray / Residual Heat Removal Heat Exchanger Outlet Temperature	RHS-TE-014, 024, 034, 044	—	Yes	—	Yes/No	-	—	—

NOTE:
Dash (-) indicates not applicable

Table 2.4.5-3 Residual Heat Removal System Piping Characteristics

Pipe Line Name	ASME Code Section III Class	Leak Before Break	Seismic Category I
RHRS suction piping and valves on the RCS side between the hot legs, up to and including the motor operated valves RHS-MOV-002 A, B, C, D	1	Yes	Yes
RHRS discharge piping and valves on the RCS side between the cold legs, up to and including the check valves RHS-VLV-027 A, B, C, D	1	Yes	Yes
RHRS piping and valves on the RHR side from and excluding the motor operated valves RHS-MOV-002 A, B, C, D to and excluding the second check valves	2	No	Yes
All RHRS piping and valves not mentioned above up to and including the valves interfacing with systems of a lower classification.	2	No	Yes

Table 2.4.5-4 Residual Heat Removal System Equipment Alarms, Displays, and Control Functions

Equipment Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
CS/RHR Pumps RHS-MPP-001A, B, C, D	No	Yes	Yes	Yes
1st and 2nd CS/RHR Pump Hot Leg Isolation Valves RHS-MOV-001A, B, C, D and -002A, B, C, D	Yes	Yes	Yes	Yes
RHR Discharge Line Containment Isolation Valves RHS-MOV-021A, B, C, D	No	Yes	Yes	Yes
RHR Flow Control Valves RHS-MOV-026A, B, C, D	No	Yes	Yes	Yes
CS/RHR Pump Full-flow Test Line Stop Valves RHS-MOV-025A, B, C, D	No	Yes	Yes	Yes
CS/RHR Heat Exchanger Inlet Temperature RHS-TE-012, 022, 032, 042	No	Yes	No	Yes
CS/RHR Hx Outlet Temperature RHS-TE-014, 024, 034, 044	No	Yes	No	Yes
CS/RHR Pump Discharge Flow RHS-FT-011, 021, 031, 041	Yes	Yes	No	Yes
CS/RHR Pump Minimum Flow RHS-FT-014, 024, 034, 044	No	Yes	No	Yes
CS/RHR Pump Discharge Pressure RHS-PT-011, 021, 031, 041	Yes	Yes	No	Yes
CS/RHR Pump Suction Pressure RHS-PT-010, 020, 030, 040	No	Yes	No	Yes

Table 2.4.5-5 Residual Heat Removal System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a The functional arrangement of the RHRS is as described in the Design Description of Section 2.4.5.1 and as shown on Figure 2.4.5-1.	1.a An inspection of the as-built RHRS will be performed.	1.a The as-built RHRS conforms to the functional arrangement as described in the Design Description of this Subsection 2.4.5.1 and as shown in Figure 2.4.5-1.
1.b Each mechanical division of the RHRS (Divisions A, B, C & D) is physically separated from the other divisions with the exception of inside the containment.	1.b Inspections of the as-built RHRS will be performed.	1.b Each mechanical division of the as-built RHRS is physically separated from other mechanical divisions of the system by structural barriers with the exception of inside the containment.
2.a.i The ASME Code Section III components of the RHRS, identified in Table 2.4.5-2, are fabricated, installed and inspected in accordance with ASME Code Section III requirements.	2.a.i An inspection of the as-built ASME Code Section III components of the RHRS will be performed.	2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the RHRS identified in Table 2.4.5-2 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.a.ii The ASME Code Section III components of the RHRS identified in Table 2.4.5-2 are reconciled with the design requirements.	2.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the RHRS identified in Table 2.4.5-2 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.

Table 2.4.5-5 Residual Heat Removal System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.b.i The ASME Code Section III piping of the RHRS, including supports, identified in Table 2.4.5-3, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.b.i An inspection of the as-built ASME Code Section III piping of the RHRS, including supports, will be performed.	2.b.i The ASME Code Section III data report(s) (certified when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the RHRS, including supports, identified in Table 2.4.5-3 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.b.ii The ASME Code Section III piping of the RHRS, including supports, identified in Table 2.4.5-3 are reconciled with the design requirements.	2.b.ii A reconciliation analysis of the piping of the RHRS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.b.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the RHRS, including supports, identified in Table 2.4.5-3 is reconciled with the design requirements. The report documents the results of the reconciliation analysis.
3.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.4.5-2, meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of as-built pressure boundary welds.
3.b Pressure boundary welds in ASME Code Section III piping, identified in Table 2.4.5-3, meet ASME Code Section III requirements for non-destructive examination of welds.	3.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of as-built pressure boundary welds.

Table 2.4.5-5 Residual Heat Removal System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4.a The ASME Code Section III components, identified in Table 2.4.5-2, retain their pressure boundary integrity at their design pressure.	4.a A hydrostatic test will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	4.a The results of the hydrostatic test of the as-built components identified in Table 2.4.5-2 as ASME Code Section III conform with the requirements of the ASME Code Section III.
4.b The ASME Code Section III piping, identified in Table 2.4.5-3, retains its pressure boundary integrity at its design pressure.	4.b A hydrostatic test will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the hydrostatic test of the as-built piping identified in Table 2.4.5-3 as ASME Code Section III conform to the requirements of the ASME Code Section III.
5.a The seismic Category I equipment, identified in Table 2.4.5-2, is designed to withstand seismic design basis loads without loss of safety function.	5.a.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.4.5-2 is located in the containment and the reactor building.	5.a.i The seismic Category I as-built equipment identified in Table 2.4.5-2 is located in the containment and the reactor building.
	5.a.ii Type tests and/or analyses of seismic Category I equipment will be performed.	5.a.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.a.iii Inspections will be performed on the as-built equipment including anchorage.	5.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.
5.b Each of the seismic Category I piping, including supports, identified in Table 2.4.5-3 is designed to withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table 2.4.5-3 are supported by a seismic Category I structure(s).	5.b.i Reports(s) document that each of the as-built seismic Category I piping, including supports, identified in Table 2.4.5-3 is supported by a seismic Category I structure(s).

Table 2.4.5-5 Residual Heat Removal System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	5.b.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, identified in Table 2.4.5-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, identified in Table 2.4.5-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.
6.a The Class 1E equipment identified in Table 2.4.5-2 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.a.i Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	6.a.i The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.4.5-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	6.a.ii Inspections will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.4.5-2 as being qualified for a harsh environment are bounded by type tests and/or analyses.
6.b The Class 1E equipment, identified in Table 2.4.5-2, is powered from their respective Class 1E division.	6.b A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.4.5-2 under test.
6.c Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	6.c Inspections of the as-built Class 1E divisional cables will be performed.	6.c Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.

Table 2.4.5-5 Residual Heat Removal System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7.a The RHRS is provided with isolation valves in each pump suction piping with interlock capabilities to prevent them from being opened to the RCS above the pressure setpoint.	7.a Tests will be performed using a simulated test signal.	7.a The interlocks prevent the as-built RHRS isolation valves in each pump suction piping from being opened to the RCS above the pressure setpoint.
7.b Deleted.	7.b Deleted.	7.b Deleted.
8.a The RHRS is designed to cool the reactor by removing decay heat, and other residual heat from the reactor core and the RCS during the normal plant shutdown and cool down condition.	8.a.i An inspection will be performed for the existence of a report that determines the heat removal capability of the as-built CS/RHR heat exchangers.	8.a.i The product of the overall heat transfer coefficient and the effective heat transfer area, UA, of each as-built CS/RHR heat exchanger is greater than or equal to 1.852×10^{6} Btu/hr-°F.
	8.a.ii Tests will be performed to confirm that the as-built RHRS can provide flow through the CS/RHR heat exchangers when the pump suction is aligned to the RCS hot leg and the discharge is aligned to RCS cold leg, with the RCS at atmospheric pressure.	8.a.ii Each as-built CS/RHR pump is sized to deliver 3,000 gpm at a discharge head of 410 ft, and provides at least 2645 gpm to the RCS when the RCS is at atmospheric pressure.
8.b The RHRS is designed to provide a portion of the RCS flow to the CVCS during normal plant cool down operations.	8.b A test of the as-built RHRS will be performed by aligning a flow path from the CS/RHR pumps to the CVCS.	8.b The as-built CS/RHR pump provides RCS flow to the CVCS.
8.c The RHRS is designed to transfer borated water from the RWSP to the refueling cavity at the beginning of a refueling operation.	8.c A test of the as-built RHRS will be performed by aligning a flow path to the CS/RHR pumps from the RWSP.	8.c The as-built CS/RHR pump transfer water from the RWSP to the refueling cavity.
8.d The RHRS is designed to provide cooling for the in-containment RWSP during normal plant operations.	8.d A test will be performed to confirm that the as-built RHRS can provide flow through the CS/RHR heat exchangers when the pump suction is aligned to the RWSP and the discharge is aligned to the RWSP.	8.d Each operating as-built CS/RHR pump provides at least 2645 gpm to the RWSP.

Table 2.4.5-5 Residual Heat Removal System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8.e The RHRS provides low temperature overpressurization protection (LTOP) for the RCS during shutdown operation.	8.e.i Inspections will be conducted on the as-built CS/RHR pump suction relief valves to confirm that the value of the vendor code plate rating is greater than or equal to system relief requirements.	8.e.i The rated capacity recorded on the valve ASME Code plates of the as-built valve is not less than the flow required to provide low temperature overpressure protection for the as-built RCS, as determined by the LTOP system evaluation based on the pressure-temperature curves developed for the as-procured reactor vessel material.
	8.e.ii Tests and/or analysis in accordance with the ASME Code Section III will be performed to confirm set pressure.	8.e.ii The relief valve opens at a pressure not greater than the set pressure required to provide low temperature overpressure protection for the RCS, as determined by the LTOP system evaluation based on the pressure-temperature curves developed for the as-procured reactor vessel material.
8.f The CS/RHR pumps have sufficient net positive suction head (NPSH).	8.f Tests to measure the as-built CS/RHR pump suction pressure will be performed. Inspections and analysis to determine NPSH available to each CS/RHR pump will be performed. The analysis will consider the effects of: - pressure losses for pump inlet piping and components, - suction from the RWSP water level at the minimum value, - vendor test results of required NPSH.	8.f The as-built system meets the design, and the analysis confirms that the NPSH available is at least 17.9 feet at 3650 gpm.

Table 2.4.5-5 Residual Heat Removal System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 7 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9. Controls exist in the MCR to open and close the remotely operated valves identified in Table 2.4.5-2.	9. Tests will be performed on the as-built remotely operated valves listed in Table 2.4.5-2 using controls in the as-built MCR.	9. Controls exist in the as-built MCR to open and close the as-built remotely operated valves listed in Table 2.4.5-2.
10.a The motor-operated and check valves, identified in Table 2.4.5-2, perform an active safety function to change position as indicated in the table.	10.a.i Tests or type tests of motor-operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	10.a.i Each motor-operated valve changes position as indicated in Table 2.4.5-2 under design conditions.
	10.a.ii Tests of the as-built motor-operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	10.a.ii Each as-built motor-operated valve changes position as indicated in Table 2.4.5-2 under pre-operational test conditions.
	10.a.iii Tests of the as-built check valves with active safety functions identified in Table 2.4.5-2 will be performed under pre-operational test pressure, temperature and fluid flow conditions.	10.a.iii Each as-built check valve changes position as indicated in Table 2.4.5-2.
10.b After loss of motive power, the remotely operated valves, identified in Table 2.4.5-2, assume the indicated loss of motive power position.	10.b Tests of the as-built valves will be performed under the conditions of loss of motive power.	10.b Upon loss of motive power, each as-built remotely operated valve identified in Table 2.4.5-2 assumes the indicated loss of motive power position.
11. Controls exist in the MCR to start and stop the pumps identified in Table 2.4.5-4.	11. Tests will be performed on the as-built pumps in Table 2.4.5-4 using controls in the as-built MCR.	11. Controls exist in the as-built MCR to start and stop the as-built pumps listed in Table 2.4.5-4.
12. MCR alarms and displays of the parameters identified in Table 2.4.5-4 can be retrieved in the MCR.	12. Inspections will be performed for retrievability of the RHRS parameters in the as-built MCR.	12. MCR alarms and displays identified in Table 2.4.5-4 can be retrieved in the as-built MCR.

Table 2.4.5-5 Residual Heat Removal System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 8 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
13. RSC alarms, displays and controls are identified in Table 2.4.5-4.	13. Inspections of the as built RSC alarms, displays and controls will be performed.	13. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.4.5-4.
14. Each of the as-built piping identified in Table 2.4.5-3 as designed for LBB meets the LBB criteria, or an evaluation is performed of the protection from the dynamic effects of a rupture of the line.	14. Inspections of the as-built piping will be performed based on the evaluation report for the LBB or the protection from dynamic effects of a pipe break, as specified in Section 2.3.	14. The LBB acceptance criteria are met by the as-built piping and pipe materials, or protection is provided for the dynamic effects of the piping break.
15.a The materials of construction of the ASME Code Section III, Class 1 components, identified in Table 2.4.5-2, are in accordance with ASME Code requirements.	15.a Inspection of the certified material test reports will be performed.	15.a The materials of construction of the ASME Code Section III, Class 1 components identified in Table 2.4.5-2 conform to the requirements of the ASME Code.
15.b The materials of construction of the ASME Code Section III, Class 1 piping, identified in Table 2.4.5-3, are in accordance with ASME Code requirements.	15.b Inspection of the certified material test reports will be performed.	15.b The materials of construction of the ASME Code Section III, Class 1 piping identified in Table 2.4.5-3 conform to the requirements of the ASME Code.

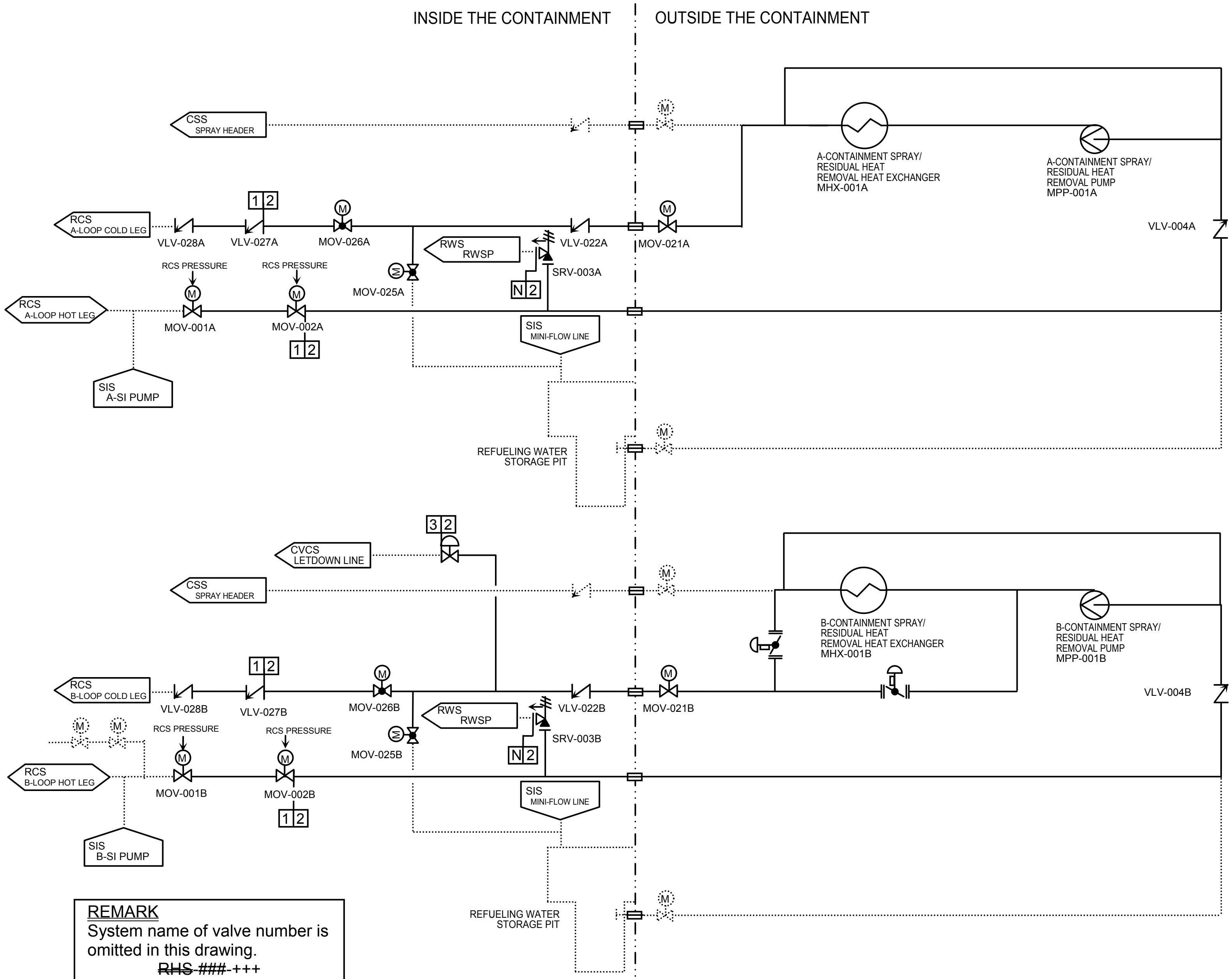


Figure 2.4.5-1 Residual Heat Removal System (Sheet 1 of 2)

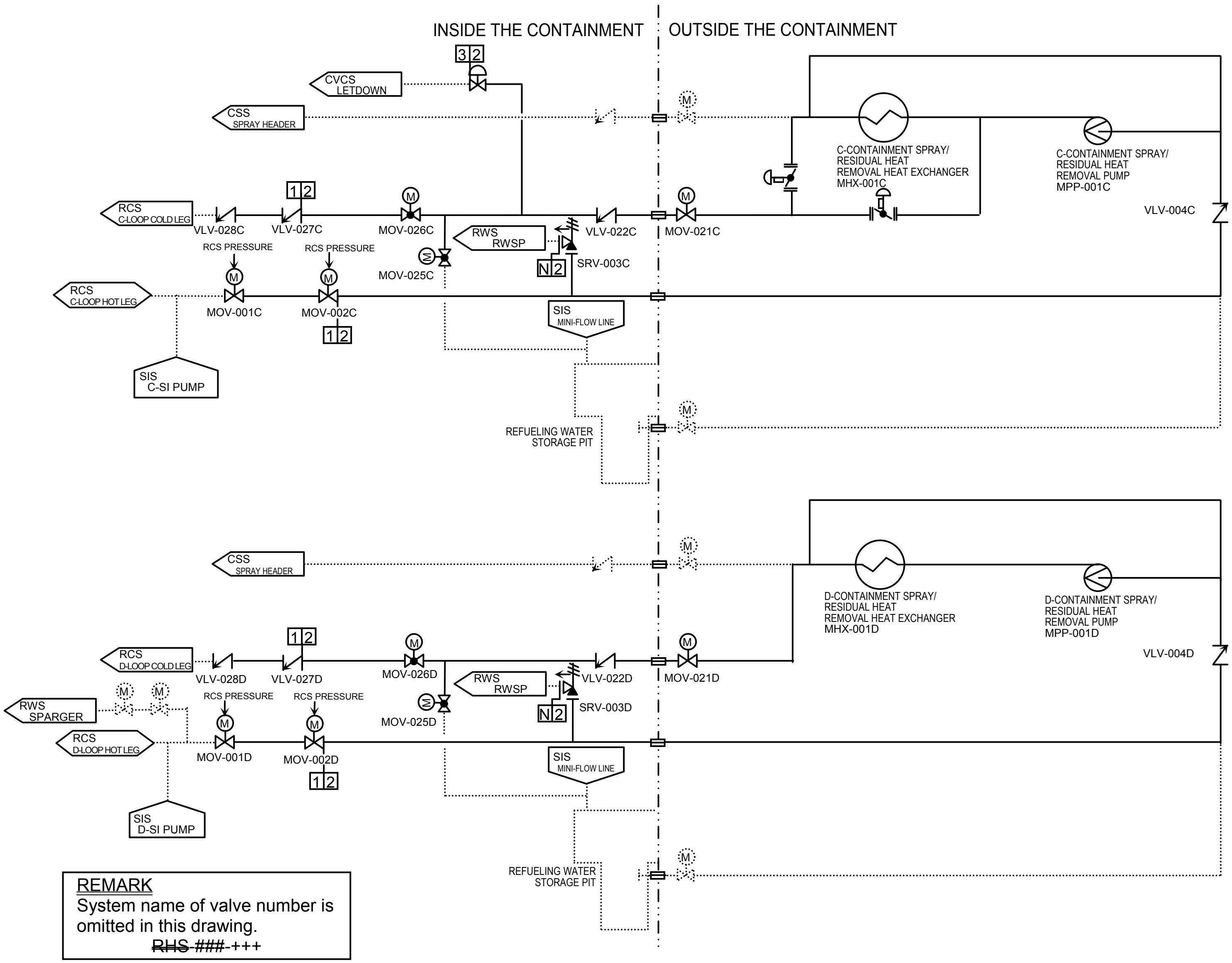


Figure 2.4.5-1 Residual Heat Removal System (Sheet 2 of 2)

2.4.6 Chemical and Volume Control System

2.4.6.1 Design Description

System Purpose and Functions

The purpose of the CVCS are to maintain the coolant inventory of the RCS and to provide chemical and radioactive cleanup of the RCS. Some components of the CVCS, such as the containment isolation valves, are safety-related, while other CVCS components, such as those associated with the boron recycle system (BRS), are non-safety related.

CVCS safety functions include:

- Providing a portion of the reactor coolant pressure boundary
- Providing the containment isolation function, as described in Section 2.11.2, of CVCS lines penetrating the containment
- Providing isolation of a source of water connected to the RCS to prevent inadvertent dilution of boron in the coolant
- Providing isolation of a charging line upon an ECCS actuation signal and high pressurizer water level signal

CVCS non-safety functions include:

- Maintaining appropriate volume and quality of reactor coolant for the RCS
- Regulating the boron concentration for the chemical shim control
- Removing fission products and ionic corrosion products in the reactor coolant
- Supplying seal water to the reactor coolant pump seals
- Receiving borated water discharged from the RCS
- Providing pressurizer auxiliary spray water for depressurization of the RCS when none of the RCPs are operating

Location and Functional Arrangement

The CVCS is located in the containment, in the reactor building, and in auxiliary building. Table 2.4.6-1 identifies the locations of specific CVCS equipment and piping. The functional arrangement of CVCS equipment and piping is shown on Figure 2.4.6-1.

Table 2.4.6-2 and 2.4.6-3 provide information on design characteristics of system components and system piping, respectively. Information in these tables is discussed below.

Key Design Features

The key design features of the CVCS are reflected in the system design bases, as follows:

- Letdown flow comes from the RCS and flows through the regenerative heat exchanger, where its temperature is reduced by transferring heat to the incoming charging flow. The coolant is then depressurized and is further cooled in the letdown heat exchanger.

- The letdown water then flows through the purification loop, and purified coolant is routed to the volume control tank (VCT), where hydrogen is supplied to strip fission gases from the reactor coolant. The pressure of hydrogen in the VCT is controlled to establish the concentration of hydrogen dissolved in the reactor coolant.

- The centrifugal charging pumps are provided to take suction from the VCT and return the cooled, purified reactor coolant to the RCS. The charging flow is pumped to the RCS through the regenerative heat exchanger, and injected into a cold leg of the reactor coolant system. A portion of the charging pump flow is directed to the reactor coolant pumps through a seal water injection filter.

- An auxiliary pressurizer spray provides a means of cooling and depressurizing the pressurizer when the reactor coolant pumps are not operated.

- An excess letdown path is provided in the event that the normal letdown path is inoperable. The excess letdown flow path is also used to provide additional letdown capability during the final stages of plant heatup.

- The CVCS is designed to provide containment isolation of CVCS lines penetrating the containment.

Seismic and ASME Code Classifications

The seismic classifications for system component and piping are identified in Table 2.4.6-2 and 2.4.6-3. The ASME Code Section III requirements for system component and piping are also identified in Table 2.4.6-2 and 2.4.6-3. Pressure boundary welds in ASME Code Section III component and piping meet ASME Code Section III requirements.

The materials used in the RCPB conform to the applicable ASME code rules. The welding materials used for joining RCPB materials conform to the requirements of the ASME Code Section III.

System Operation

System operation under different conditions – power operation, cooldown, shutdown, etc. – is addressed under key design features. The CVCS performs these functions during normal modes of operation, including power generation and shutdown.

Alarms, Displays, and Controls

Table 2.4.6-4 identifies the important alarms, displays, and controls associated with the CVCS that are located in the main control room.

Logic

The containment isolation valves in the CVCS letdown line and charging line close on a containment isolation signal. The seal water return line close on a containment isolation signal with the undervoltage signal present; where as the containment isolation valves in the seal water injection line are closed manually.

Interlocks

The CVCS is provided with a boron dilution interlock that blocks primary makeup water flow, preventing over dilution of the RCS. The CVCS is also provided with charging line isolation upon an ECCS actuation signal and high pressurizer water level signal.

Class 1E Electrical Power Sources and Divisions

The CVCS equipment identified in Table 2.4.6-2 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

The equipment identified in Table 2.4.6-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITAAC acceptance criteria in Table 2.4.6-5.

2.4.6.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4.6-5 describes the ITAAC for the CVCS.

The ITAAC associated with the CVCS equipment, components, and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.4.6-1 Chemical and Volume Control System Location of Equipment and Piping (Sheet 1 of 2)

System and Components	Location
Regenerative heat exchanger	Containment
Letdown heat exchanger	Containment
Excess letdown heat exchanger	Containment
Seal Water Heat Exchanger	Reactor Building
Volume control tank	Reactor Building
Charging pumps	Reactor Building
Letdown line and valves from RCS to and including valve CVS-LCV-362 prior to Regenerative Heat Exchanger.	Containment
Letdown line piping and valves from and excluding the valve CVS-LCV-362 prior to Regenerative Heat Exchanger to the following valves: RHRS valves (2 each) (excluding the valves) RHS-AOV-024 B, C; Containment isolation valve (excluding the valve) CVS-AOV-005	Containment
All CVCS containment isolation valves and piping between the valves.	Containment and Reactor Building
Excess letdown piping and valves from RCS to and excluding containment isolation valves CVS-MOV-203 and CVS-VLV-202. This includes piping related to seal water return line from and excluding 4 valves CVS-AOV-192 A, B, C, D and to seal water return line relief valve CVS-SRV-201 (including the valve).	Containment
RCP seal water return piping and valves from RCP seal to and including 4 valves CVS-AOV-192 A, B, C, D	Containment
RCP seal water injection piping and valves excluding following valves and piping: containment isolation valves, piping between these valves; piping downstream of CVS-VLV-180 A, B, C, D (including valves); seal injection filter line from CVS-VLV-168 to CVS-VLV-173 (excluding valves)	Reactor Building and Containment
RCP seal water injection piping and valves downstream of including valves CVS-VLV-180 A, B, C, D	Containment
Charging lines from and including valves CVS-VLV-158 and CVS-AOV-159 to their penetration into the RCS	Containment
Auxiliary Spray line from and including valves CVS-AOV-155 to the penetration into the RCS	Containment
Charging line and Auxiliary Spray line piping and valves between the following valves (excluding the valves) downstream of the Regenerative Heat Exchanger: CVS-VLV-158, CVS-AOV-159, CVS-AOV-155 and the containment isolation valve CVS-VLV-153	Containment

Table 2.4.6-1 Chemical and Volume Control System Location of Equipment and Piping (Sheet 2 of 2)

System and Components	Location
Charging line piping and valves from and including the volume control outlet valve CVS-LCV-031B to charging pump minimum flow orifices and following valves: CVS-VLV-213 (including valve); CVS-VLV-585 (including valve); CVS-VLV-557 (including valve) ; CVS-VLV-163 and 164 (excluding valves); CVS-VLV-591 and 593 (including valve); and CVS-MOV-152 (excluding valve)	Reactor Building
CVCS piping and valves related to the primary makeup water supply isolation from and including the isolation valve CVS-FCV-128 to primary makeup flow control valve CVS-FCV-133A (including valve).	Reactor Building
CVCS Charging Line Isolation (CVS-MOV-151)	Reactor Building
CVCS Charging Line Containment Isolation (CVS-MOV-152)	Reactor Building
RCP Seal Water Return Line Containment Isolation (CVS-MOV-203, 204)	Containment/ Reactor Building
RCP Seal Water Injection Line Containment Isolation (CVS-MOV-178 A, B, C, D)	Reactor Building
RCP Seal Water Injection Line Containment Isolation Check (CVS-VLV-179 A, B, C, D)	Containment
Letdown Orifice Stop (CVS-AOV-001 A, B, C)	Containment
Auxiliary Pressurizer Spray Line Isolation (CVS-AOV-155)	Containment
CVCS Charging Line Isolation (CVS-AOV-159)	Containment
CVCS Letdown Line Isolation (CVS-LCV-361, 362)	Containment
Air Operated Valve (CVS-AOV-192 A, B, C, D)	Containment
Excess Letdown Isolation CVS-AOV-221, 222	Containment
Auxiliary Pressurizer Spray Line Check (CVS-VLV-156)	Containment
Letdown Containment Isolation (CVS-AOV-005, 006)	Containment/ Reactor Building
Volume Control Tank Outlet Valve (CVS-LCV-031B, C)	Reactor Building
Charging Pump Alternate Makeup Line Stop (CVS-LCV-031 D, E, F, G)	Reactor Building
Primary Makeup Water Supply Isolation (CVS-FCV-128, 129)	Reactor Building

Table 2.4.6-2 Chemical and Volume Control System Equipment Characteristics (Sheet 1 of 6)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Charging pumps	CVS-MPP-001 A, B	3	Yes	—	Yes / No	Undervoltage Signal	Start	—
Regenerative heat exchanger	CVS-MHX-001	3	Yes	—	— / —	—	—	—
Letdown heat exchanger – Tube Side	CVS-MHX-002	3	Yes	—	— / —	—	—	—
Letdown heat exchanger – CCW Side		2	Yes	—	— / —	—	—	—
Excess letdown heat exchanger – Tube Side	CVS-MHX-003	3	Yes	—	— / —	—	—	—
Excess letdown heat exchanger – CCW side		2	Yes	—	— / —	—	—	—
Letdown Orifice Stop Valve	CVS-AOV-001 A, B, C	3	Yes	Yes	Yes/Yes	Containment Isolation Phase A	Transfer Closed	Closed
Letdown Containment Isolation Valve (First)	CVS-AOV-005	2	Yes	Yes	Yes/Yes	Containment Isolation Phase A	Transfer Closed	Closed
Letdown Containment Isolation Valve (Second)	CVS-AOV-006	2	Yes	Yes	Yes/No	Containment Isolation Phase A	Transfer Closed	Closed

Table 2.4.6-2 Chemical and Volume Control System Equipment Characteristics (Sheet 2 of 6)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Volume Control Tank Outlet Valve	CVS-LCV-031 B, C	3	Yes	Yes	Yes/No	—	Transfer Closed	As Is
Charging Pump Alternate Makeup Valve	CVS-LCV-031 D, E,F,G	3	Yes	Yes	Yes/No	—	Transfer Closed/ Open	As Is
Volume control tank outlet check Valve	CVS-VLV-125	3	Yes	No	— / —	—	Transfer Closed	—
Charging pump minimum flow check Valve	CVS-VLV-129A, B	3	Yes	No	— / —	—	Transfer Closed/ Open	—
Charging pump discharge check Valve	CVS-VLV-131A, B	3	Yes	No	— / —	—	Transfer Closed/ Open	—
CVCS Charging Line Isolation Valve	CVS-MOV-151	3	Yes	Yes	Yes/No	ECCS Actuation and CVCS isolation	Transfer Closed	As Is
CVCS Charging Line Containment Isolation Valve	CVS-MOV-152	2	Yes	Yes	Yes/No	ECCS Actuation and CVCS isolation	Transfer Closed	As Is

Table 2.4.6-2 Chemical and Volume Control System Equipment Characteristics (Sheet 3 of 6)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
CVCS Charging Line Isolation Check Valve	CVS-VLV-153	2	Yes	No	— / —	—	Transfer Closed	—
Auxiliary Pressurizer Spray Line Isolation Valve	CVS-AOV-155	1	Yes	Yes	Yes/Yes	—	Transfer Closed	Closed
Auxiliary Pressurizer Spray Line Check Valve	CVS-VLV-156	1	Yes	No	— / —	—	Transfer Closed	—
Charging Line Check Valve	CVS-VLV-158	1	Yes	No	— / —	—	—	—
CVCS Charging Line Isolation Valve	CVS-AOV-159	1	Yes	Yes	Yes/Yes	—	Transfer Closed/ Open	Open
CVCS Charging Line Check Valve	CVS-VLV-160, 161	1	Yes	No	— / —	—	Transfer Closed	—
RCP Seal Injection Line Containment Isolation	CVS-MOV-178 A, B, C, D	2	Yes	Yes	Yes/No	—	Transfer Closed	As Is
RCP Seal Injection Line Containment Isolation Check Valve	CVS-VLV-179 A, B, C, D	2	Yes	No	— / —	—	Transfer Closed/ Open	—
RCP Seal Water Injection Valve	CVS-VLV-180 A, B, C, D	1	Yes	No	— / —	—	—	—

Table 2.4.6-2 Chemical and Volume Control System Equipment Characteristics (Sheet 4 of 6)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
RCP Seal Injection Line Check Valve (First)	CVS-VLV-181 A, B, C, D	1	Yes	No	— / —	—	Transfer Closed/ Open	—
RCP Seal Injection Line Check Valve (Second)	CVS-VLV-182 A, B, C, D	1	Yes	No	— / —	—	Transfer Closed/ Open	—
Air Operated Valve	CVS-AOV-192 A, B, C, D	2	Yes	Yes	Yes/Yes	Undervoltage Signal	Transfer Closed	Closed
RCP Seal Return Line Containment Isolation Valve	CVS-MOV-203	2	Yes	Yes	Yes/Yes	Containment Isolation Phase A Containment Isolation Phase B with Undervoltage Signal	Transfer Closed	As Is
Air Operated Valve	CVS-AOV-196 A, B, C, D	3	Yes	Yes	Yes/Yes	Undervoltage signal	Transfer Closed	Closed
RCP Seal Return Line Containment Isolation Check valve	CVS-VLV-202	2	Yes	No	— / —	—	Transfer Closed	—

Table 2.4.6-2 Chemical and Volume Control System Equipment Characteristics (Sheet 5 of 6)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
RCP Seal Return Line Containment Isolation Valve	CVS-MOV-204	2	Yes	Yes	Yes/No	Containment Isolation Phase A Containment Isolation Phase B with Undervoltage Signal	Transfer Closed	As Is
Primary Makeup Water Supply Isolation	CVS-FCV-128, 129	3	Yes	Yes	Yes/No	Reactor Makeup Water Line Isolation	Transfer Closed	As Is
Excess Letdown Isolation Valve	CVS-AOV-221, 222	1	Yes	Yes	Yes/Yes	—	Transfer Closed	Closed
CVCS Letdown Line Isolation Valve	CVS-LCV-361	1	Yes	Yes	Yes/Yes	—	Transfer Closed	Closed
CVCS Letdown Line Isolation Valve	CVS-LCV-362	1	Yes	Yes	Yes/Yes	—	Transfer Closed	Closed
Charging pump alternate makeup line check	CVS-VLV-592	3	Yes	No	— / —	—	Transfer Open	—

Table 2.4.6-2 Chemical and Volume Control System Equipment Characteristics (Sheet 6 of6)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Charging pump alternate makeup line check	CVS-VLV-594	3	Yes	No	— / —	—	Transfer Open	—
Charging pump alternate makeup line check	CVS-VLV-595	3	Yes	No	— / —	—	Transfer Closed/ Open	—
Primary Makeup Water Supply Flow	CVS-FT-128, 129	—	Yes	—	Yes/No	—	—	—

NOTE:
Dash (—) indicates not applicable

Table 2.4.6-3 Chemical and Volume Control System Piping Characteristics (Sheet 1 of 2)

Pipe Line Name	ASME Code Section III Class	Seismic Category I
Letdown line and valves from RCS to and including valve CVS-LCV-362 prior to Regenerative Heat Exchanger.	1	Yes
Letdown line piping and valves from and excluding the valve CVS-LCV-362 prior to Regenerative Heat Exchanger to the following valves: RHRS valves (2 each) (excluding the valves) RHS-AOV-024 B, C; Containment isolation valve (excluding the valve) CVS-AOV-005.	3	Yes
All CVCS containment isolation valves and piping between the valves.	2	Yes
Excess letdown piping and valves from RCS to and including valve CVS-AOV-222 just prior to excess letdown heat exchanger.	1	Yes
Excess letdown piping and valves from but excluding valve CVS-AOV-222 just prior to excess letdown heat exchanger to and excluding containment isolation valves CVS-MOV-203 and CVS-VLV-202. This includes piping related to seal water return from RCP seals to but excluding 4 valves CVS-AOV-192 A, B, C, D.	3	Yes
RCP seal water return piping and valves from RCP seal to and including valves CVS-AOV-192 A, B, C, D	2	Yes
RCP seal water injection piping and valves excluding following valves and piping: containment isolation valves, piping between these valves; piping downstream of CVS-VLV-180 A, B, C, D (including valves); seal injection filter line from CVS-VLV-168 to CVS-VLV-173 (excluding valves)	3	Yes
RCP seal water injection piping and valves downstream of including valves CVS-VLV-180 A, B, C, D	1	Yes
Charging lines from and including valves CVS-VLV-158 and CVS-AOV-159 to their penetration into the RCS	1	Yes
Charging line piping and valves between the following valves (excluding the valves) downstream of the Regenerative Heat Exchanger: CVS-VLV-158 and CVS-AOV-159. And, containment isolation valve CVS-VLV-153 (excluding the valve)	3	Yes
Auxiliary Spray line from and including valves CVS-AOV-155 to the penetration into the RCS	1	Yes
Auxiliary Spray piping up to but excluding CVS-AOV-155	3	Yes

Table 2.4.6-3 Chemical and Volume Control System Piping Characteristics (Sheet 2 of 2)

Pipe Line Name	ASME Code Section III Class	Seismic Category I
Charging line piping and valves from and including the volume control outlet valve CVS-LCV-031B to charging pump minimum flow orifices and the following valves: CVS-VLV-213 (including valve); CVS-VLV-585 (including valve); CVS-VLV-557 (including valve); CVS-VLV-163 and 164 (excluding valves); CVS- VLV-591 and 593 (including valves); and CVS-MOV-152 (excluding valve)	3	Yes
CVCS piping and valves related to the primary makeup water supply isolation from and including the isolation valve CVS-FCV-128 to primary makeup flow control valve CVS-FCV-133A (including valve).	3	Yes

Table 2.4.6-4 Chemical and Volume Control System Equipment, Alarms, Displays, and Control Functions (Sheet 1 of 2)

Equipment Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Charging Pump (Run Status)	No	Yes	Yes	Yes
Primary Makeup Water Supply Flow	Yes	Yes	No	Yes
Letdown Containment Isolation Valves (CVS-AOV-005,006)	No	Yes	Yes	Yes
CVCS Charging Line Containment Isolation Valve (CVS-MOV-152)	No	Yes	Yes	Yes
RCP Seal Injection Line Containment Isolation (CVS-MOV-178 A, B, C, D)	No	Yes	Yes	Yes
RCP Seal Return Line Containment Isolation Valves (CVS-MOV-203,204)	No	Yes	Yes	Yes
Volume Control Tank Outlet Valves (CVS-LCV-031 B, C)	No	Yes	Yes	Yes
Charging Pump Alternate Makeup Valves (CVS-LCV-031 D,E,F,G)	No	Yes	Yes	Yes
CVCS Charging Line Isolation Valve (CVS-MOV-151)	No	Yes	Yes	Yes
Auxiliary Pressurizer Spray Line Isolation Valve (CVS-AOV-155)	No	Yes	Yes	Yes
CVCS Charging Line Isolation Valve (CVS-AOV-159)	No	Yes	Yes	Yes
Air Operated Valves (CVS-AOV-192 A, B, C, D)	No	Yes	Yes	Yes
Air Operated Valves (CVS-AOV-196 A, B, C, D)	No	Yes	Yes	Yes
Primary Makeup Water Supply Isolation (CVS-FCV-128, 129)	No	Yes	Yes	Yes

Table 2.4.6-4 Chemical and Volume Control System Equipment, Alarms, Displays, and Control Functions (Sheet 2 of 2)

Equipment Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Excess Letdown Isolation Valve (CVS-AOV-221, 222)	No	Yes	Yes	Yes
CVCS Letdown Line Isolation Valve (CVS-LCV-361)	No	Yes	Yes	Yes
CVCS Letdown Line Isolation Valve (CVS-LCV-362)	No	Yes	Yes	Yes

Table 2.4.6-5 Chemical and Volume Control System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the CVCS is as described in the Design Description of Subsection 2.4.6 and as shown on Figure 2.4.6-1.	1. An inspection of the as-built CVCS will be performed.	1. The as-built CVCS conforms with the functional arrangement as described in the Design Description of this Subsection 2.4.6.1 and as shown on Figure 2.4.6-1.
2.a.i The ASME Code Section III components of the CVCS, identified in Table 2.4.6-2, are fabricated, installed and inspected in accordance with ASME Code Section III requirements.	2.a.i An inspection of the as-built ASME Code Section III components of the CVCS will be performed.	2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components identified in Table 2.4.6-2 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.a.ii The ASME Code Section III components of the CVCS identified in Table 2.4.6-2 are reconciled with the design requirements.	2.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the CVCS identified in Table 2.4.6-2 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.
2.b.i The ASME Code Section III piping of the CVCS, including supports, identified in Table 2.4.6-3, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.b.i An inspection of the as-built ASME Code Section III piping of the CVCS, including supports, will be performed.	2.b.i The ASME Code Section III data report(s) (certified when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the CVCS, including supports, identified in Table 2.4.6-3 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

Table 2.4.6-5 Chemical and Volume Control System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.b.ii The ASME Code Section III piping of the CVCS, including supports, identified in Table 2.4.6-3 are reconciled with the design requirements.	2.b.ii A reconciliation analysis of the piping of the CVCS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.b.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the CVCS, including supports, identified in Table 2.4.6-3 is reconciled with the design requirements. The report documents the results of the reconciliation analysis.
3.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.4.6-2, meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
3.b Pressure boundary welds in ASME Code Section III piping, identified in Table 2.4.6-3, meet ASME Code Section III requirements for non-destructive examination of welds.	3.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
4.a The ASME Code Section III components, identified in Table 2.4.6-2, retain their pressure boundary integrity at their design pressure.	4.a A hydrostatic test will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	4.a The results of the hydrostatic test of the as-built components identified in Table 2.4.6-2 as ASME Code Section III conform with the requirements of the ASME Code, Section III.
4.b The ASME Code Section III piping, identified in Table 2.4.6-3, retains its pressure boundary integrity at its design pressure.	4.b A hydrostatic test will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the hydrostatic test of the as-built piping identified in Table 2.4.6-3 as ASME Code Section III conform with the requirements of the ASME Code, Section III.

Table 2.4.6-5 Chemical and Volume Control System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5.a The seismic Category I equipment, identified in Table 2.4.6-2, is designed to withstand seismic design basis loads without loss of safety function.	5.a.i Inspections will be performed to verify that the seismic Category I as-built equipment and valves identified in Table 2.4.6-2 are located in the containment or reactor building.	5.a.i The as-built seismic Category I as-built equipment identified in Table 2.4.6-2 is located in the containment or reactor building.
	5.a.ii Type tests and/or analyses of the seismic Category I equipment will be performed.	5.a.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.a.iii An inspection will be performed on the as-built equipment including anchorage.	5.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.
5.b Each of the seismic Category I piping, including supports, identified in Table 2.4.6-3 is designed to withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table 2.4.6-3 are supported by a seismic Category I structure(s).	5.b.i Reports(s) document that each of the as-built seismic Category I piping, including supports, identified in Table 2.4.6-3 is supported by a seismic Category I structure(s).
	5.b.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, identified in Table 2.4.6-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, identified in Table 2.4.6-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.

Table 2.4.6-5 Chemical and Volume Control System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6.a The Class 1E equipment identified in Table 2.4.6-2 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.a.i Type tests and/or analyses will be performed on Class 1E equipment located in a harsh environment.	6.a.i The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.4.6-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	6a.ii Inspections will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.4.6-2 as being qualified for a harsh environment are bounded by type tests and/or analyses.
6.b The Class 1E equipment, identified in Table 2.4.6-2, is powered from their respective Class 1E division.	6.b A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.4.6-2 under test.
6.c Separation is provided between CVCS Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	6.c Inspections of the as-built Class 1E divisional cables will be performed.	6.c Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.
7. Deleted.	7. Deleted.	7. Deleted.
8.a The CVCS provides makeup capability to maintain the RCS volume.	8.a A test of the as-built CVCS will be performed to measure the makeup flow rate.	8.a Each as-built CVCS charging pump provides a flow rate of greater than or equal to 160 gpm.
8.b The CVCS provides pressurizer auxiliary spray water for depressurization.	8.b A test of the as-built CVCS will be performed by aligning a flow path from each CVCS charging pump to the pressurizer auxiliary spray.	8.b Each as-built CVCS charging pump provides spray flow to the pressurizer.

Table 2.4.6-5 Chemical and Volume Control System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8.c The CVCS supplies seal water to the RCP seals.	8.c A test of the as-built CVCS will be performed by aligning a flow path to each RCP.	8.c Each as-built CVCS charging pump provides a flow rate of greater than or equal to 8 gpm to each RCP seal.
9. Controls exist in the MCR to open and close the remotely operated valves identified in Table 2.4.6-2 to perform active functions.	9. Tests will be performed on the as-built remotely operated valves listed in Table 2.4.6-2 using controls in the as-built MCR.	9. Controls exist in the as-built MCR to open and close the as-built remotely operated valves to perform active functions.
10.a. The motor-operated valves, air-operated valves and check valves, identified in Table 2.4.6-2, perform an active safety function to change position as indicated in the table.	10.a.i Tests or type tests of motor-operated valves and air-operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	10.a.i Each valve changes position as indicated in Table 2.4.6-2 under design conditions.
	10.a.ii Tests of the as-built motor-operated valves and air-operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	10.a.ii Each as-built valve changes position as indicated in Table 2.4.6-2 under pre-operational test conditions.
	10.a.iii Tests of the as-built check valves with active safety functions identified in Table 2.4.6-2 will be performed under pre-operational test pressure, temperature, and fluid flow conditions.	10.a.iii Each as-built check valve changes position as indicated in Table 2.4.6-2.
10.b After loss of motive power, the remotely operated valves, identified in Table 2.4.6-2, assume the indicated loss of motive power position.	10.b Tests of the as-built valves will be performed under the conditions of loss of motive power.	10.b Upon loss of motive power, each as-built remotely operated valve identified in Table 2.4.6-2 assumes the indicated loss of motive power position.
11. Controls exist in the MCR to start and stop the pumps identified in Table 2.4.6-4.	11. Tests will be performed on the as-built pumps in Table 2.4.6-4 using controls in the as-built MCR.	11. Controls exist in the as-built MCR to start and stop the as-built pumps listed in Table 2.4.6-4.

Table 2.4.6-5 Chemical and Volume Control System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
12. MCR alarms and displays of the parameters identified in Table 2.4.6-4 can be retrieved in the MCR.	12. Inspections will be performed for retrievability of the CVCS parameters in the as-built MCR.	12. MCR alarms and displays identified in Table 2.4.6-4 can be retrieved in the as-built MCR.
13. RSC alarms, displays and controls are identified in Table 2.4.6-4.	13. Inspections of the as-built RSC alarms, displays and controls will be performed.	13. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.4.6-4.
14.a The materials of construction of the ASME Code Section III, Class 1 components, identified in Table 2.4.6-2, are in accordance with ASME Code requirements.	14.a Inspection of the certified material test reports will be performed.	14.a The materials of construction of the ASME Code Section III, Class 1 components identified in Table 2.4.6-2 conform to the requirements of the ASME Code.
14.b The materials of construction of the ASME Code Section III, Class 1 piping, identified in Table 2.4.6-3, are in accordance with ASME Code requirements.	14.b Inspection of the certified material test reports will be performed.	14.b The materials of construction of the ASME Code Section III, Class 1 piping identified in Table 2.4.6-3 conform to the requirements of the ASME Code.

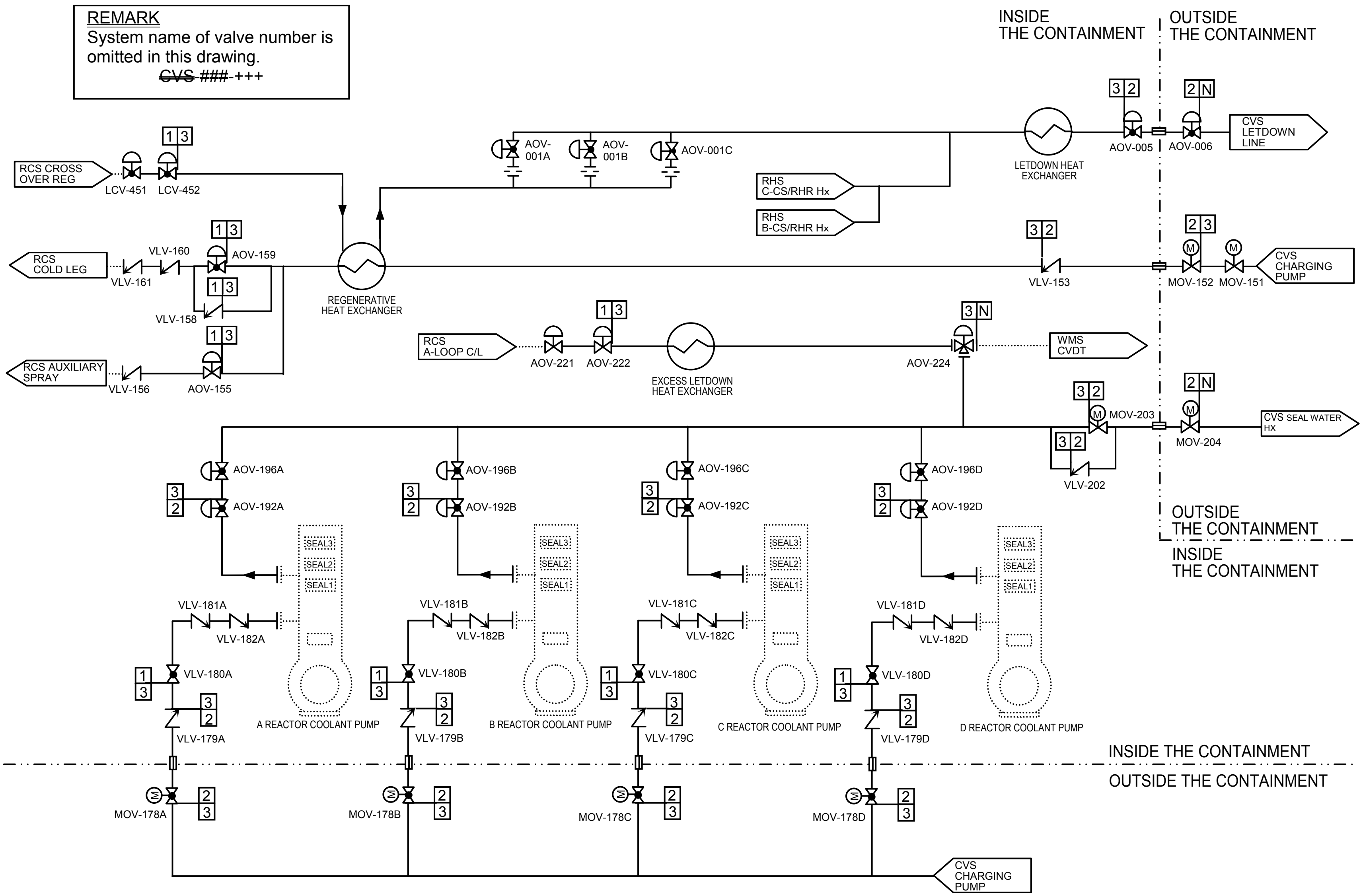


Figure 2.4.6-1 Chemical and Volume Control System (Sheet 1 of 2)

REMARK
System name of valve number is omitted in this drawing.
~~CVS~~ ~~###~~-+++

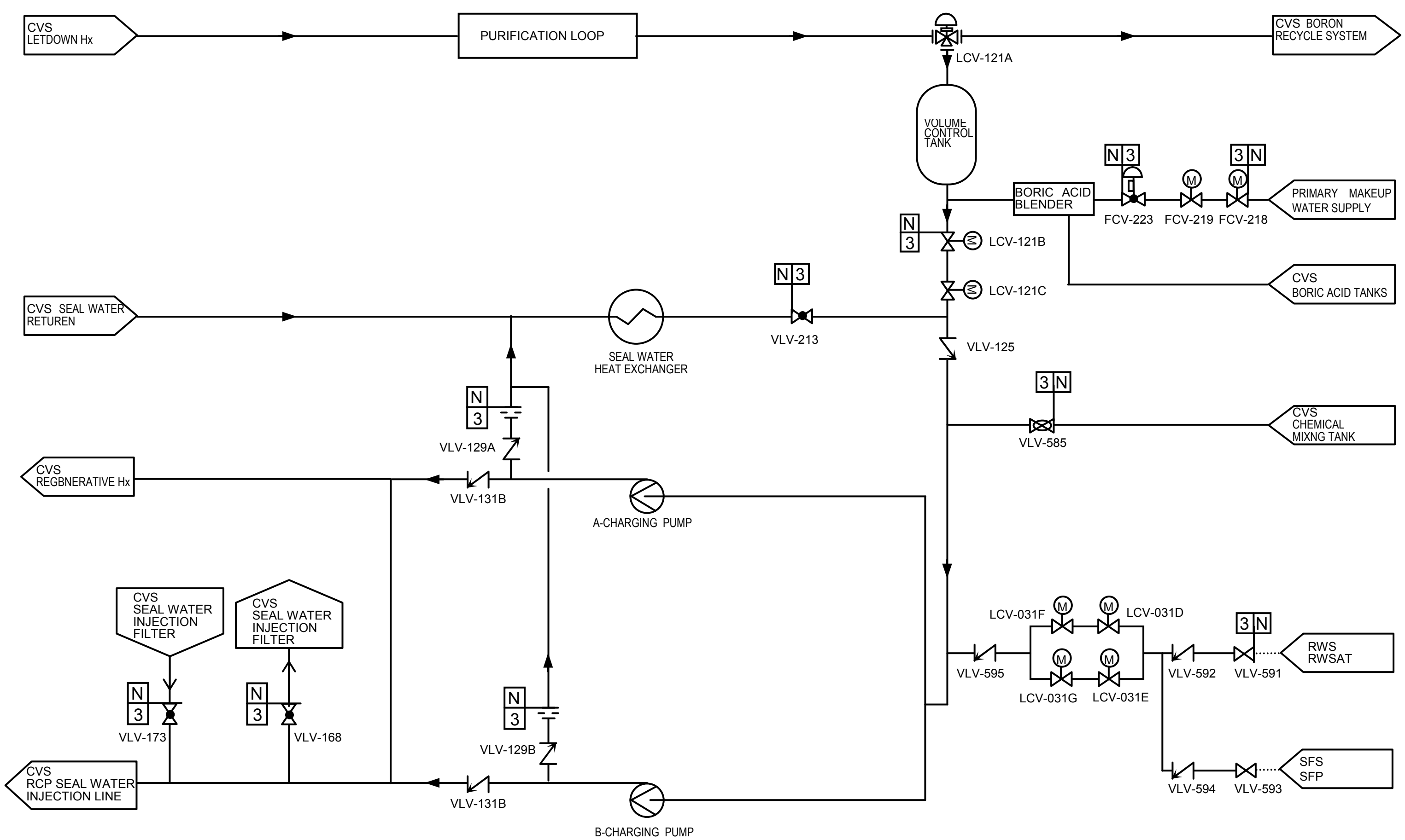


Figure 2.4.6-1 Chemical and Volume Control System (Sheet 2 of 2)

2.4.7 Reactor Coolant Pressure Boundary Leakage Detection System

2.4.7.1 Design Description

The reactor coolant pressure boundary (RCPB) leakage detection system provides a mean of detecting and monitoring the reactor coolant leakage by measuring the leakage rate or common leakage equivalent. The following leak detection methods quantify the leakage rate and provide information to locate the leakage in order to detect unidentified coolant leakage into containment:

- Containment sump level
- Condensate flow rate from air coolers
- Containment airborne particulate radioactivity

Detecting and monitoring the leakage are performed using instruments and components. Reactor coolant pressure boundary leakage detection methods provide the nonsafety-related function of detecting leaks from the reactor coolant system.

2.4.7.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4.7-1 describes the ITAAC for reactor coolant pressure boundary leakage detection system.

Table 2.4.7-1 Reactor Coolant Pressure Boundary Leakage Detection System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. Reactor coolant pressure boundary leakage detection methods provide the nonsafety-related function of detecting leaks from the reactor coolant system.	1.i Inspection will be performed for retrievability of the displays of the following channels in the MCR. ・Containment sump level channels LMS-LT-093A,B ・Standpipe level channel LMS-LT-092	1.i Nonsafety-related displays of the following channels can be retrieved in the MCR. ・Containment sump level channels LMS-LT-093A,B ・Standpipe level channel LMS-LT-092
	1.ii Testing will be performed by adding water to the sump and observing display of sump level.	1.ii A report exists and concludes sump level channels LMS-LT-093A,B can detect level change due to adding water, which corresponds to required sensitivity, response time and set point.
	1.iii Testing will be performed by adding water to the standpipe and observing display of standpipe level.	1.iii A report exists and concludes standpipe level channel LMS-LT-092 can detect level change due to adding water, which corresponds to required sensitivity, response time and set point.
	1.iv See Tier1 Material sections: Section 2.7.6.6 for the containment radiation particulate monitor RMS-RE-040	1.iv See Tier1 Material sections: Section 2.7.6.6 for the containment radiation particulate monitor RMS-RE-040
2. The functional arrangement of the reactor coolant pressure boundary leakage detection monitors is as described in Subsection 2.7.6.6 Design Description.	2. An inspection of the as-built RCPB leakage detection monitors will be performed.	2. The as-built RCPB leakage detection monitors conform to the functional arrangement as described in the Design Description of this Subsection 2.7.6.6.

2.5 INSTRUMENTATION AND CONTROLS

2.5.1 Reactor Trip System and Engineered Safety Feature Systems

2.5.1.1 Design Description

The reactor trip (RT) system and the engineered safety feature (ESF) system consist of the protection and safety monitoring system (PSMS) and the field equipment. The PSMS includes the reactor protection system (RPS), the engineered safety features actuation system (ESFAS), the safety logic system (SLS) and the safety grade human system interface system (HSIS). The PSMS consists of four safety divisions.

The purpose of the PSMS is to provide protection against unsafe reactor operation during steady-state and transient power operation by automatically tripping the reactor and actuating necessary engineered safety features. These functions are referred to as the RT system and the ESF system. The safety grade HSIS includes conventional switches for manual actuation of reactor trip and ESF actuation. Table 2.5.1-1 shows equipment names and classifications of the PSMS and the field equipment for the RT system and the ESF system. ESF systems are automatically initiated from signals that originate in the RPS. Manual actuation of ESF systems is carried out through a diverse signal path that bypasses the RPS.

Figures 2.5.1-1 and 2.5.1-2 show the configuration of the RPS, ESFAS, and SLS for implementation of the RT system and the ESF system, respectively. Figure 2.5.1-3 shows the configuration of the ESFAS, SLS, HSIS and diverse actuation system (DAS) for implementation of the safety grade component control system. Figure 2.5.1-4 shows the configuration of the reactor trip breakers (RTBs).

The PSMS is located in areas that provide protection from accident related hazards such as missiles, pipe breaks, and flooding. The redundant divisions of the PSMS are isolated from each other and isolated from non-safety systems. Each division of the PSMS is electrically independent, and by placement in different equipment rooms is physically separated from other safety divisions. The redundant divisions of the PSMS are configured for the RT system and the ESF system functions, as shown in Figures 2.5.1-1 and 2.5.1-2. The redundancy in combination with safety division independence, separation, and isolation provided for each PSMS division, ensure protection from a single failure preventing actuation of a safety function. Isolation is provided between the PSMS and the plant control and monitoring system (PCMS) to ensure failures in the PCMS cannot adversely affect the PSMS.

The PSMS initiates automatic reactor trips and ESF actuations, identified in Table 2.5.1-2 and 2.5.1-3, when the plant process signals reach a predetermined limit (setpoint). The PSMS signals are derived from direct measurements. Automatically or manually initiated PSMS protection functions are sealed-in to ensure that the protective actions go to completion. A deliberate operator action is required to reset the seal-in feature. There are no interlocks that prevent manual PSMS actuations. The PSMS can perform its protective functions in the presence of a maintenance bypass. The PSMS automatically removes operating bypasses when permissive conditions are not met.

The PSMS is designed to facilitate the timely recognition, location, replacement, repair and adjustment of malfunctioning components or modules. The built-in diagnostics, along with operational VDU alarms and engineering tool provide a mechanism for rapidly identifying and locating malfunctioning assemblies. A single channel or division can be bypassed to allow on-line testing, maintenance or repair during the plant operation and this capability does not prevent the PSMS from performing its safety function. For many measurement channels and many division level functions, the PSMS can perform its safety function with a single failure and with one channel or division bypassed, or with two channels or divisions bypassed (but without an additional single failure). The technical specifications distinguish the functions for which these capabilities are applicable.

Input sensors from each PSMS are compared continuously in the PCMS to detect abnormal deviations for checking the operational availability of each PSMS input sensor that may be required for a safety function during reactor operation.

Spatially dependent sensors that are required for protective actions are identified in Table 2.5.1-2 and Table 2.5.1-3, and have the minimum number of sensors and locations to perform the protective action.

The RT logic of the PSMS is designed to fail to a safe state such that loss of electrical power to a division of PSMS results in a trip condition for that division.

The RT and ESF actuation setpoints of the PSMS are determined using a proven nuclear industry standard methodology. This methodology accounts for uncertainties in determination of device setpoints to maintain adequate margin between analytical limits and device setpoints.

The PSMS and the field equipment listed in Table 2.5.1-1 are qualified to meet environmental, seismic and EMI/RFI (electromagnetic interference and radio frequency interference) condition without loss of the function for the analyzed design basis events. The equipment is designed and manufactured under a quality program that ensures highly reliable and safe operation.

The safety VDUs and the safety VDU processors, which are part of the PSMS, provide monitoring and control for the safety-related plant components and instrumentation, including monitoring and control for the credited manual operator actions. The operational VDUs, which are part of the PCMS, also provide monitoring and control for the safety-related plant components and instrumentation, including the monitoring and control for the credited manual operator actions. In addition, the operational VDUs provide monitoring for the critical safety functions, monitoring of automatic ESF actuations, and automatic indications whenever a protective function is either bypassed or inoperable. Isolation is provided between the PSMS and the operational VDU to ensure that credible failures of the operational VDU do not degrade the performance of the PSMS. Figure 2.5.1-3 shows the configuration of the ESFAS, SLS, safety VDU and operational VDU.

The signal selector algorithm (SSA) of the PCMS ensures that the PCMS does not take an erroneous control action based on a single instrument channel failure or a single RPS train failure that results in a condition which requires RT or ESF action. The SSAs are provided in the PCMS to the monitored variables which are commonly used in the PSMS and PCMS as listed in Table 2.5.1-5.

Manual controls from the operational VDU can be blocked and disabled manually from the safety VDU. The logic in the SLS blocks non-safety signals from the PCMS when any safety function signal is present, such as a safety interlock or ESF actuation signal.

The PSMS cabinets are located in a secure area with key locks and alarms. The PSMS equipment is provided with a clear means of identification. Identification shall not require frequent use of reference material.

Each division of the PSMS is supplied from two safety-related Class 1E power sources to ensure reliability.

The PSMS and the field equipment provide the safety-related interlocks important to safety. These interlocks are listed in Table 2.5.1-4. The PSMS provides the operator with automatic indications whenever an interlock function is either bypassed or inoperable.

The PSMS hardware and software are developed in accordance with a design process, qualification program and quality assurance (QA) program that conform to the U.S. regulatory requirements for the Class 1E safety systems. These programs encompass the entire product life cycle including software verification and validation (V&V), configuration management, and cyber security.

2.5.1.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.5.1-6 describes the ITAAC for the RT system and the ESF system.

Table 2.5.1-1 Equipment Names and Classifications of PSMS and Field Equipment for RT System and ESF System

Equipment Name	Seismic Category I	Class 1E	Qualification for Harsh Environment
PSMS			
RPS Division A/B/C/D	Yes	Yes	No
ESFAS Division A/B/C/D	Yes	Yes	No
SLS Division A/B/C/D	Yes	Yes	No
MCR*[1] Safety VDU Division A/B/C/D	Yes	Yes	No
RSR*[2] Safety VDU Division A/B/C/D	Yes	Yes	No
Safety VDU Processor Division A/B/C/D	Yes	Yes	No
MCR Division Level Switches A/B/C/D	Yes	Yes	No
MCR/RSR Transfer Panels*[3]	Yes	Yes	No
Field Equipment			
RTB Division A/B/C/D	Yes	Yes	No
RT and ESF Measurement Instrumentation	Yes	Yes	Yes*[4]/No

Note1: Main Control Room
Note2: Remote Shutdown Room
Note3: Transfer function is described in Subsection 2.5.2.
Note4: Field equipments which are located in the harsh environment

Table 2.5.1-2 Reactor Trip and Monitored Variables

Actuation Signal	Monitored Variables
High Source Range Neutron Flux	Neutron Flux
High Intermediate Range Neutron Flux	Neutron Flux
High Power Range Neutron Flux (Low Setpoint)	Neutron Flux(1)
High Power Range Neutron Flux (High Setpoint)	Neutron Flux(1)
High Power Range Neutron Flux Positive Rate	Neutron Flux(1)
High Power Range Neutron Flux Negative Rate	Neutron Flux(1)
Over Temperature ΔT	Reactor Coolant Temperature(2)
	Pressurizer Pressure
	Neutron Flux(1)
Over Power ΔT	Reactor Coolant Temperature(2)
	Neutron Flux(1)
Low Reactor Coolant Flow	Reactor Coolant Flow
Low Reactor Coolant Pump Speed	Reactor Coolant Pump Speed
Low Pressurizer Pressure	Pressurizer Pressure
High Pressurizer Pressure	Pressurizer Pressure
High Pressurizer Water Level	Pressurizer Water Level
Low Steam Generator Water Level	Steam Generator Water Level
High-High Steam Generator Water Level	Steam Generator Water Level
ECCS Actuation	Refer to ECCS Actuations in Table 2.5.1-3.
Manual Actuation	Manual Switch Position (Reactor Trip Switch)

Notes:
1: Power Range Neutron flux is a spatially dependent variable due to axial variations.
2. Reactor Coolant System hot leg (3 sensors) are spatially dependent variables.

Table 2.5.1-3 ESF Actuations and Monitored Variables (Sheet 1 of 3)

ESF Function	Actuation Signal	Monitored Variables
ECCS Actuation	Low Pressurizer Pressure	Pressurizer Pressure
	Low Main Steam Line Pressure	Main Steam Line Pressure
	High Containment Pressure	Containment Pressure
	Manual Actuation	Manual Switch Position (ECCS Actuation Switch)
Main Steam Line Isolation	High-High Containment Pressure	Containment Pressure
	Low Main Steam Line Pressure	Main Steam Line Pressure
	High Main Steam Line Pressure Negative Rate	Main Steam Line Pressure
	Manual Actuation	Manual Switch Position (Main Steam Line Isolation Switch)
Containment Isolation Phase A	ECCS Actuation	ECCS Actuation Signal
	Manual Actuation	Manual Switch Position (Containment Isolation Switch)
Containment Isolation Phase B	High-3 Containment Pressure	Containment Pressure
	Manual Actuation	Manual Switch Position (Containment Spray Switch)
Containment Purge Isolation	ECCS Actuation	ECCS Actuation Signal
	High Containment Area Radiation	Containment Area Radiation
	Manual Actuation	Manual Switch Position (Containment Isolation Switch) (Containment Spray Switch)
Containment Spray	High-3 Containment Pressure	Containment Pressure
	Manual Actuation	Manual Switch Position (Containment Spray Switch)

Table 2.5.1-3 ESF Actuations and Monitored Parameters (Sheet 2 of 3)

ESF Function	Actuation Signal	Monitored Variables
Emergency Feedwater Actuation	ECCS Actuation	ECCS Actuation Signal
	Low Steam Generator Water Level	Steam Generator Water Level
	Loss of Offsite Power	Class 1E 6.9kV Bus Voltage
	Manual Actuation	Manual Switch Position (Emergency Feedwater Actuation Switch)
Emergency Feedwater Isolation Loop A (Loop B, C, D) *1	Low Main Steam Line Pressure	Main Steam Line Pressure
	High Steam Generator Water level	Steam Generator Water Level
	Manual Actuation	Manual Switch Position (Emergency Feedwater Isolation Switch)
Main Control Room Isolation	ECCS Actuation	ECCS Actuation Signal
	High Main Control Room Outside Air Intake Radiation	Main Control Room Outside Air Intake Gas Radiation
		Main Control Room Outside Air Intake Iodine Radiation
		Main Control Room Outside Air Intake Particulate Radiation
	Manual Actuation	Manual Switch Position (Main Control Room Isolation Switch)
Main Feedwater Regulation Valve Closure	Low T_{avg} coincident with RT (P-4)	Reactor Coolant Temperature(2)
		Reactor Trip (RTB Open)
Main Feedwater Isolation	High-High Steam Generator Water Level	Steam Generator Water Level
	ECCS Actuation	ECCS Actuation Signal
	Manual Actuation	Manual Switch Position (Main Feedwater Isolation Switch)

Note1: Loop A isolation is initiated by steam generator water level signal and main steam line pressure signal from loop A. All loops are identical (e.g., loop B isolation is initiated by the signal from loop B).
Note 2: Reactor Coolant System hot leg (3 sensors) are spatially dependent variables.

Table 2.5.1-3 ESF Actuations and Monitored Parameters (Sheet 3 of 3)

ESF Function	Actuation Signal	Monitored Variables
CVCS Isolation	High Pressurizer Water Level	Pressurizer Water Level
	Manual Actuation	Manual Switch Position (CVCS Isolation Switch)
Block Turbine Bypass and Cooldown Turbine Bypass Valves	Low-Low T_{avg}	Reactor Coolant Temperature(2)
	Manual Actuation	Manual Switch Position (Turbine Bypass Block Switch)

Note 2: Reactor Coolant System hot leg (3 sensors) are spatially dependent variables.

Table 2.5.1-4 Interlocks Important to Safety

Containment Spray/Residual Heat Removal Pump Hot Leg Isolation Valve Open Permissive Interlock
Simultaneous-Open Block Interlock with Residual Heat Removal Discharge Line Containment Isolation Valve and Containment Spray Header Containment Isolation Valve
Simultaneous-Open Block Interlock with Containment Spray/Residual Heat Removal Pump Hot Leg Isolation Valve and Containment Spray Header Containment Isolation Valve
Reactor Makeup Water Line Isolation Interlock
Accumulator Discharge Valve Open Interlock
Component Cooling Water Supply and Return Header Tie Line Isolation Interlock
RCP Thermal Barrier Heat Exchanger Component Cooling Water Return Line Isolation Interlock

Table 2.5.1-5 Monitored Variables Using Signal Selection Algorithms (SSA)

Power Range Neutron Flux
Reactor Coolant Temperature
Pressurizer Pressure
Pressurizer Water Level
Steam Generator Water Level
Main Steam Line Pressure
Turbine Inlet Pressure

Table 2.5.1-6 RT System and ESF System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the RPS is as described in the design description and as shown in Figures 2.5.1-1 and 2.5.1-2.	1. An inspection of the as-built RPS will be performed.	1. The as-built RPS conforms to the functional arrangement as described in the design description and as shown in Figures 2.5.1-1 and 2.5.1-2.
2. The functional arrangements of the ESFAS, SLS, HSIS and DAS are as described in the design description and as shown in Figures 2.5.1-2 and 2.5.1-3.	2. An inspection of the as-built ESFAS, SLS, HSIS and DAS will be performed.	2. The as-built ESFAS, SLS, HSIS and DAS conform to the functional arrangement as described in the design description and as shown in Figures 2.5.1-2 and 2.5.1-3.
3. The functional arrangement of the RTB is as described in the design description and as shown in Figure 2.5.1-4.	3. An inspection of the as-built RTB will be performed.	3. The as-built RTB conforms to the functional arrangement as described in the design description and as shown in Figure 2.5.1-4.
4. PSMS switches in the MCR can be used to provide manual initiation for reactor trip and ESF actuations identified in Tables 2.5.1-2 and 2.5.1-3.	4. A test of the as-built equipment will be performed.	4. As-built PSMS switches in the MCR can be used to provide manual initiation for reactor trip and ESF actuations identified in Tables 2.5.1-2 and 2.5.1-3.
5. The seismic Category I equipment, identified in Table 2.5.1-1, can withstand seismic design basis loads without loss of safety function.	5.i Inspection will be performed to verify that the seismic Category I as-built equipment identified in Table 2.5.1-1 are located in the containment and reactor building.	5.i The seismic Category I as-built equipment identified in Table 2.5.1-1 is located in the containment and reactor building.
	5.ii Type tests and/or analyses of seismic Category I equipment will be performed.	5.ii The result of the type tests and/or analyses concludes that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.iii Inspection will be performed on the as-built equipment including anchorage.	5.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.

Table 2.5.1-6 RT System and ESF System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6. The Class 1E equipment identified in Table 2.5.1-1 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.i Type tests and/or analyses will be performed on Class 1E equipment located in a harsh environment.	6.i The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.5.1-1 as being qualified for a harsh environment can withstand the environmental conditions.
	6.ii Inspections will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.5.1-1 as being qualified for a harsh environment are bounded by type tests and/or analyses.
7. The RPS, ESFAS, SLS, safety VDU processor, and safety VDU are qualified to meet the electromagnetic conditions that would exist before, during, and following a design basis accident, with respect to its location in the facility, without loss of safety function for the time required to perform the safety function.	7. Type tests and/or analyses will be performed on the equipment.	7. A report exists and concludes that the RPS, ESFAS, SLS, safety VDU processor, and safety VDU are qualified to meet the electromagnetic conditions that would exist before, during, and following a design basis accident, with respect to its location in the facility, without loss of safety function for the time required to perform the safety function.
8. The Class 1E equipment listed in Table 2.5.1-1 is located in a facility area that provides protection from natural phenomena hazards such as tornadoes, and accident related hazards such as missiles, pipe breaks and flooding.	8. An inspection of the as-built equipment location will be performed.	8. The as-built equipment listed in Table 2.5.1-1 is located in a plant area that provides protection from natural phenomena hazards such as tornadoes, and accident related hazards such as missiles, pipe breaks and flooding.
9. The Class 1E equipment listed in Table 2.5.1-1 is powered from two safety related power sources: the first source is its respective Class 1E division and the second source is from another division to ensure reliable power to each PSMS.	9. Inspection of the as-built equipment will be performed.	9. The Class 1E equipment listed in Table 2.5.1-1 is powered from two safety related power sources: the first source is its respective Class 1E division and the second source is from another division to ensure reliable power to each PSMS.

Table 2.5.1-6 RT System and ESF System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10.a The PSMS and field equipment listed in Table 2.5.1-1 redundant divisions are physically and electrically independent of each other and physically and electrically independent of any non-safety divisions. Physical independence is provided by distance or barriers, which prevent propagation of fire or electrical faults. Electrical independence is achieved by using independent power sources and electrical circuits for each safety division and by using qualified electrical fault isolation devices at interfaces between redundant divisions and interfaces between safety and non-safety divisions.	10.a.i An inspection of the as-built equipment will be performed.	10.a.i The results of the inspection conclude that: 1) The as-built physical independence is provided by distance or barriers, which prevent propagation of fire or electrical faults. 2) The as-built electrical independence is achieved by maintaining separate power sources and electrical circuits for each division and by fiber optic cable interfaces, conventional isolators, or other proven isolation methods or devices at interfaces between redundant divisions and interfaces between safety and non-safety divisions.
	10.a.ii Type tests and/or analyses of the isolation devices will be performed.	10.a.ii The results of the type tests and/or analyses conclude that the isolation devices prevent credible faults.
10.b Digital communication independence is achieved between redundant divisions of the PSMS and field equipment listed in Table 2.5.1-1 or between non-safety divisions and the PSMS and field equipment listed in Table 2.5.1-1, by communication processing functions that are independent of trip and actuation processing functions.	10.b.i An inspection of the as-built equipment will be performed.	10.b.i The as-built communication independence is achieved by communication processing functions that are independent of trip and actuation processing functions.
	10.b.ii Type tests and/or analyses of the communication processing devices will be performed.	10.b.ii The results of the type tests and/or analyses conclude that the isolation devices prevent credible faults.
11. The PSMS provides the operator with: (1) automatic non-safety HSIS indications of the bypassed or inoperable status indication (BISI) for protective actions; and (2) the ability to manually actuate BISI for protective actions.	11. A test of the as-built equipment will be performed.	11. The as-built PSMS provides the operator with: (1) automatic non-safety HSIS BISI for protective actions and (2) the ability to manually actuate BISI for these protective actions.

Table 2.5.1-6 RT System and ESF System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
12. The PSMS cabinets have key locks and alarms, and are located in a secure area of the facility.	12.i A test of the as-built PSMS cabinets will be performed for key lock and alarms.	12.i Each cabinet of the as-built PSMS has a key lock and appropriate alarm measures.
	12.ii An inspection of the as-built PSMS cabinets will be performed for the installed location.	12.ii Each cabinet of the as-built PSMS is located in the secure area of the facility.
13. Redundant safety equipment of the PSMS and field equipment listed in Table 2.5.1-1 are provided with a clear means of identification. Identification shall not require frequent use of reference material.	13. An inspection of the as-built equipment will be performed.	13. Documentation exists that describes distinct color coding for each redundant division. The as-built equipment listed in Table 2.5.1-1 complies with the color coding documentation. Identification shall not require frequent use of reference material.
14.a.The PSMS initiates automatic reactor trips and ESF actuations, identified in Tables 2.5.1-2 and 2.5.1-3, when the plant process signals reach a predetermined limit.	14 a. A test of the as-built PSMS will be performed.	14 a.The as-built PSMS initiates automatic reactor trips and ESF actuations, identified in Tables 2.5.1-2 and 2.5.1-3, when the plant process signals reach a predetermined limit.
14b. Once initiated (automatically or manually), the intended sequences of safety-related functions of the PSMS continue until completion, and, after completion, deliberate operator action is required to return the safety related systems to normal.	14b. A test of the as-built PSMS will be performed.	14b. Once initiated (automatically or manually), the intended sequences of safety-related functions of the as-built PSMS continue until completion, and, after completion, deliberate operator action is required to return the safety related systems to normal.
15. Deleted.	15. Deleted.	15. Deleted.
16. The PSMS signals are derived from direct measurements.	16. An inspection of the as-built PSMS will be performed.	16. The as-built PSMS signals are derived from direct measurements.

Table 2.5.1-6 RT System and ESF System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
17.a The PSMS is designed to facilitate the timely recognition, location, replacement, repair and adjustment of malfunctioning components or modules.	17.a An inspection of the as-built PSMS will be performed.	17a. The as-built PSMS is designed to facilitate the timely recognition, location, replacement, repair and adjustment of malfunctioning components or modules.
17. b A single channel or division of the PSMS can be bypassed to allow on-line testing, maintenance or repair without impeding the safety function.	17. b Tests will be performed to confirm the as-built channel or division bypass capabilities and to confirm the function of the bypass interlock logic.	17. b A single channel or division of the as-built PSMS can be bypassed to allow on-line testing, maintenance or repair without impeding the safety function.
18. The PSMS automatically removes operating bypasses when permissive conditions are not met.	18. A test of the as-built PSMS will be performed.	18. The as-built PSMS automatically removes operating bypasses when permissive conditions are not met.
19. The PSMS setpoints are determined using a methodology based on proven nuclear industry standards. This methodology provides allowance for uncertainties between analytical limits and device setpoints.	19. An inspection will be performed to define the as-built PSMS setpoints in accordance with the acceptable methodology.	19. The as-built PSMS setpoints are determined using the acceptable methodology, which provides allowance for uncertainties between analytical limits and device setpoints based on proven nuclear industry standards.
20. Each division of the PSMS and field equipment listed in Table 2.5.1-1 is supplied from two safety-related Class 1E power sources. Either power source is sufficient to power each division of the PSMS.	20. A test of the as-built equipment will be performed.	20. Each division of the as-built PSMS and field equipment listed in Table 2.5.1-1 is supplied from two safety-related Class 1E power sources. Either power source is sufficient to power each division of the as-built PSMS.
21. The PSMS logic is designed to fail to a safe state such that loss of electrical power to a division of PSMS results in a reactor trip condition for that division. Loss of electrical power does not result in ESF actuation.	21. A test will be performed by disconnecting the electrical power to each division of the as-built PSMS.	21. Each division of the as-built PSMS will fail to a safe state upon loss of electrical power to the division (i.e., results in a reactor trip condition for that division), and loss of electric power does not result in ESF actuation.

Table 2.5.1-6 RT System and ESF System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
22. The instrumentation that is required to function during normal operation, anticipated operational occurrence (AOO) and postulated accident (PA) conditions is provided with adequate range to monitor operating events. The monitored variables are listed in Tables 2.5.1-2 and 2.5.1-3.	22. An inspection of the as-built instrumentation will be performed.	22. The as-built instrumentation that is required to function during normal operation, anticipated operational occurrence (AOO) and postulated accident (PA) conditions and that is listed in Tables 2.5.1-2 and 2.5.1-3 is provided with adequate range to monitor operating events.
23. The PSMS provides the interlocks important to safety identified in Table 2.5.1-4.	23. A test of the as-built PSMS will be performed.	23. The as-built PSMS provides the interlocks important to safety identified in Table 2.5.1-4 when the simulated plant process signals reach a predetermined limit.
24. The PSMS hardware and software are developed and managed by a life cycle process that meets the regulatory requirements for Class 1E safety systems, and which encompasses the entire product life cycle including software V&V, configuration management and cyber security.	24. Inspections of the as-built hardware and software life cycle documentation of the PSMS will be performed.	24. The as-built PSMS hardware and software are developed and managed by a life cycle process that meets the regulatory requirements for Class 1E safety systems, and which encompasses the entire product life cycle including software V&V, configuration management and cyber security.
25. Manual controls from the operational VDU can be blocked and disabled manually from the safety VDU. The logic in the SLS blocks non-safety signals from the PCMS when any safety function signal is present, such as a safety interlock or ESF actuation signal.	25. An inspection of the as-built PSMS functions will be performed.	25. Manual controls from the operational VDU can be blocked and disabled manually from the as-built safety VDU. The logic in the as-built SLS blocks non-safety signals from the PCMS when any safety function signal is present, such as a safety interlock or ESF actuation signal.

Table 2.5.1-6 RT System and ESF System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 7 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
26. A signal selector algorithm (SSA) is provided in the PCMS for the monitoring variables as listed in Table 2.5.1-5 to ensure the PCMS does not take an erroneous control action that results in a condition which requires RT or ESF action to consider a single instrument channel failure or a single RPS train failure.	26. An inspection of the as-built SSA functional arrangement will be performed.	26. The as-built PSMS and PCMS conform to the functional arrangement of the SSA functions as described in the design description and Table 2.5.1-5.
27. Input sensors from each PSMS are compared continuously in the PCMS to detect abnormal deviations for checking the operational availability of each PSMS input sensor that may be required for a safety function during reactor operation.	27. An inspection of the as-built PSMS and PCMS functions will be performed.	27. The input sensors from each as-built PSMS are compared continuously in the as-built PCMS to detect abnormal deviations.
28. The spatially dependent sensors that are required for protective actions are identified in Table 2.5.1-2 and Table 2.5.1-3.	28. An inspection of the as-built spatially dependent sensors required for protective actions will be performed.	28. The as-built PSMS includes the minimum number and locations of spatially dependent sensors that are required for protective actions as identified in Table 2.5.1-2 and Table 2.5.1-3.
29a. ESF systems are automatically initiated from signals that originate in the RPS.	29a. A test of the as-built PSMS will be performed.	29a. As-built ESF systems are automatically initiated from signals that originate in the as-built RPS.
29b. Manual actuation of ESF systems is carried out through a diverse signal path that bypasses the RPS.	29b. A test of the as-built PSMS will be performed.	29b. Manual actuation of the as-built ESF systems is carried out through a diverse signal path that bypasses the as-built RPS.

Table 2.5.1-6 RT System and ESF System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 8 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
30a. The PSMS digital platform is developed by a design process that has been determined to be equivalent to the regulatory requirements for Class 1E safety systems, including V&V of programmable functions and devices, configuration management and cyber security. Equivalence has been determined through an evaluation conducted by persons independent of the platform developers and under a quality program that meets the requirements of 10CFR50 Appendix B. The equivalence evaluation determines that the digital platform contains the critical characteristics and built-in quality necessary for Class 1E safety systems, in accordance with the commercial grade dedication requirements of 10CFR21.	30a. Inspections of the commercial grade dedication report for the PSMS digital platform will be performed.	30a. The report exists and concludes that the PSMS digital platform contains the critical characteristics and built-in quality necessary for Class 1E safety systems.
30b. After commercial grade dedication, the PSMS digital platform is managed by a life cycle process that meets the regulatory requirements for Class 1E safety systems. The Class 1E product life cycle management encompasses manufacturing, configuration management, design change management, error reporting and corrective actions, and cyber security.	30b. Inspections of the post-development life cycle documentation of the PSMS digital platform will be performed.	30b. The PSMS digital platform is managed by a life cycle process that meets the regulatory requirements for Class 1E safety systems.

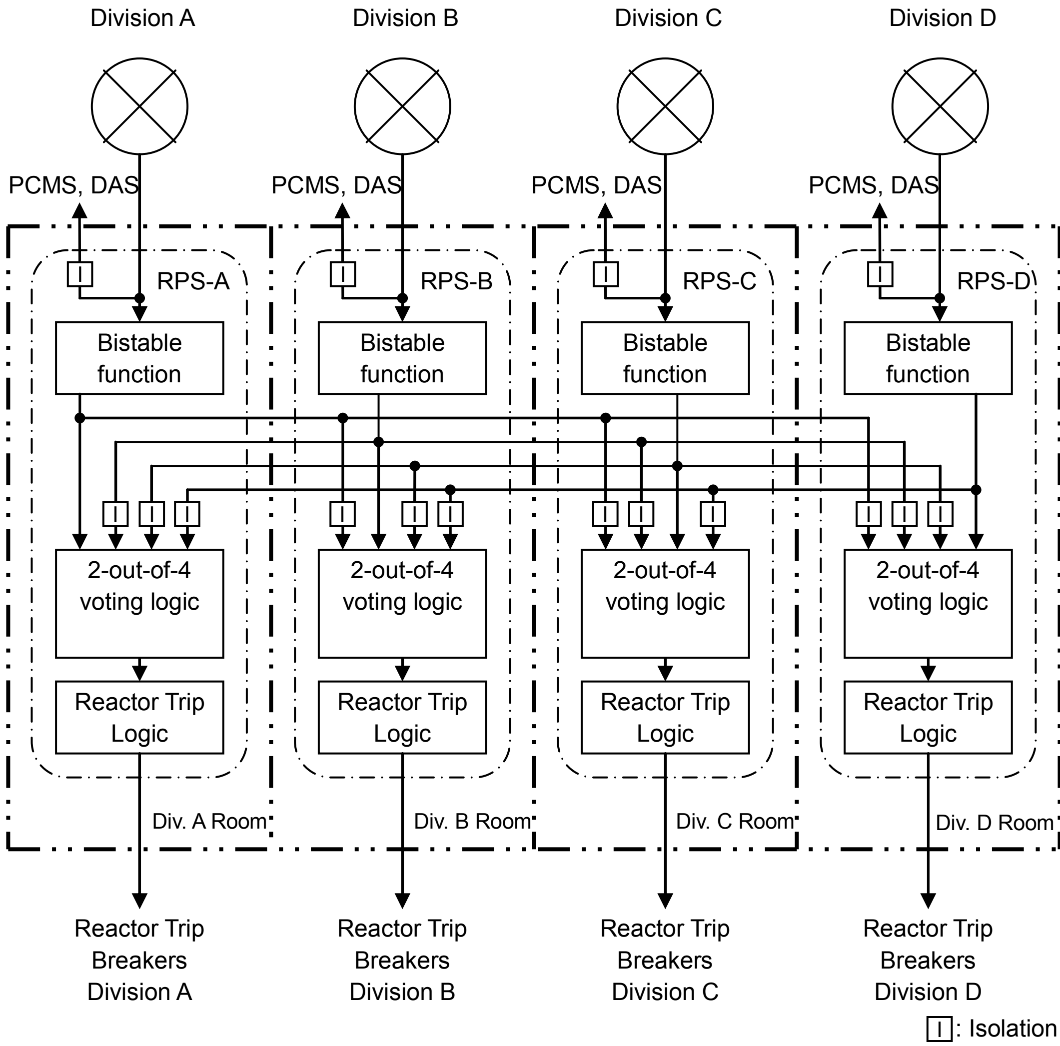


Figure 2.5.1-1 Configuration of the Reactor Trip System

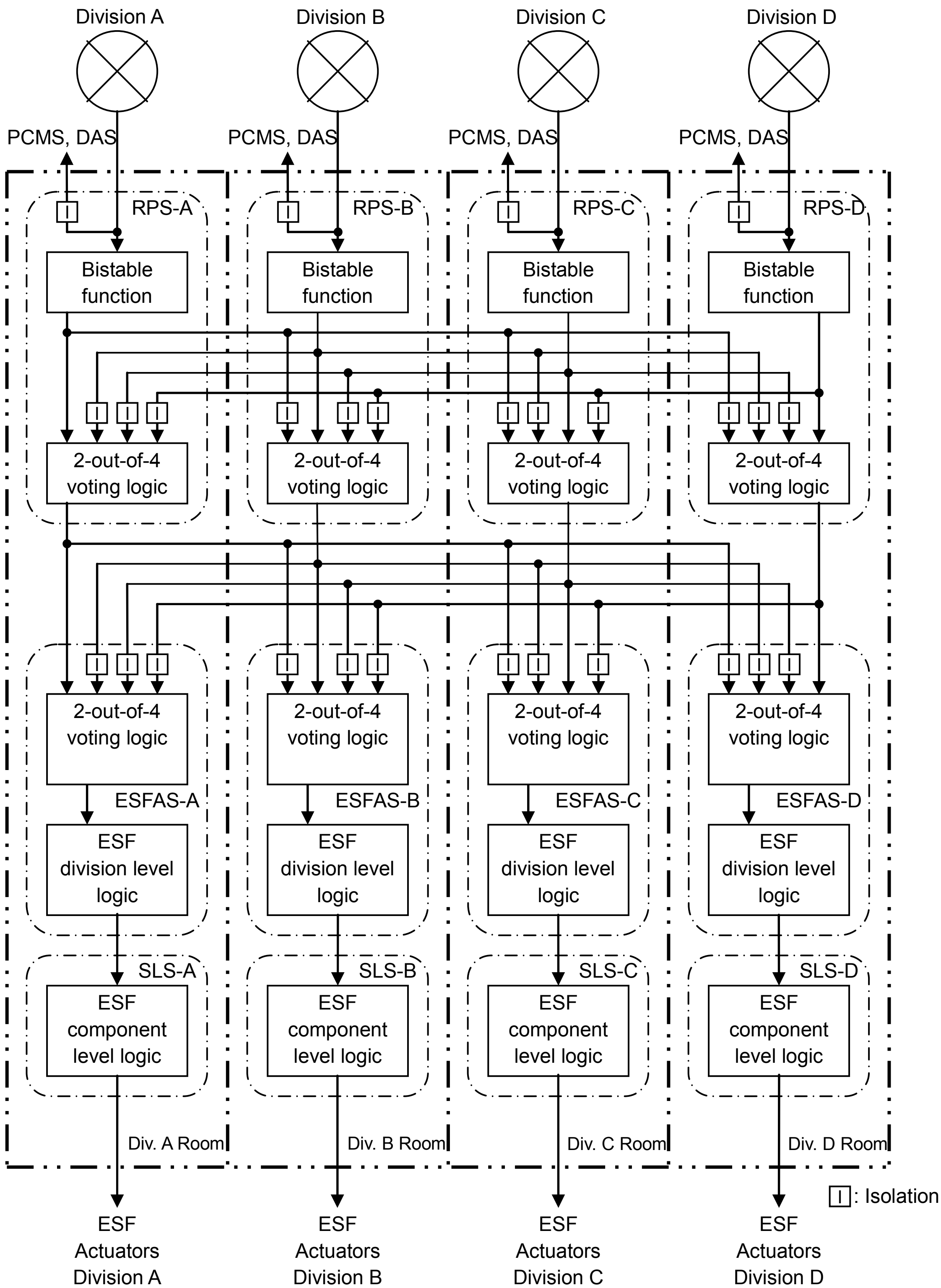


Figure 2.5.1-2 Configuration of the Engineered Safety Feature System

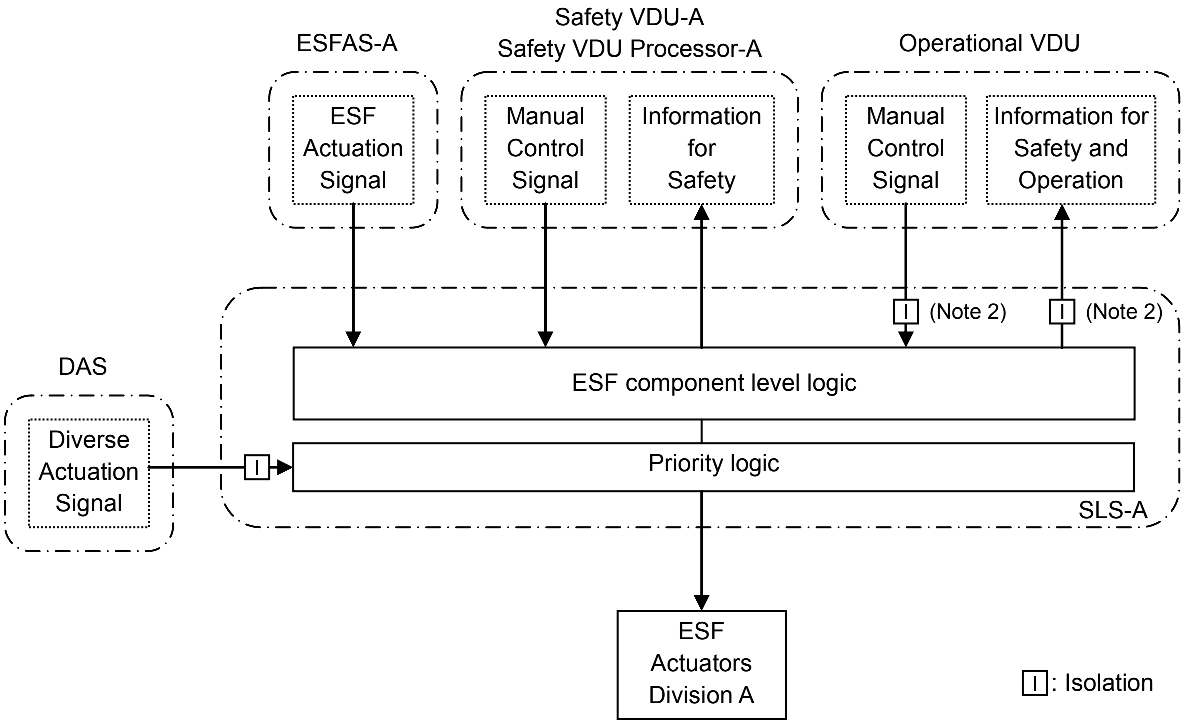
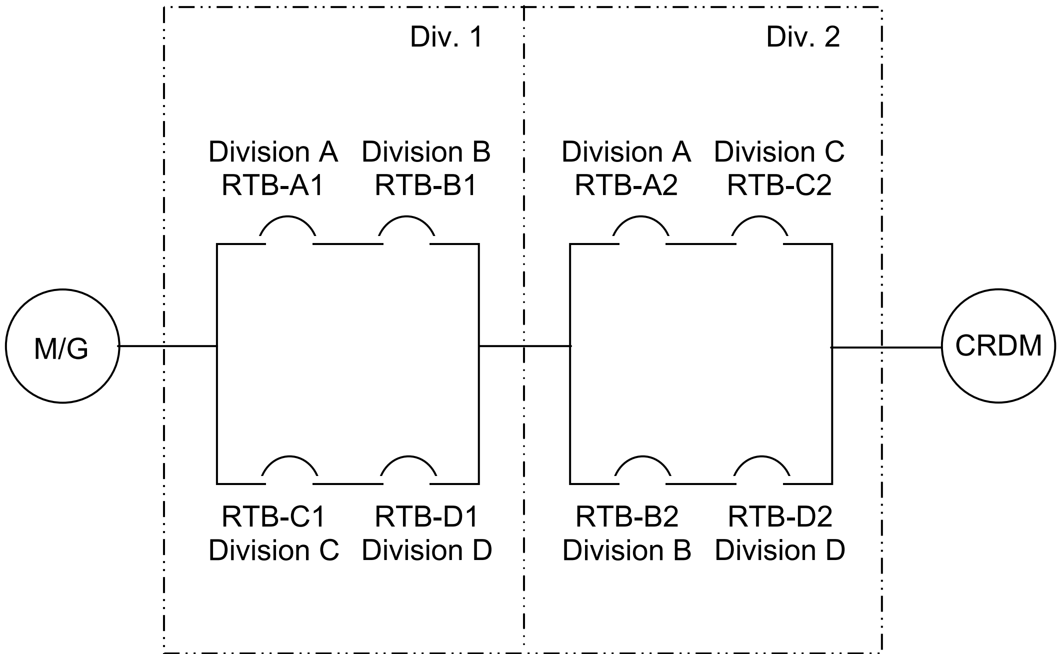


Figure 2.5.1-3 Configuration of the Safety Grade Component Control System



M/G: Motor-Generator Set

CRDM: Control Rod Drive Mechanism

Note: Div. 1 and Div. 2 show the separate fire area.

Figure 2.5.1-4 Configuration of the Reactor Trip Breakers

2.5.2 Systems Required for Safe Shutdown

2.5.2.1 Design Description

The safe shutdown is achieved from the MCR or the remote shutdown room (RSR) using safety-related instrumentation and control (I&C) systems of the PSMS, including the RPS, ESFAS, SLS and safety VDUs. The operational VDUs may also be used for monitoring safety-related instrumentation and manually controlling safety components. The normal shutdown can be achieved using non-safety instrumentation and non-safety component controls via the PCMS, including the operational VDUs, in addition to the above safety-related I&C systems. There are no plant systems specifically and solely dedicated for the safe and normal shutdown systems.

The remote shutdown console (RSC) is located in the RSR. The RSR is capable of being locked to prevent inadvertent access. Access to the RSC, and the MCR/RSR transfer systems including the transfer switches, is through secured areas with key access. Any access to these areas is indicated and alarmed in the MCR.

The systems required for the safe shutdown perform two basic functions. First, they provide the necessary reactivity control to maintain the core in a sub-critical condition. Second, the systems provide the RHR capability to maintain adequate core cooling. A boration capability is provided to compensate for xenon decay and to maintain the required core shutdown margin.

Manual controls through the safety VDUs or the operational VDUs in the MCR or the RSR, allow operators to transition to and maintain hot standby, and transition to and maintain cold shutdown. If the MCR is uninhabitable, the same control and monitoring of the safe shutdown and the normal shutdown functions can be performed from the RSR. Transfer of control from the MCR to the RSR is provided for each PSMS division and for the PCMS. When the MCR is enabled, failures in the RSR, including electrical faults due to fire, cannot adversely affect the ability to achieve and maintain the safe shutdown from the MCR. Similarly, when the RSR is enabled, failures in the MCR, including electrical faults due to fire, cannot adversely affect the ability to achieve and maintain safe shutdown from the RSR.

Upon manual reactor trip from the RSC, once initiated, the intended sequences of safety-related functions of the execute features continue until completion.

Figure 2.5.2-1 shows the configuration of the SLS and HSIS for implementation of the safe shutdown functions. The safe shutdown can be achieved and maintained using redundant plant instrumentation and components, through redundant divisions of the PSMS. The PSMS redundancy, independence, testability, qualification, quality and life cycle descriptions of Subsection 2.5.1 are also applicable to the safe shutdown functions of the PSMS.

Redundant safety related equipment of the safe shutdown system are provided with a clear means of identification. Identification shall not require frequent use of reference material.

The safe shutdown functions and related process systems are identified in Tables 2.5.2-1 and 2.5.2-2.

2.5.2.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.5.2-3 describes the ITAAC for the systems required for safe shutdown.

Table 2.5.2-1 Safe shutdown Functions and Related Process Systems for Hot Standby

Reactor Trip
RCS Heat Removal
RCS Pressure Control
HVAC Functions to the required areas
Emergency Power Supply in the event of LOOP*[1]

Note1: Loss of Offsite Power

Table 2.5.2-2 Safe shutdown Functions and Related Process Systems for Cold Shutdown

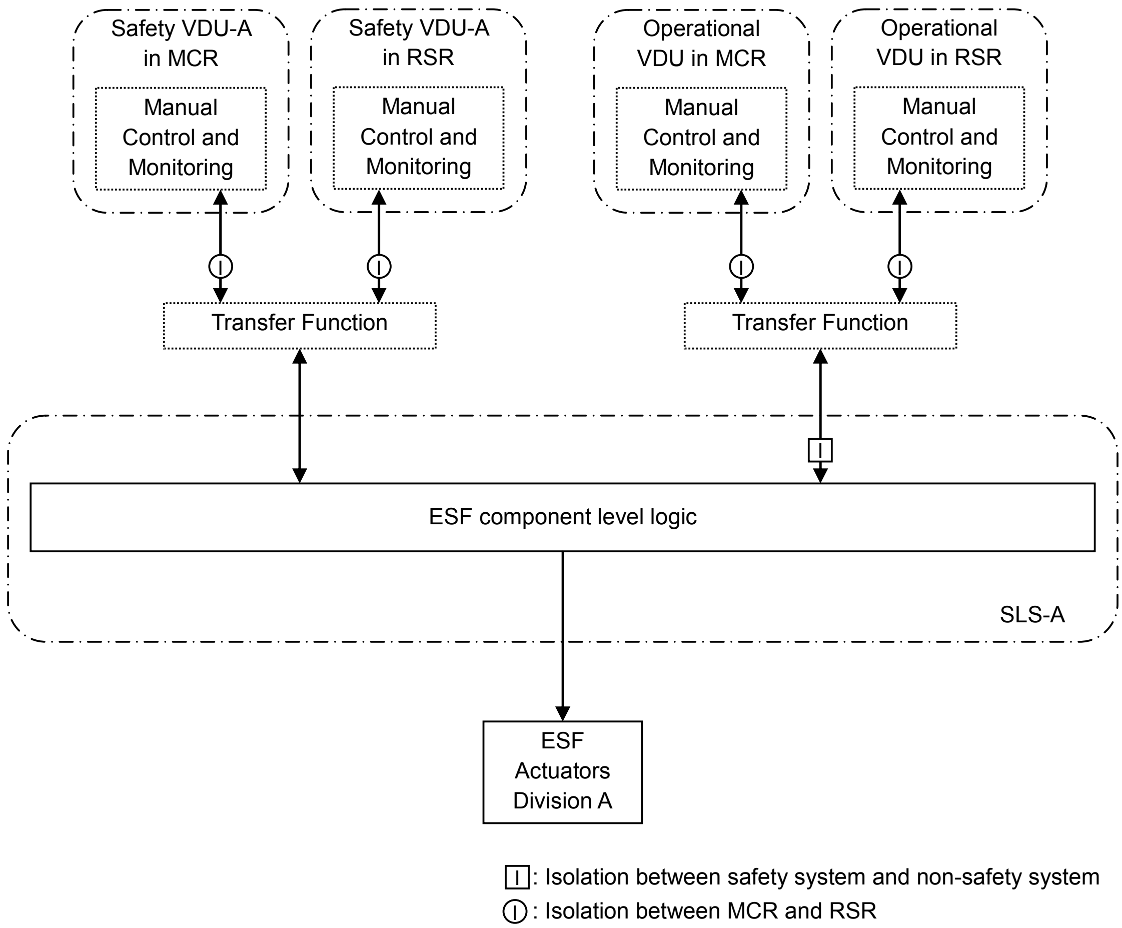
RCS Heat Removal
RCS Pressure Control
Boric Acid Water Supply to RCS
Component Cooling
HVAC Functions to the required areas
Neutron Flux Monitoring
Operating Bypass for ECCS
Emergency Power Supply in the event of LOOP

Table 2.5.2-3 Systems Required for Safe Shutdown Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The systems required for safe shutdown control and monitor appropriate functions and related process systems identified in Tables 2.5.2-1 and 2.5.2-2.	1. An inspection of the as-built systems required for safe shutdown will be performed.	1. The as-built systems required for safe shutdown conform to the functions and related process systems as described in the design description and as shown in Tables 2.5.2-1 and 2.5.2-2.
2.a The PSMS provides for the transfer of control capability from the MCR to the RSR. Separate transfer capability is provided for each of the four PSMS divisions.	2.a A test of the as-built PSMS transfer capability will be performed.	2.a The as-built PSMS provides for the transfer of control capability from the MCR to the RSR. Separate transfer capability is provided for each of the four as-built PSMS divisions.
2.b The PCMS provides for the transfer of control capability from the MCR to the RSR.	2.b A test of the as-built PCMS transfer capability will be performed.	2.b The as-built PCMS provides for the transfer of control capability from the MCR to the RSR.
2.c The transfer of control capability from the MCR to the RSR is fully testable in accordance with Technical Specification periodic surveillance requirements.	2.c A test of the as-built transfer capability will be performed.	2.c The as-built transfer of control capability from the MCR to the RSR is fully testable in accordance with Technical Specification periodic surveillance requirements.
3. Electrical isolation is provided between the MCR and RSR.	3. An inspection of the as-built PSMS and PCMS will be performed.	3. The as-built PSMS and PCMS provide electrical isolation between the MCR and the RSR.

Table 2.5.2-3 Systems Required for Safe Shutdown Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4. The RSC is located in the RSR. The RSR is capable of being locked to prevent inadvertent access. Access to the RSC, and the MCR/RSR transfer systems including the transfer switches, is through secured areas with key access. Any access to these areas is indicated and alarmed in the MCR.	4. An inspection of the as-built systems required for safe shutdown will be performed.	4. The as-built RSC is located in the RSR. The as-built RSR is capable of being locked to prevent inadvertent access. Access to the RSC, and the MCR/RSR transfer systems including the transfer switches, is through secured areas with key access. Any access to these areas is indicated and alarmed in the as-built MCR.
5. Redundant safety related equipment of the safe shutdown system are provided with a clear means of identification. Identification shall not require frequent use of reference material.	5. An inspection of the as-built equipment will be performed.	5. Documentation exists that describes distinct color coding for each redundant division. The as-built equipment of the safe shutdown system complies with the color coding documentation. Identification shall not require frequent use of reference material.
6. The functional arrangement of the safe shutdown system is as described in the Design Description and as shown in Figure 2.5.2-1.	6. An inspection of the as-built safe shutdown system will be performed.	6. The as-built safe shutdown system conforms to the functional arrangement as described in the Design Description and as shown in Figure 2.5.2-1.
7. Upon manual reactor trip from the RSC, once initiated, the intended sequences of safety-related functions of the execute features continue until completion.	7. A test of the as-built RSC will be performed.	7. Upon manual reactor trip from the as-built RSC, once initiated, the intended sequences of safety-related functions of the execute features continue until completion.



Note: Division A system is shown for the representative configuration.

Figure 2.5.2-1 Configuration of the SLS and HSIS for Safe Shutdown

2.5.3 Diverse Actuation System

2.5.3.1 Design Description

The DAS is a non-safety system that is diverse from the software of the PSMS, and is also diverse from the hardware used in the reactor trip function of the RT system. The DAS provides monitoring, control and actuation of the safety and the non-safety systems required to mitigate the AOOs and the PAs concurrent with a common cause failure (CCF) that could disable the functions of the PSMS and the PCMS.

The DAS design consists of equipment that is diverse and independent from the digital platforms of the PSMS and PCMS. The DAS includes internal redundancy to prevent spurious actuation of automatic or manual functions due to a single component failure.

The DAS consists of two divisions. Both divisions must actuate in a 2-out-of-2 configuration to generate diverse actuation signals to plant components. Each division consists of a diverse automatic actuation cabinet (DAAC). A diverse HSI panel (DHP) includes HSI components for both divisions.

The DAACs provide automatic actuation functions for conditions where there is insufficient time for manual operator action needed for the accident mitigation. The DHP provides indications, alarms and manual actuation for mitigation actions, where there is sufficient time for manual operation action needed for the accident mitigation. In addition, the DHP provides indications and system level manual controls to maintain critical safety functions, indications and alarms for RCS leak detection monitoring, and indications and manual controls to achieve and maintain the hot standby (refer to Tables 2.5.3-1, 2.3.3-2 and 2.5.3-3).

The DAACs are located in two separate I&C rooms. Each DAAC is powered by a separate non-safety uninterruptible power source (UPS). The DHP is located in the MCR.

The DAS sensor input signals and output actuation signals are isolated within the PSMS to prevent adverse interactions with the PSMS safety functions due to the DAS failures. Isolated the DAS actuation signals are interfaced to output modules within the SLS and PCMS. These modules consist of the Class 1E logic elements which are not affected by a PSMS and PCMS software CCF. This ensures that the DAS signal is not affected by a PSMS and PCMS software CCF. The SLS and PCMS output modules, which are also used for the DAS, are not used for the PSMS reactor trip function. Therefore, the DAS signal is not affected by a hardware CCF in the PSMS that could result in an anticipated transient without scram (ATWS). Once diverse automatic actuation signals (reactor trip, turbine trip, main feedwater isolation and emergency feedwater) are generated from the DAAC, these signals are latched.

During the plant online operation, the system can be tested manually without causing component actuations that would disturb the plant operations.

The DAS utilizes conventional hardware circuits (analog circuits, solid-state logic processing, relay circuits, switches, etc.). Therefore, a software CCF in the digital safety and non-safety systems (PSMS and PCMS), would not affect the DAS. Figure 2.5.3-1 shows the configuration of the DAS. The quality of DAS components and modules, and the quality of the DAS design process is controlled by an augmented quality program that meets the regulatory requirements for ATWS equipment.

2.5.3.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.5.3-4 describes the ITAAC for the DAS.

Table 2.5.3-1 Variables Monitored by DAS

Critical Safety Function	Variables
Reactivity Control	Wide Range Neutron Flux
RCS Integrity	Pressurizer Pressure
	Reactor Coolant Pressure
Core Heat Removal	Reactor Coolant Cold Leg Temperature
RCS Inventory Control	Pressurizer Water Level
Secondary Heat Sink	Steam Generator Water Level
	Main Steam Line Pressure
Containment Integrity	Containment Pressure

Table 2.5.3-2 Equipment Actuated by DAS

Safety Function/Associated Components	Actuation Type
Diverse Reactor Trip (M/G set trip)	Automatic/Manual (MCR)
Turbine Trip	Automatic/Manual (MCR)
Emergency Feedwater Pump	Automatic/Manual (MCR)
ECCS Pump	Manual (MCR)
Safety Depressurization Valve	Manual (MCR)
Main Steam Depressurization Valve	Manual (MCR)
Steam Generator Blowdown Isolation Valve	Automatic/Manual (MCR)
Main Feedwater Regulation Valve	Automatic/Manual (MCR)
Emergency Feedwater Control Valve	Manual (MCR)
Containment Isolation Valves	Manual (MCR)

Table 2.5.3-3 DAS Functions and Actuation Signals

DAS Function	Actuation Signal
Reactor Trip, Turbine Trip and Main Feedwater Isolation	Low Pressurizer Pressure
	High Pressurizer Pressure
	Low Steam Generator Water Level
	Manual Switch Signal
Emergency Feedwater Actuation	Low Steam Generator Water Level
	Manual Switch Signal
ECCS Actuation	Manual Switch Signal
Containment Isolation	Manual Switch Signal

Table 2.5.3-4 Diverse Actuation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a The DAS has the following configuration: • The functional arrangement of the DAS is as described in the design description and as shown in Figure 2.5.3-1. • Automatic and manual functions to allow coping with either an AOO or PA. Refer to Table 2.5.3-1 for monitored variables, Table 2.5.3-2 for actuated equipment and Table 2.5.3-3 for DAS functions and initiating signals.	1.a An inspection of the as-built DAS will be performed for functional arrangement and configuration of the DAS.	1.a The as-built DAS conforms to the functional arrangement and configuration as described in the design description and as shown in Figure 2.5.3-1. The as-built DAS is configured with the monitored variables in Table 2.5.3-1, the actuated equipment in Table 2.5.3-2, and the DAS automatic and manual functions and initiating signals in Table 2.5.3-3 to allow coping with an AOO and PA.
1.b Deleted.	1.b Deleted.	1.b Deleted
1.c The DAS is physically and electrically independent from the PSMS. Physical independence is provided by distance or barriers, which prevent propagation of fire or electrical faults. Electrical independence is achieved by using independent power sources and electrical circuits and by using qualified electrical fault isolation devices.	1.c An inspection of the as-built DAS will be performed for independence of the DAS from the PSMS.	1.c The as-built DAS is physically and electrically independent from the as-built PSMS. Physical independence is provided by distance or barriers, which prevent propagation of fire or electrical faults. Electrical independence is achieved by using independent power sources and electrical circuits and by using qualified electrical fault isolation devices.

Table 2.5.3-4 Diverse Actuation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.d The DAS is designed to prevent spurious actuation due to credible single failures or due to a fire. Spurious actuations are prevented by the DAS design configuration. Automatic DAS functions are actuated by two subsystems and DAS actuation needs coincidence of both subsystems. The DAS is designed to prevent spurious actuation due to a seismic event. Thus the SSE will not result in a DAS failure that adversely affects the safety system. The redundant DAS cabinets are located in separate fire areas to prevent spurious actuation from a fire in one area.	1.d An analysis of the as-built DAS will be performed.	1.d The as-built DAS is designed to prevent spurious actuation due to credible single failures or due to a fire. Automatic DAS functions are actuated by two subsystems and DAS actuation needs coincidence of both subsystems. The DAS is designed to prevent spurious actuation due to a seismic event. The redundant DAS cabinets are located in separate fire areas to prevent spurious actuation from a fire in one area.

Table 2.5.3-4 Diverse Actuation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.The DAS has the following capabilities: • Operates with both DAAC divisions operable (i.e., in a two-out-of-two configuration), or with one division manually tripped and one division operable. • The system can be tested manually without causing component actuation which would disturb plant operations. • Loss of power or removal of a module does not cause spurious DAS actuation. • Capability to bypass failed sensors functions. • The DHP provides system level manual controls to maintain critical safety functions as described in the Design Description.	2. Tests of the as-built DAS will be performed. The tests will include tests of the manual controls as well as simulated signal inputs to test the system.	2. A report exists and concludes that the as-built DAS has the following capabilities: • Operates with both as-built DAAC divisions operable (i.e., in a two-out-of-two configuration), or with one division manually tripped and one division operable. • The system can be tested manually without causing component actuation which would disturb plant operations. • Loss of power or removal of a module does not cause spurious DAS actuation. • Capability to bypass failed sensors functions. • The as-built DHP provides system level manual controls to maintain critical safety functions as described in the Design Description.

Table 2.5.3-4 Diverse Actuation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3. The DAS equipment, including input/ output interfaces, signal processing and HSI, consists of conventional hardware circuits (analog circuits, solid-state logic processing, relay circuits, switches, etc.), and is diverse from software used within the PSMS.	3. Inspection of the as-built DAS and the software within the as-built PSMS will be performed.	3. The as-built DAS equipment consists of conventional hardware circuits (analog circuits, solid-state logic processing, relay circuits, switches, etc.), and is diverse from software used within the as-built PSMS.
4. The DAS equipment used for the ATWS mitigation (i.e., reactor trip, turbine trip and emergency feedwater actuation) consists of conventional hardware circuits (analog circuits, solid-state logic processing, relay circuits, switches, etc.), and is diverse from the hardware used for the reactor trip function of the PSMS. This design commitment does not apply to measurement instrumentation and signal splitters, which distribute measurement signals to the DAS and the PSMS.	4. Inspection of the as-built DAS and RT system hardware within the as-built PSMS will be performed.	4. The as-built DAS equipment used for the ATWS mitigation (i.e., reactor trip, turbine trip and emergency feedwater actuation) consists of conventional hardware circuits (analog circuits, solid-state logic processing, relay circuits, switches, etc.), and is diverse from the hardware used for the reactor trip function of the as-built PSMS.
5. The quality of DAS components and modules and the quality of the DAS design process are controlled by an augmented quality program that meets the regulatory requirements.	5. Inspection of the QA program will be performed.	5. The QA program assures the quality of as-built DAS components and modules and the quality of the DAS design process are controlled by an augmented quality program that meets the regulatory requirements.

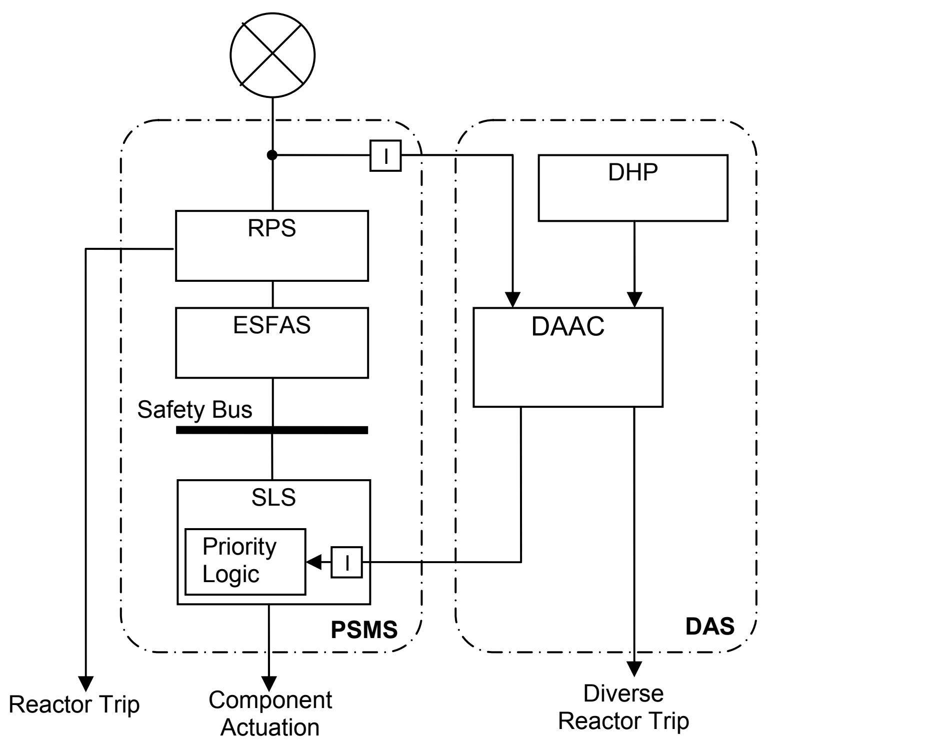


Figure 2.5.3-1 DAS Configuration

2.5.4 Information Systems Important to Safety

2.5.4.1 Design Description

The PSMS and PCMS provide plant operators with the information systems important to safety for: (1) assessing plant conditions and safety system performance, and making decisions related to plant responses to abnormal events; and (2) preplanned manual operator actions related to accident mitigation. The information systems important to safety also provide the necessary information from which appropriate actions can be taken to mitigate the consequences of the AOOs.

The information important to safety includes the following:

- Post accident monitoring (PAM)
- Bypassed and inoperable status indication (BISI)
- Plant annunciators (alarms)
- Safety parameter displays system (SPDS)
- Information and control for credited manual operator actions

The necessary information important to safety is available for the display at the following facilities:

- Main control room (MCR)
- Remote shutdown room (RSR)
- Technical support center (TSC)
- Emergency operations facility (EOF)

Controls for credited manual operator actions are available in the MCR.

Figure 2.5.4-1 shows the configuration of the PSMS and PCMS for implementation of the information systems important to safety. The PSMS redundancy, independence, testability, qualification, quality and life cycle descriptions of Subsection 2.5.1 are also applicable to the information systems important to safety within the PSMS. The PCMS redundancy, qualification and quality descriptions applicable to the information systems important to safety are as described in Subsection 2.5.5.

The PAM variables are identified in Table 2.5.4-1.

2.5.4.2 Inspections, Tests, Analyses, and Acceptance Criteria

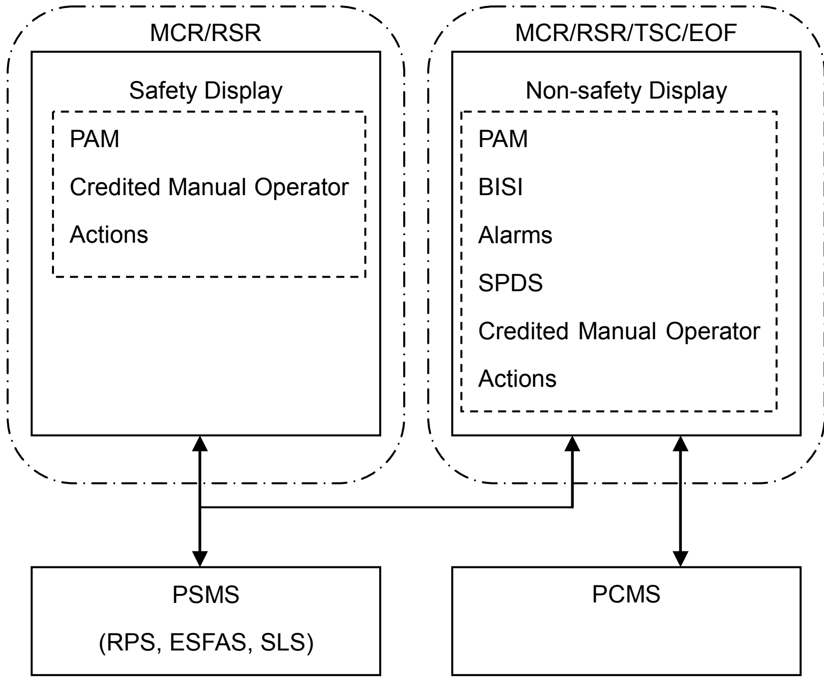
Table 2.5.4-2 describes the ITAAC for the information systems important to safety.

Table 2.5.4-1 Post Accident Monitoring Variables

Reactor Coolant Hot Leg Temperature (Wide Range)
Reactor Coolant Cold Leg Temperature (Wide Range)
Reactor Coolant Pressure
Degrees of Subcooling
Pressurizer Water Level
Steam Generator Water Level (Wide Range)
Steam Generator Water Level (Narrow Range)
Main Steam Line Pressure
Emergency Feedwater Flow
Wide Range Neutron Flux
Core Exit Temperature
Containment Pressure
Reactor Vessel Water Level
Containment Isolation Valve Position (Excluding Check Valves)
Refueling Water Storage Pit Water Level (Wide Range)
Refueling Water Storage Pit Water Level (Narrow Range)
Emergency Feedwater Pit Water Level
Containment High Range Area Radiation

Table 2.5.4-2 Information Systems Important to Safety Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. Information systems important to safety (PAM, BISI, alarms, SPDS) are appropriately displayed and alarmed in the MCR, RSR, TSC and EOF, as appropriate.	1. A test will be performed to demonstrate alarm, display and control capabilities for information systems important to safety.	1. The as-built information systems important to safety (PAM, BISI, alarms, SPDS) are appropriately displayed and alarmed in the MCR, RSR, TSC and EOF, as appropriate.
2. Information and controls for credited manual operator actions are provided in the MCR.	2. A test of the as-built PSMS and PCMS will be performed.	2. The information and controls for credited manual operator actions are provided in the as-built MCR.
3. The field instrumentation for the PAM variables identified in Table 2.5.4-1 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	3.i Type tests and/or analyses will be performed on the field instrumentation located in a harsh environment.	3.i The results of the type tests and/or analyses conclude that the field instrumentation for the PAM variables identified in Table 2.5.4-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	3.ii Inspections will be performed on the as-built field instrumentation and the associated wiring, cables, and terminations located in a harsh environment.	3.ii The as-built field instrumentation and the associated wiring, cables, and terminations identified in Table 2.5.4-1 as being qualified for a harsh environment are bounded by type tests and/or analyses.
4. The functional arrangement of the information systems important to safety is as described in the Design Description and as shown in Figure 2.5.4-1	4. An inspection of the as-built information systems important to safety will be performed.	4. The as-built information systems important to safety conform to the functional arrangement as described in the Design Description and as shown in Figure 2.5.4-1.



Note: Controls for credited manual operator actions are available in the MCR.

Figure 2.5.4-1 Configuration of the PSMS and PCMS for Information Systems Important to Safety

2.5.5 Control Systems Not Required for Safety

2.5.5.1 Design Description

The non-safety PCMS provides for automatic and manual control of non safety-related plant components and monitoring of non safety-related plant instrumentation. The operational VDUs which are part of the PCMS, provide monitoring and control for safety-related plant components and instrumentation, including monitoring and control for the credited manual operator actions. The PCMS regulates conditions in the plant automatically in response to changing plant processes and load demand to establish and maintain the plant operating conditions within the prescribed limits. The PCMS controls and monitors neutron flux, temperatures, pressures, liquid levels, flows and other process parameters through out the plant.

The PCMS is fully redundant to ensure credible single malfunctions do not result in loss of any control, monitoring or alarm functions. The PCMS is powered from two non safety-related UPSs to ensure reliability.

The PCMS is tested to meet the environmental, seismic and EMI/RFI conditions without loss of function. The PCMS hardware and software are developed in accordance with a design process and QA program that ensure highly reliable equipment and safe operation. These programs encompass the entire product life cycle including software verification and validation, configuration management, and cyber security.

Some safety-related signals used by the PSMS are also used by the PCMS for control functions. The PCMS includes signal selection logic that ensures a single failed protection channel does not cause erroneous control system actions.

2.5.5.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.5.5-1 describes the ITAAC for the control systems not required for safety.

Table 2.5.5-1 Control Systems Not Required for Safety Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The following systems are controlled and monitored by the PCMS: • Rod Control • Pressurizer Pressure Control • Pressurizer Water Level Control • Steam Generator Water Level Control • Turbine Bypass Control • Balance of Plant Control • Turbine Electro-Hydraulic Governor Control • Turbine Protection Control • Electrical System Control • Auxiliary Equipment Control • Safety Related Plant Equipment through Operational VDUs	1. An inspection of the as-built PCMS functional arrangement will be performed.	1. The following systems are controlled and monitored by the as-built PCMS: • Rod Control • Pressurizer Pressure Control • Pressurizer Water Level Control • Steam Generator Water Level Control • Turbine Bypass Control • Balance of Plant Control • Turbine Electro-Hydraulic Governor Control • Turbine Protection Control • Electrical System Control • Auxiliary Equipment Control • Safety Related Plant Equipment through Operational VDUs

Table 2.5.5-1 Control Systems Not Required for Safety Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2. The following systems are monitored by the PCMS: • Nuclear Instrumentation System • Rod Position Indication System • Incore Instrumentation System • Turbine Supervisory Instrumentation System • Radiation Monitoring System • Safety Related Plant Instrumentation through Operational VDUs	2. An inspection of the as-built PCMS functional arrangement will be performed.	2. The following systems are monitored by the as-built PCMS: • Nuclear Instrumentation System • Rod Position Indication System • Incore Instrumentation System • Turbine Supervisory Instrumentation System • Radiation Monitoring System • Safety Related Plant Instrumentation through Operational VDUs
3. The PCMS includes signal selection logic which ensures a single failed protection measurement channel does not cause erroneous control system actions, while another protection channel is continuously bypassed or out of service.	3. An inspection of the as-built PCMS will be performed.	3. The as-built PCMS includes signal selection logic which ensures a single failed protection measurement channel does not cause erroneous control system actions, while another protection channel is continuously bypassed or out of service.

2.5.6 Data Communication Systems

2.5.6.1 Design Description

The data communication systems (DCS) consist of:

- Plant-wide unit bus
- Safety bus (for each PSMS division)
- Data links for point-to-point communication
- Input/Output (I/O) bus
- Maintenance network for each PSMS division and the PCMS

The DCS is a distributed and highly interconnected system, which has communication independence to prevent electrical and communication processing faults in one division (safety or non-safety) from affecting the performance of any other safety or non-safety functions in other divisions. Qualified fiber-optic isolators are used to prevent electrical faults from transferring between divisions. Communication faults are prevented through data integrity verification.

The safety-related portions of the DCS are located in a facility area that provides protection from natural phenomena hazards such as tornadoes, and accident related hazards such as missiles, pipe breaks and flooding. Figure 2.5.6-1 shows the configuration of the DCS.

Unit Bus, Safety Bus and Station Bus

Redundant multi-drop network technology is utilized for the plant-wide unit bus and the safety bus. The safety bus provides safety-related data communication within each PSMS division. There is a separate safety bus for each PSMS division. The unit bus provides non-safety data communication between the PSMS and the PCMS, and within the PCMS.

The station bus provides information to plant and corporate personnel and to the EOF and ERDS. The station bus receives information from the DCS via the unit management computer (UMC), which is connected to the unit bus. The UMC provides a firewalled interface, which allows only outbound communication from the unit bus to the station bus. There are no other connections from external sources to the DCS.

Data Link

A non-redundant data link communication is used to transmit signals between the control elements in different divisions and within control elements of the same division. There are multiple data links. Each provides point to point communication. The data links within the PSMS are safety-related. The data links within the PCMS are non safety-related.

I/O Bus

The I/O bus communication is applied between the main CPU and the I/O modules of the control processor. The I/O bus is configured for redundancy in applications with the redundant CPUs or the redundant I/O modules, or in applications with the remotely distributed I/O modules. The I/O bus communication within the PSMS is safety-related. The I/O bus communication within the PCMS is non safety-related.

Maintenance Network

A non-redundant multi-drop maintenance network is provided separately within each PSMS division and within the PCMS. The maintenance network is used to transmit signals between the engineering tools and each PSMS or PCMS control processor. The engineering tools are used for diagnostic monitoring, manual surveillance testing and software maintenance. The maintenance network is non safety-related in all divisions of the PSMS and within the PCMS. During normal operation, the control processors of the PSMS are configured to only transmit data to the maintenance network. A deliberate manual action is required to enable the PSMS control processor to receive data from the maintenance network. The control processors are considered inoperable in this configuration.

2.5.6.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.5.6-1 describes the ITAAC for the DCS.

Table 2.5.6-1 Data Communication Systems Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The DCS conforms to the functional arrangement shown in Figure 2.5.6-1 and consists of: • A non safety-related plant-wide Unit Bus • Separate safety-related Safety Buses for each PSMS division • A separate non safety-related Maintenance Network for each PSMS division and for the PCMS • Safety and non safety-related Data Links and I/O Buses	1. An inspection of the as-built DCS functional arrangement will be performed.	1. The as-built DCS conforms to the functional arrangement shown in Figure 2.5.6-1 and consists of: • A non safety-related plant-wide Unit Bus • Separate safety-related Safety Buses for each PSMS division • A separate non safety-related Maintenance Network for each PSMS division and for the PCMS • Safety and non safety-related Data Links and I/O Buses
2. The DCS provides adequate throughput to meet the response time requirements for all safety functions under the full range of applicable conditions enumerated in the design basis. On-line diagnostics do not interrupt plant control.	2. Type tests and/or analyses will be performed on the equipment.	2. A report exists and concludes that the as-built DCS provides adequate throughput to meet the response time requirements for all safety functions under the full range of applicable conditions enumerated in the design basis, and that on-line diagnostics do not interrupt plant control.
3. The DCS between plant safety/unit buses and external networks is through a firewalled interface.	3. An inspection of the as-built DCS will be performed.	3 The as-built DCS between plant safety/unit buses and external networks is through a firewalled interface.
4. The safety-related portions of the DCS are located in a facility area that provides protection from natural phenomena hazards such as tornadoes, and accident related hazards such as missiles, pipe breaks and flooding.	4. An inspection of the as-built equipment location will be performed.	4. The safety- related portions of the as-built DCS are located in the as-built facility area that provides protection from natural phenomena hazards such as tornadoes, and accident related hazards such as missiles, pipe breaks and flooding.

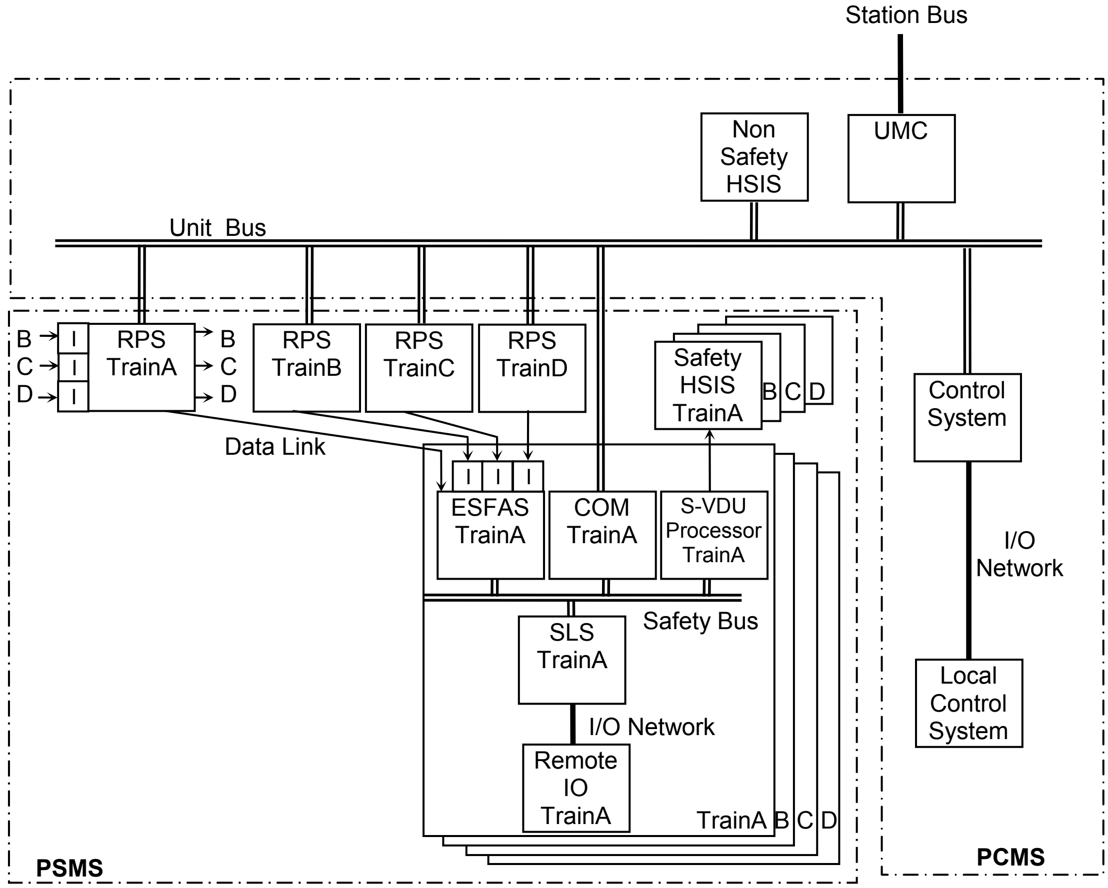


Figure 2.5.6-1 DCS Configuration

2.6 ELECTRICAL SYSTEMS

This section describes the US-APWR electrical systems, with emphasis on the onsite power system.

The onsite power system is comprised of the alternating current (ac) electric power system and the direct current (dc) electric power system, each of which is comprised of a safety-related Class 1E power system and a non safety-related non-Class 1E power system. The purpose and function of the onsite power system is to provide power to the plant auxiliary and service loads during all modes of plant operation, including safe shutdown and accident conditions.

This section addresses the following major systems and equipment, and their key subsystems:

- AC electric power system
- DC electric power system
- Instrumentation and control (I&C) power supply system
- Emergency power sources (EPSs)
- Alternate ac (AAC) power sources
- Plant lighting systems
- Grounding and lightning protection system
- Electrical penetration assemblies

This section also provides ITAAC for each major system and safety-related support system.

The US-APWR electric systems as described herein are entirely within the scope of the certified design unless specifically indicated otherwise.

2.6.1 AC Electric Power Systems

2.6.1.1 Design Description

The ac electric power system includes the following system and components: offsite transmission system, plant switchyard, main transformer (MT), main generator (MG), generator load break switch (GLBS), unit auxiliary transformers (UATs), reserve auxiliary transformers (RATs), station service transformers (SSTs), switchgear, load centers, motor control centers (MCCs), panel boards, and cables for power, control and instrumentation. The 6.9kV buses of the onsite Class 1E ac electric power systems are supplied from offsite sources through the UATs, RATs or from onsite EPSs. Normal preferred supply to the Class 1E 6.9kV buses is through the RATs. During SBO, these buses can be powered from onsite AAC power sources. Separation is maintained between these buses for all incoming circuits. Class 1E divisional independence is maintained through all voltage levels.

The onsite electric power system configuration is depicted on Figure 2.6.1-1. Table 2.6.1-1 shows electrical and seismic classification of major Class 1E ac electrical power distribution equipment.

Class 1E power systems have four independent redundant divisions, A, B, C and D, corresponding to four divisions of safety-related load groups except for systems containing two 100% redundant load groups. The two 100% load groups are powered from divisions A and D distribution systems identified as A1 and D1. The A1 buses can be powered from A or B division power sources, and D1 buses can be powered from D or C division power sources.

Independence is maintained between each division of the Class 1E equipment and circuits, and between Class 1E equipment and circuits and non-Class 1E equipment and circuits.

Independence is established between each of the four divisions of the Class 1E AC electric power system and its associated distribution equipment. Class 1E electric power distribution equipment, shown in Table 2.6.1-1, is located in separate rooms in the reactor building. Areas containing Class 1E power distribution equipment are designated as vital areas and have controlled access.

The A, B, C and D EPSs are located in separate rooms in the power source buildings.

All Class 1E equipment and raceway are seismic Category I and qualified for postulated environmental conditions.

During all normal modes of plant operation and accident conditions, the Class 1E 6.9kV buses are powered through the RATs. If power from the RATs is not available, the buses are automatically transferred to the UATs, if they are available. If both offsite sources are not available, the buses automatically connect to their respective EPS. For all trip conditions, except for a trip due to electrical fault in the MT, MG, GLBS, UATs and associated equipment and circuits, the GLBS is opened. For electrical faults in these equipment and circuits, the MT circuit breaker at the switchyard is opened.

Class 1E ac electric distribution system overcurrent protection is set for proper coordination.

The post-fire safe-shutdown circuit analysis ensures that one success path of shutdown SSCs remains free of fire damage.

The potential effects of harmonics introduced by non-linear loads are evaluated for effects on Class 1E equipment.

Class 1E 6.9kV switchgear and 480V load center bus incoming circuit breakers have local and remote control and status displays in the MCR. See Table 2.6.1-2 for details.

The Class 1E ac power systems are designed to permit periodic inspection and testing at appropriate intervals in order to assess system continuity, availability and the condition of system components. Class 1E ac power systems are designed to provide the capability to perform integral periodic testing of safety systems.

The connection between the Class 1E 6.9kV buses and non-Class 1E AAC power sources is provided through two isolation devices in series, which are normally open. One Class 1E circuit breaker is provided at the Class 1E 6.9kV switchgear and the other is a non-Class 1E disconnect switch at the selector circuits.

Independence is maintained between Class 1E electric power distribution equipment and non safety-related loads by Class 1E qualified isolation devices.

UATs, RATs, SSTs and EPSs are sized for worst case loading conditions for all normal modes of plant operation, including safe shutdown and accident conditions. The Class 1E distribution equipment and circuits are sized to carry the worst case load currents, to withstand the maximum fault currents, and to provide minimum design basis voltage at load terminals for all modes of plant operation and accident conditions. Cables are sized considering their potential derating due to ambient temperature and raceway loading. The interrupting ratings of the circuit breakers and fuses are adequate for maximum available fault currents.

The MT, UATs, and RATs have their own fire deluge system, oil pit and drain system.

Power feeders for the RATs, UATs, EPSs and AAC power sources are separated from each other. Power feeders for the MT and GLBS are separated from the RATs, EPSs and AAC power sources.

The dc control power for Class 1E switchgear and load centers of each division are supplied from the same division of the dc system.

Equipment and circuits of each Class 1E division are uniquely identified.

Class 1E equipment are protected from sustained degraded voltage conditions.

There is no provision for automatic connection between redundant Class 1E buses.

2.6.1.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.6.1-3 describes the ITAAC for the onsite electric power system.

Table 2.6.1-1 AC Electric Power Systems – Safety-related Equipment Characteristics

Equipment Name	Seismic Category	Class 1E/Qual. for Harsh Environ.
A-Class 1E 6.9kV Switchgear	I	Yes/No
B-Class 1E 6.9kV Switchgear	I	Yes/No
C-Class 1E 6.9kV Switchgear	I	Yes/No
D-Class 1E 6.9kV Switchgear	I	Yes/No
A-RCP Trip Switchgear	I	Yes/No
B-RCP Trip Switchgear	I	Yes/No
C-RCP Trip Switchgear	I	Yes/No
D-RCP Trip Switchgear	I	Yes/No
A-Class 1E 480V Load Center	I	Yes/No
A1-Class 1E 480V Load Center	I	Yes/No
B-Class 1E 480V Load Center	I	Yes/No
C-Class 1E 480V Load Center	I	Yes/No
D-Class 1E 480V Load Center	I	Yes/No
D1-Class 1E 480V Load Center	I	Yes/No
A-Class 1E Motor Control Center	I	Yes/No
A1-Class 1E Motor Control Center	I	Yes/No
B-Class 1E Motor Control Center	I	Yes/No
C-Class 1E Motor Control Center	I	Yes/No
D-Class 1E Motor Control Center	I	Yes/No
D1-Class 1E Motor Control Center	I	Yes/No

Table 2.6.1-2 AC Electric Power Systems Equipment Displays and Control Functions

Equipment Name	MCR Display	MCR Control Function
A-Class 1E 6.9kV Switchgear	Yes	Yes (Breaker open/close)
B-Class 1E 6.9kV Switchgear	Yes	Yes (Breaker open/close)
C-Class 1E 6.9kV Switchgear	Yes	Yes (Breaker open/close)
D-Class 1E 6.9kV Switchgear	Yes	Yes (Breaker open/close)
A-RCP Trip Switchgear	Yes	Yes (Breaker open/close)
B-RCP Trip Switchgear	Yes	Yes (Breaker open/close)
C-RCP Trip Switchgear	Yes	Yes (Breaker open/close)
D-RCP Trip Switchgear	Yes	Yes (Breaker open/close)
A-Class 1E 480V Load Center	Yes	Yes (Breaker open/close)
A1-Class 1E 480V Load Center	Yes	Yes (Breaker open/close)
B-Class 1E 480V Load Center	Yes	Yes (Breaker open/close)
C-Class 1E 480V Load Center	Yes	Yes (Breaker open/close)
D-Class 1E 480V Load Center	Yes	Yes (Breaker open/close)
D1-Class 1E 480V Load Center	Yes	Yes (Breaker open/close)
A-Class 1E Motor Control Center	Yes	No
A1-Class 1E Motor Control Center	Yes	No
B-Class 1E Motor Control Center	Yes	No
C-Class 1E Motor Control Center	Yes	No
D-Class 1E Motor Control Center	Yes	No
D1-Class 1E Motor Control Center	Yes	No
Unit Auxiliary Transformer (UAT 1, 2, 3, 4)	Yes	No
Reserve Auxiliary Transformer (RAT 1, 2, 3, 4)	Yes	No

Table 2.6.1-3 AC Electric Power Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the ac electric power systems is as described in the Design Description of this Subsection 2.6.1 and as shown in Figure 2.6.1-1.	1. An inspection of the as-built ac electric power systems will be performed.	1. The as-built ac electric power systems conform to the functional arrangement as described in the Design Description of this Subsection 2.6.1 and as shown in Figure 2.6.1-1.
2. Independence is maintained between each of the four divisions of the Class 1E distribution equipment, and between Class 1E distribution equipment and non-Class 1E distribution equipment.	2. Tests will be performed on the as-built Class 1E and non-Class 1E distribution equipment by providing a test signal in only one division at a time.	2. The test signal exists in the as-built Class 1E division or non-Class 1E division under test.
3. Independence between Class 1E electric power distribution equipment and non safety-related loads is maintained by Class 1E qualified isolation devices so as to meet RG 1.75.	3. Tests and analyses on the as-built Class 1E electric power distribution equipment will be performed.	3. The as-built Class 1E electric power distribution equipment is isolated from the as-built non safety-related loads by the Class 1E qualified isolation devices so as to meet RG 1.75.
4. The Class 1E electric power distribution equipment of redundant divisions is located in separate rooms in the reactor building.	4. An inspection of the as-built Class 1E electric power distribution equipment will be performed.	4. The as-built Class 1E electric power distribution equipment of redundant divisions is located in the separate rooms in the reactor building.
5. Each Class 1E EPS is located in a separate room in the power source buildings.	5. An inspection of the as-built EPS will be performed.	5. The as-built each EPS is located in a separate room in the power source buildings.

Table 2.6.1-3 AC Electric Power Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6.a Each of the four divisions of the Class 1E AC electrical power system equipment, identified in Table 2.6.1-1 is designed to withstand seismic design basis loads without loss of safety function.	6.a.i Inspections will be performed to verify that the as-built Class 1E equipment identified in Table 2.6.1-1 is located in the reactor building.	6.a.i Each of the four divisions of the as-built Class 1E AC electric power system equipment, identified in Table 2.6.1-1, is located in the reactor building.
	6.a.ii Type tests and/or analyses of the Class 1E equipment will be performed.	6.a.ii The results of the type tests and/or analyses conclude that each of the four divisions of the as-built Class 1E AC electric power system equipment can withstand seismic design basis loads without loss of safety function.
	6.a.iii. Inspection will be performed on the as-built equipment including anchorage.	6.a.iii Each of the four divisions of the as-built Class 1E AC electric power system equipment including anchorage is seismically bounded by the tested or analyzed conditions.
6.b If power through the RATs is not available, each Class 1E medium voltage bus is automatically transferred to the UATs if available.	6.b A test will be performed to verify that each as-built Class 1E medium voltage bus is automatically transferred to the UAT upon simulated loss of power from the RAT.	6.b Each as-built Class 1E medium voltage bus is automatically transferred to the UAT if power through the RATs is not available.
6.c If both offsite power sources are not available, each Class 1E medium voltage bus automatically connects to its respective EPS.	6.c A test will be performed to verify that each as-built Class 1E medium voltage bus automatically connects to the respective EPS upon simulated loss of power from the RAT and UAT.	6.c Each as-built Class 1E medium voltage bus automatically connects to its respective EPS if both offsite power sources are not available.
7. For all plant trip conditions, except for a trip due to electrical fault in the MT, MG, GLBS, UATs and associated equipment and circuits, the GLBS opens.	7. A test will be performed to verify that the as-built GLBS is opened by a simulated non-electrical fault trip signal, including a simulated ECCS actuation signal.	7. For all plant trip conditions, except for a trip due to electrical fault in the MT, MG, GLBS, UATs and associated equipment and circuits, the as-built GLBS opens.

Table 2.6.1-3 AC Electric Power Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8. For electrical faults in the MT, MG, GLBS, UATs and associated equipment and circuits, the MT circuit breaker at the switchyard opens.	8. A test will be performed to verify that the as-built MT circuit breaker trip signal is actuated by a simulated electrical fault trip signal for a fault in the MT, MG, GLBS, UATs and associated equipment and circuits.	8. For electrical faults in the MT, MG, GLBS, UATs and associated equipment and circuits, the as-built MT circuit breaker at the switchyard opens.
9. The Class 1E ac power systems are designed to permit appropriate periodic inspection and testing in order to assess the system continuity, availability and condition of the system components.	9. Inspections and testing of the as-built Class 1E ac power systems will be performed.	9. Periodic inspection and testing of the as-built Class 1E ac power systems can be performed in order to assess the system continuity, availability and condition of the system components.
10. The UATs, RATs, SSTs and EPS power sources are sized for worst case loading conditions for all modes of plant operation and accident conditions.	10.i Analyses will be performed to verify the UATs, RATs, SSTs and EPS power sources are sized for worst case loading conditions for all modes of plant operation and accident conditions.	10.i The UATs, RATs, SSTs and EPS power sources are sized for worst case loading conditions for all modes of plant operation and accident conditions.
	10.ii Inspections will be performed to verify that the ratings of as-built UATs, RATs, SSTs and EPS power sources meet the size requirements determined by the analysis for worst case loading conditions for all modes of plant operation and accident conditions.	10.ii The ratings of as-built UATs, RATs, SSTs and EPS power sources bound the size requirements determined by the analysis for worst case loading conditions for all modes of plant operation and accident conditions.

Table 2.6.1-3 AC Electric Power Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 6)

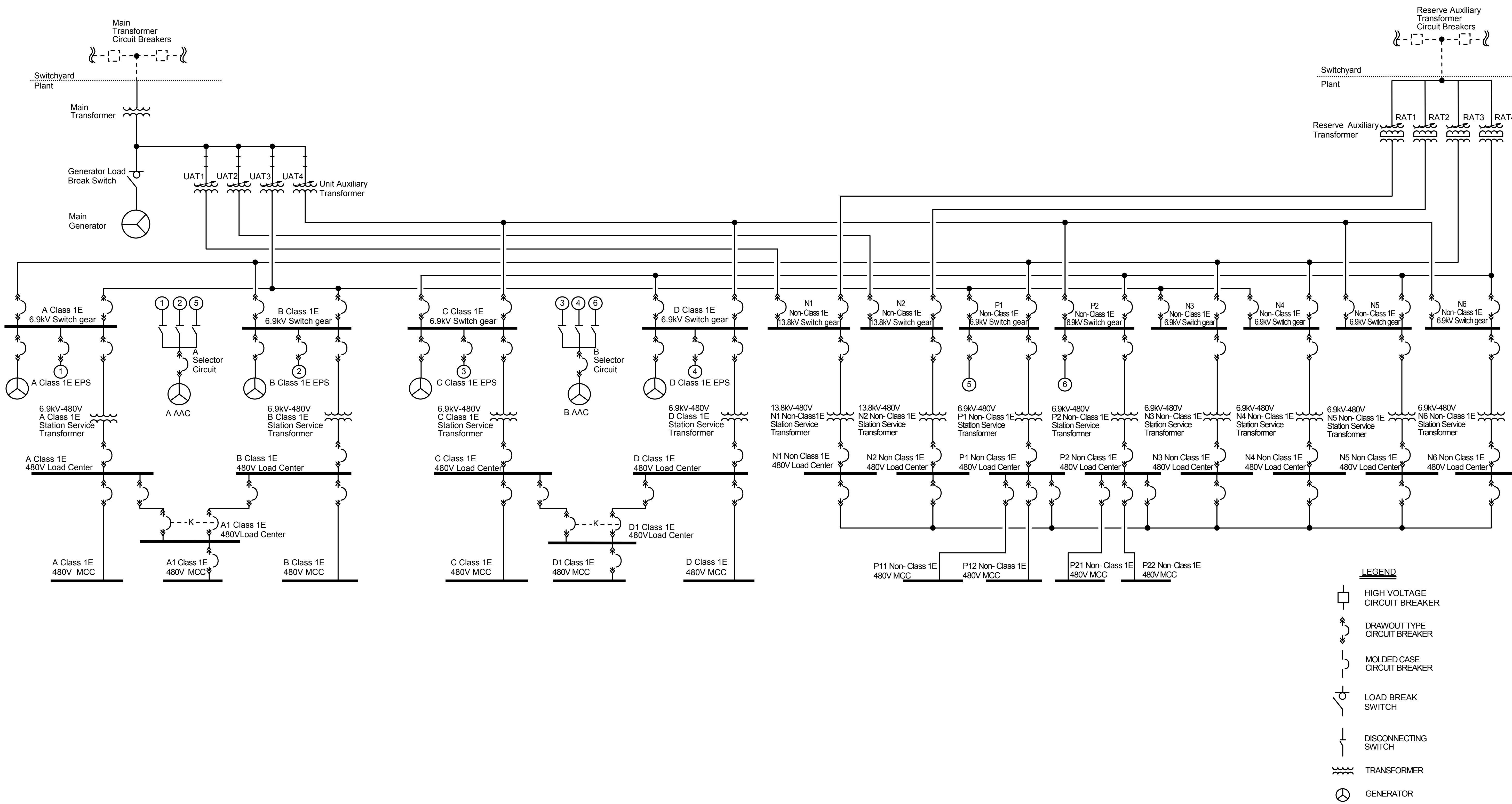
Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
11.a The Class 1E distribution equipment and circuits are sized to carry the worst case load currents, to withstand the maximum fault currents, and to provide minimum design basis voltage at load terminals for all modes of plant operation and accident conditions.	11.a.i Analyses will be performed to verify the Class 1E distribution equipment and circuits are sized to carry the worst case load currents, to withstand the maximum fault currents, and to provide minimum design basis voltage at load terminals for all modes of plant operation and accident conditions.	11.a.i The Class 1E distribution equipment and circuits are sized to carry the worst case load currents, can withstand the maximum fault currents, and are able to provide minimum design basis voltage at load terminals for all modes of plant operation and accident conditions.
	11.a.ii An inspection will be performed to verify that the ratings of as-built Class 1E distribution equipment and circuits bound the results of the analysis to carry the worst case load currents, to withstand the maximum fault currents, and to provide minimum design basis voltage at load terminals for all modes of plant operation and accident conditions.	11.a.ii The ratings of as-built Class 1E distribution equipment and circuits bound the results of the analysis to carry the worst case load currents, can withstand the maximum fault currents, and are able to provide minimum design basis voltage at load terminals for all modes of plant operation and accident conditions.
11.b The cables are sized considering derating due to ambient temperature and raceway loading.	11.b.i An analysis will be performed to verify the cables are sized considering derating due to ambient temperature and raceway loading.	11.b.i The cables are sized considering derating due to ambient temperature and raceway loading.
	11.b.ii An inspection will be performed to verify that the as-built cables' size bounds the minimum size determined by the analysis.	11.b.ii The as-built cables' size bound the minimum size determined by the analysis.

Table 2.6.1-3 AC Electric Power Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
12. The interrupting ratings of the circuit breakers and fuses are adequate for maximum available fault currents.	12.i An analysis will be performed to verify interrupting ratings of the circuit breakers and fuses are adequate for maximum available fault currents.	12.i The interrupting ratings of the circuit breakers and fuses are adequate for maximum available fault currents.
	12.ii An inspection will be performed to verify the interrupting ratings of the circuit breakers and fuses bound the requirements of the analysis for maximum available fault currents.	12.ii The interrupting ratings of the as-built circuit breakers and fuses bound the requirements of the analysis for maximum available fault currents.
13. The MT, UATs, and RATs have their own fire deluge system, oil pit and drain system.	13. An inspection of the as-built fire deluge system, oil pit and drain system for the MT, UATs, and RATs will be performed.	13. The as-built MT, UATs, and RATs have their own fire deluge system, oil pit and drain system.
14. The UATs power feeders are separated from RATs power feeders.	14. An inspection of the as-built UATs power feeders and the as-built RATs power feeders will be performed.	14. The as-built UATs power feeders are separated from the as-built RATs power feeders.
15. The MT and GLBS power feeders are separated from the RATs power feeders.	15. An inspection of the as-built MT, GLBS and RATs will be performed.	15. The as-built MT and GLBS power feeders are separated from the as-built RATs power feeders.
16. The dc control power for Class 1E switchgear and load centers of each division are supplied from the same division of the dc system.	16. An inspection of the as-built dc control power source of the Class 1E switchgear and load centers will be performed.	16. The dc control power for as-built Class 1E switchgear and load centers of each division are supplied from the same division of the dc system.
17. Equipment and circuits of each Class 1E division are uniquely identified.	17. An inspection of the as-built equipment and circuits of each Class 1E division will be performed.	17. The as-built equipment and circuits of each Class 1E division are uniquely identified.

Table 2.6.1-3 AC Electric Power Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
18. The Class 1E equipment is protected from sustained degraded voltage conditions.	18.i An analysis will be performed to verify the Class 1E equipment is protected from sustained degraded voltages conditions.	18.i The Class 1E equipment is protected from sustained degraded voltage conditions.
	18.ii An inspection will be performed to verify the as-built protection system bounds the result of analysis for Class 1E equipment protection from sustained degraded voltages conditions.	18.ii The as-built protection system bounds the result of analysis for Class 1E equipment protection from sustained degraded voltages conditions.
19. There is no provision for automatic connection between redundant Class 1E buses.	19. An inspection of the as-built Class 1E buses will be performed.	19. There is no provision for automatic connection between redundant as-built Class 1E buses.
20. The voltage and current of the Class 1E medium voltage bus are displayed in the MCR.	20. An inspection of the as-built MCR will be performed.	20. The voltage and current of the Class 1E medium voltage bus are displayed in the as-built MCR.
21. Class 1E ac electric distribution system overcurrent protection is set for proper coordination.	21. Analyses of ac electrical distribution system overcurrent protection will be performed to verify proper coordination.	21. A report exists and concludes that the as-built Class 1E ac electric distribution system overcurrent protection is set for proper coordination.
22. The post-fire safe-shutdown circuit analysis ensures that one success path of shutdown SSCs remains free of fire damage.	22. Analyses of post fire safe shutdown circuit analysis and supporting breaker coordination will be performed.	22. A report exists and concludes that the post-fire safe-shutdown circuit analysis ensures that one success path of shutdown SSCs remains free of fire damage.
23. The potential effects of harmonics introduced by non-linear loads are evaluated for effects on Class 1E equipment.	23. Analyses will be performed to determine the potential effects on class 1E equipment of harmonics introduced by non-linear loads.	23. A report exists and concludes that the potential effects of harmonics introduced by non-linear loads do not adversely affect Class 1E equipment.
24. The non-segregated busducts/cable buses to safety buses in the T/B electrical room are segregated into two groups by qualified fire barriers.	24. An inspection will be performed of the as-built non-segregated busducts/cable buses to safety buses in the T/B electrical room.	24. The as-built non-segregated busducts/cable buses to safety buses in the T/B electrical room are segregated into two groups by qualified fire barriers.



- - K - - MECHANICAL KEY

Figure 2.6.1-1 Onsite ac Power One line Diagram

2.6.2 DC Power Systems

2.6.2.1 Design Description

The onsite dc power systems include independent Class 1E and non-Class 1E dc power systems. Each Class 1E and non-Class 1E dc power system is provided with its own battery, battery charger, switchboard and associated power distribution equipment. Class 1E dc power systems have four independent redundant divisions A, B, C and D, corresponding to four divisions of safety load groups, except for systems containing two 100% redundant load groups. The two 100% load groups are powered basically from divisions A and D distribution systems identified as A1 and D1. The A1 switchboard bus can be connected to the A or B division switchboard bus, and the D1 switchboard bus can be connected to the D or C division switchboard bus.

The dc power system configuration is shown on Figure 2.6.2-1.

All Class 1E dc power system equipment is classified seismic Category I and qualified for postulated environmental conditions. Table 2.6.2-1 shows electrical and seismic classification of major Class 1E dc power system equipment.

The Class 1E batteries have enough capacity to carry the worst case load profile for two hours assuming their chargers are unavailable. The Class 1E battery chargers have enough capacity to carry the continuous dc system loads and charge the associated battery (which has undergone a design basis discharge) to 95% of its full capacity within twenty-four hours.

Independence is maintained between Class 1E dc power system distribution equipment and non safety-related dc loads by Class 1E qualified isolation devices.

Alarms initiate in MCR to indicate Class 1E dc power system malfunctions and status conditions.

Class 1E dc power system is provided with the following alarms and available displays in the MCR:

- Switchboard bus voltage and battery current displays
- DC system ground fault alarm
- Battery charger output voltage low alarm
- Battery charger ac input failure alarm
- Battery charger dc output failure alarm
- Battery circuit breaker/disconnect switch open alarm
- Battery charger circuit breaker open alarm
- Battery test circuit breaker closed alarm
- Battery charger common failure/trouble alarm

Independence is established between each of the four divisions of the Class 1E dc power supply system and its associated distribution equipment. The Class 1E dc power system equipment is located in separate rooms in the PS/B and R/B. Areas containing Class 1E dc power system distribution equipment are designated as vital areas and have controlled access.

Cables are sized to carry required load currents and provide minimum design basis voltage at load terminals, considering derating due to ambient temperature and raceway loading. Class 1E dc system circuit breakers and fuses are sized to supply their load requirements.

The main circuit protection device in the switchboard has selective coordination with downstream protective devices.

The Class 1E dc power system operating voltage range is 108V to 140V at the battery terminals.

Equipment and circuits of each division of Class 1E dc power systems are uniquely identified. Class 1E dc cables are routed in seismic Category I raceways within their respective division.

2.6.2.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.6.2-2 describes the ITAAC for the non-Class 1E dc power systems.

Table 2.6.2-1 DC Power System Equipment Characteristics

Equipment Name	Seismic Category	Class 1E/Qual. for Harsh Environ.
A-Class 1E Battery	I	Yes/No
B-Class 1E Battery	I	Yes/No
C-Class 1E Battery	I	Yes/No
D-Class 1E Battery	I	Yes/No
A-Class 1E Battery Charger	I	Yes/No
B-Class 1E Battery Charger	I	Yes/No
C-Class 1E Battery Charger	I	Yes/No
D-Class 1E Battery Charger	I	Yes/No
A-Class 1E DC Switchboard	I	Yes/No
B-Class 1E DC Switchboard	I	Yes/No
C-Class 1E DC Switchboard	I	Yes/No
D-Class 1E DC Switchboard	I	Yes/No
A1-Class 1E DC Switchboard	I	Yes/No
D1-Class 1E DC Switchboard	I	Yes/No
A-Class 1E MOV Inverter 1	I	Yes/No
A-Class 1E MOV Inverter 2	I	Yes/No
B-Class 1E MOV Inverter	I	Yes/No
C-Class 1E MOV Inverter	I	Yes/No
D-Class 1E MOV Inverter 1	I	Yes/No
D-Class 1E MOV Inverter 2	I	Yes/No
A-Class 1E MOV Control Center 1	I	Yes/No
A-Class 1E MOV Control Center 2	I	Yes/No
B-Class 1E MOV Control Center	I	Yes/No
C-Class 1E MOV Control Center	I	Yes/No
D-Class 1E MOV Control Center 1	I	Yes/No
D-Class 1E MOV Control Center 2	I	Yes/No

Table 2.6.2-2 DC Power Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the dc electric power systems is as described in the Design Description in this Subsection 2.6.2.1 and as shown in Figure 2.6.2-1.	1. An inspection of the functional arrangement of the as-built dc electric power systems will be performed.	1. The as-built dc power systems conform to the functional arrangement as described in the Design Description in this Subsection 2.6.2.1 and as shown in Figure 2.6.2-1.
2. Each of the four divisions of Class 1E dc power supply system equipment, identified in Table 2.6.2-1, are designed to withstand seismic design basis loads without loss of safety function.	2.i Inspections will be performed to verify that the as-built Class 1E equipment identified in Table 2.6.2-1 is located in the PS/B and R/B.	2.i Each of the four divisions of as-built Class 1E dc power supply system equipment identified in Table 2.6.2-1 is located in the PS/B and R/B.
	2.ii Type tests and/or analyses of the Class 1E equipment will be performed.	2.ii The results of the type tests and/or analyses conclude that each of the four divisions of Class 1E dc power supply system equipment can withstand seismic design basis loads without loss of safety function.
	2.iii An inspection will be performed on the as-built Class 1E equipment including anchorage.	2.iii Each of the four divisions of as-built Class 1E dc power supply system equipment including anchorage is seismically bounded by the tested or analyzed conditions.
3. The Class 1E batteries have enough capacity to carry the worst case load profile for duration of two hours assuming chargers are unavailable.	3.i An analysis will be performed to verify Class 1E batteries have enough capacity to carry the worst case load profile for duration of two hours assuming chargers are unavailable.	3.i The Class 1E batteries have enough capacity to carry the worst case load profile for duration of two hours assuming chargers are unavailable.
	3.ii An inspection will be performed to verify that the rating of the as-built Class 1E batteries bound the rating of the analysis.	3.ii The rating of the as-built Class 1E batteries bound the rating of the analysis.

Table 2.6.2-2 DC Power Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4. Independence is maintained between each of the four divisions of the Class 1E dc power system distribution equipment, and between Class 1E dc power system distribution equipment and non-Class 1E dc power system distribution equipment.	4. Tests will be performed on the as-built Class 1E and non-Class 1E dc power system distribution equipment by providing a test signal in only one division at a time.	4. The test signal exists in the as-built Class 1E division or non-Class 1E division under test.
5. Independence between Class 1E dc power system distribution equipment and non safety-related loads is maintained by Class 1E qualified isolation devices so as to meet RG 1.75.	5. Tests and analyses on the as-built Class 1E dc power system distribution equipment will be performed.	5. The as-built Class 1E dc power system distribution equipment is isolated from the as-built non safety-related loads by the Class 1E qualified isolation devices so as to meet RG 1.75.
6. The Class 1E battery chargers have enough capacity to carry the continuous dc system loads and charge the associated battery (which has undergone design basis discharge) to 95% of its full capacity within twenty-four hours.	6.i An analysis will be performed to verify the Class 1E battery chargers have enough capacity to carry the continuous dc systems loads and charge the associated battery (which has undergone design basis discharge) to 95% of its full capacity within twenty-four hours.	6.i The Class 1E battery chargers have enough capacity to carry the continuous dc systems loads and charge the associated battery (which has undergone design basis discharge) to 95% of its full capacity within twenty-four hours.
	6.ii An inspection will be performed to verify that the ratings of the as-built Class 1E battery chargers bound the ratings of the analysis.	6.ii The ratings of the as-built Class 1E battery chargers bound the ratings of the analysis.
7. The alarms initiate in MCR to indicate Class 1E system malfunctions and status conditions.	7. A test will be performed to verify that alarms initiate in the as-built MCR to indicate the as-built Class 1E system malfunctions and status conditions.	7. The results of the test conclude that the alarms initiate in the as-built MCR to indicate the as-built Class 1E system malfunctions and status conditions.
8. Each Class 1E battery is located in separate battery rooms.	8. An inspection of each as-built Class 1E battery will be performed.	8. Each as-built Class 1E battery is located in separate battery rooms.
9. The Class 1E dc switchboard and battery charger of each division are located in separate rooms.	9. An inspection of the as-built Class 1E dc switchboard and battery charger will be performed.	9. The as-built Class 1E dc switchboard and battery charger of each division are located in separate rooms.

Table 2.6.2-2 DC Power Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10. The areas containing Class 1E dc power system distribution equipment are designated as vital areas and have controlled access.	10. An inspection of the as-built areas containing Class 1E dc power system distribution equipment will be performed.	10. The as-built areas containing Class 1E dc power system distribution equipment are designated as vital areas and have controlled access.
11. The cables are sized to carry required load currents and provide minimum design basis voltage at load terminals considering derating due to ambient temperature and raceway loading.	11.i An analysis will be performed to verify the cables are sized to carry required load currents and provide minimum design basis voltage at load terminals considering derating due to ambient temperature and raceway loading.	11.i The cables are sized to carry required load currents and provide minimum design basis voltage at load terminals considering derating due to ambient temperature and raceway loading.
	11.ii An inspection will be performed to verify the size of cables installed bound the minimum size required by the analysis.	11.ii The as-built cables are sized to bound the minimum sizes determined by the analysis.
12. The Class 1E dc system equipment, circuit breakers and fuses are sized to supply their load requirements.	12.i An analysis will be performed to verify the Class 1E dc system equipment, circuit breakers and fuses are sized to supply their load requirements.	12.i The Class 1E dc system equipment, circuit breakers and fuses are sized to supply their load requirements.
	12.ii An inspection will be performed to verify that the ratings of the as-built Class 1E system equipment, circuit breakers and fuses bound the size requirements of the analysis.	12.ii The ratings of the as-built Class 1E dc system equipment, circuit breakers and fuses bound the size requirements of the analysis.
13. The main circuit protection device in the switchboard of each of the four Class 1E dc power divisions, has selective coordination with downstream protective devices.	13.i An analysis will be performed to verify the main circuit protection devices have selective coordination with the downstream protective devices.	13.i The main circuit protection device in the switchboard of each of the four Class 1E dc power divisions, has selective coordination with the downstream protective devices.
	13.ii An inspection of the as-built main circuit protection devices in the as-built switchboards will be performed.	13.ii The as-built main circuit protection devices are the same as those used in the coordination analysis.

Table 2.6.2-2 DC Power Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
14. The Class 1E dc system operating voltage range at the terminals of the safety-related equipment is within the equipment's voltage limit.	14. An analysis will be performed to verify the Class 1E dc system operating voltage range at the terminals of the safety-related equipment.	14. The results of the analysis conclude that the Class 1E dc system operating voltage range at the terminals of the Class 1E equipment is within the voltage limit of the as-built safety-related equipment.
15. The equipment and circuits of each division of Class 1E dc systems are uniquely identified.	15. An inspection of the as-built equipment and circuits of each division of Class 1E dc systems will be performed.	15. The as-built equipment and circuits of each division of Class 1E dc systems are uniquely identified.
16. The Class 1E dc cables are routed in their respective divisions through seismic Category I structures and the cables and raceways are identified the same as their respective Class 1E division.	16. An inspection of the as-built Class 1E dc cables routing will be performed.	16. The as-built Class 1E dc cables are routed in their respective division through the seismic Category I structures and the cables and raceways are identified the same as their respective Class 1E division.

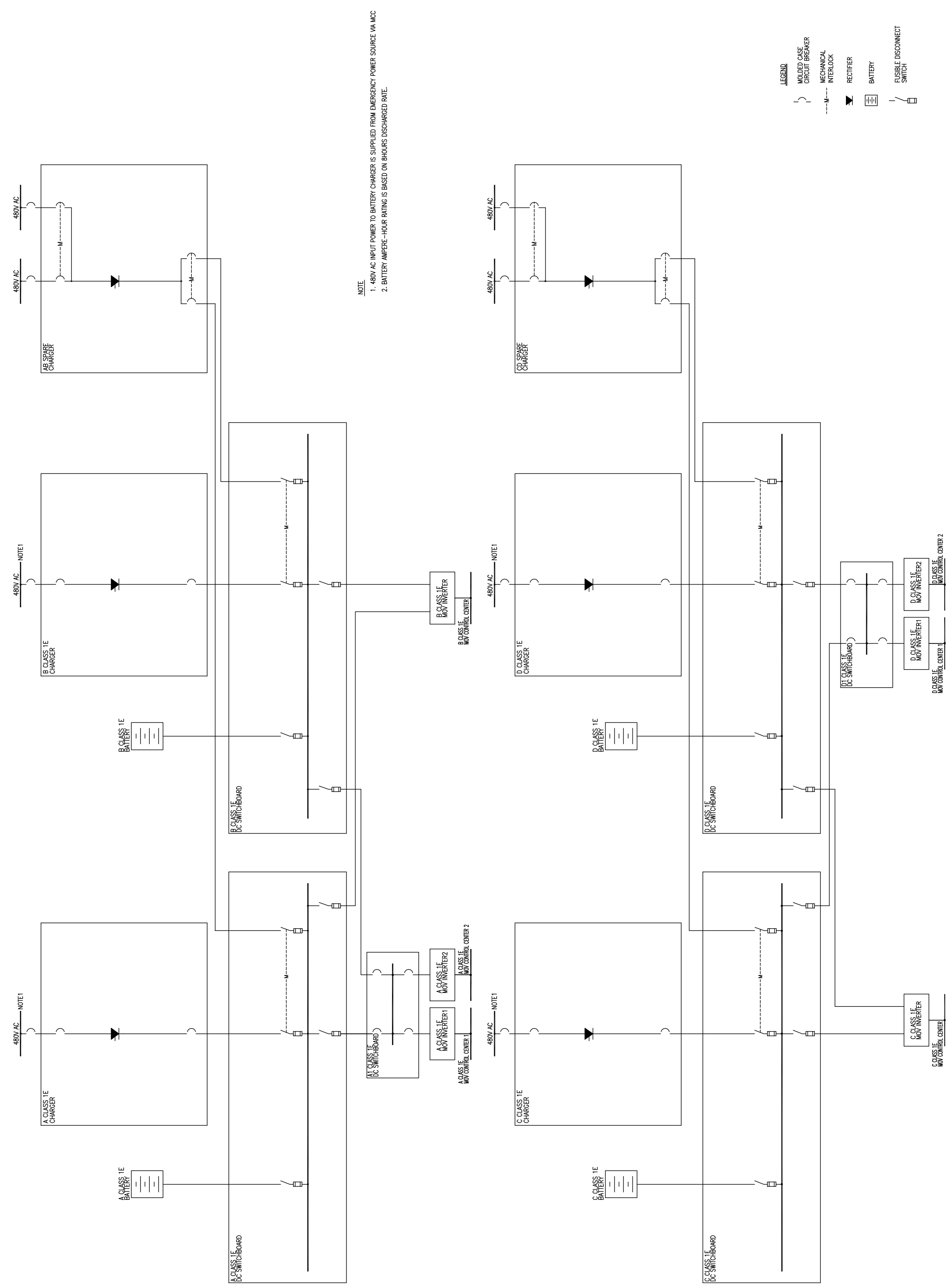


Figure 2.6.2-1 DC Power Systems

2.6.3 I&C Power Supply Systems

2.6.3.1 Design Description

Functional arrangement of onsite I&C power supply systems are depicted on Figure 2.6.3-1.

All Class 1E I&C power supply system equipment are seismic Category I and qualified for postulated environmental conditions. The Table 2.6.3-1 shows electrical and seismic classification of major Class 1E I&C power supply system equipment.

Independence is established between each of the four divisions of Class 1E I&C power supply distribution equipment. The equipment of each I&C power supply system division is located in a separate room in the reactor building. Areas containing Class 1E equipment are designated as vital areas and have controlled access.

The power supply to each of the four Class 1E panel boards transfers from its Class 1E UPS unit to its Class 1E I&C power transformer automatically on an undervoltage signal.

When a LOOP occurs, input to the UPS unit is provided by the Class 1E battery without interruption to the loads.

The Class 1E I&C power supply system equipment and cables are sized to meet load requirements and provide minimum design bases voltage at load terminals, considering derating due to ambient temperature and raceway loading. Class 1E I&C power supply system circuit breakers and fuses of the power supply system are rated adequately to interrupt the fault currents.

Equipment and circuits of each Class 1E I&C power supply division are uniquely identified. Class 1E I&C power supply system cables are routed in seismic Category I raceways within their respective division.

Independence is maintained between Class 1E I&C power supply system distribution equipment and non safety-related I&C loads by Class 1E qualified isolation devices.

Alarms initiate in MCR to indicate Class 1E power supply system malfunctions and status conditions. System control and status display that are available in the MCR are shown on Table 2.6.3-2.

2.6.3.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.6.3-3 describes the ITAAC for the Class 1E I&C power supply systems.

Table 2.6.3-1 I&C Power Supply Systems Equipment Characteristics

Equipment Name	Seismic Category	Class 1E/Qual. for Harsh Environ.
A-Class 1E UPS Unit	I	Yes/No
B-Class 1E UPS Unit	I	Yes/No
C-Class 1E UPS Unit	I	Yes/No
D-Class 1E UPS Unit	I	Yes/No
A-Class 1E I&C Power Transformer	I	Yes/No
B-Class 1E I&C Power Transformer	I	Yes/No
C-Class 1E I&C Power Transformer	I	Yes/No
D-Class 1E I&C Power Transformer	I	Yes/No
A-Switching Circuit Panel	I	Yes/No
B-Switching Circuit Panel	I	Yes/No
C-Switching Circuit Panel	I	Yes/No
D-Switching Circuit Panel	I	Yes/No
A-Class 1E AC120V Panelboard	I	Yes/No
B-Class 1E AC120V Panelboard	I	Yes/No
C-Class 1E AC120V Panelboard	I	Yes/No
D-Class 1E AC120V Panelboard	I	Yes/No

Table 2.6.3-2 I&C Power Supply Systems Equipment Displays and Control Functions

Equipment Name	MCR Display	MCR Control Function
A-Class 1E UPS Unit	Yes	No
B-Class 1E UPS Unit	Yes	No
C-Class 1E UPS Unit	Yes	No
D-Class 1E UPS Unit	Yes	No
A-Class 1E I&C Power Transformer	Yes	No
B-Class 1E I&C Power Transformer	Yes	No
C-Class 1E I&C Power Transformer	Yes	No
D-Class 1E I&C Power Transformer	Yes	No
A-Switching Circuit Panel	Yes	No
B-Switching Circuit Panel	Yes	No
C-Switching Circuit Panel	Yes	No
D-Switching Circuit Panel	Yes	No
A-Class 1E AC120V Panelboard	Yes	No
B-Class 1E AC120V Panelboard	Yes	No
C-Class 1E AC120V Panelboard	Yes	No
D-Class 1E AC120V Panelboard	Yes	No

Table 2.6.3-3 I&C Power Supply Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the I&C power supply systems is as described in the Design Description of this Subsection 2.6.3.1 and is as shown on Figure 2.6.3-1.	1. An inspection of the functional arrangement of the as-built I&C power supply systems will be performed.	1. The as-built I&C power supply systems conform to the functional arrangement described in the Design Description of this Subsection 2.6.3.1 and is as shown in Figure 2.6.3-1.
2. The Class 1E I&C power supply system equipment and cables are sized to meet load requirements and provide minimum design bases voltage at load terminals, considering derating due to ambient temperature and raceway loading.	2.i An analysis will be performed to verify the Class 1E I&C power supply system equipment and cables are sized to carry the worst case load currents, to withstand the maximum fault currents, and to provide minimum design basis voltage at load terminals for all modes of plant operation and accident conditions.	2.i The Class 1E I&C power supply system equipment and cables are sized to meet load requirements and provide minimum design bases voltage at load terminals, considering derating due to ambient temperature and raceway loading.
	2.ii An inspection will be performed to verify that the ratings of as-built Class 1E I&C power supply system equipment and cables bound the size requirements of the analysis.	2.ii The ratings of as-built Class 1E I&C power supply system equipment and cables bound the size requirements of the analysis.
3. Each of the four divisions of Class 1E I&C power supply system equipment, identified in Table 2.6.3-1, is designed to withstand seismic design basis loads without loss of safety function.	3.i. Inspections will be performed to verify that the as-built Class 1E equipment identified in Table 2.6.3-1 is located in the reactor building.	3.i. Each of the four divisions of as-built Class 1E I&C power supply system equipment identified in Table 2.6.3-1 is located in the reactor building.
	3.ii Type tests and/or analyses of the Class 1E equipment will be performed.	3.ii The results of the type tests and/or analyses conclude that the Class 1E equipment can withstand seismic design basis loads without loss of safety function.
	3.iii An inspection will be performed on the as-built Class 1E equipment including anchorage.	3.iii The as-built Class 1 E equipment including anchorage is seismically bounded by the tested or analyzed conditions.
4. The areas containing Class 1E I&C power supply system equipment are designated as vital areas and have controlled access.	4. An inspection of the as-built areas containing the as-built Class 1E I&C power supply system equipment will be performed.	4. The as-built areas containing the as-built Class 1E I&C power supply system equipment are designated as vital areas and have controlled access.

Table 2.6.3-3 I&C Power Supply Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5. The equipment of each Class 1E I&C power supply system division is located in separate rooms.	5. An inspection of each as-built Class 1E I&C power supply system division will be performed.	5. The equipment of each as-built Class 1E I&C power supply system division is located in separate rooms.
6. Independence is maintained between each of the four divisions of the Class 1E I&C power supply system distribution equipment, and between Class 1E I&C power supply system distribution equipment and non-Class 1E I&C power supply system distribution equipment.	6. Tests will be performed on the as-built Class 1E and non-Class 1E I&C power supply system distribution equipment by providing a test signal in only one division at a time.	6. The test signal exists in the as-built Class 1E division or non-Class 1E division under test.
7. Independence is maintained between Class 1E I&C power supply system distribution equipment and non safety-related loads by Class 1E qualified isolation devices.	7. An inspection of the as-built Class 1E I&C power supply system distribution equipment will be performed.	7. The as-built Class 1E I&C power supply system distribution equipment is isolated from the as-built non safety-related loads by the Class 1E qualified isolation devices.
8. The power supply to each of the four Class 1E panel boards transfers from its Class 1E UPS unit to its Class 1E I&C power transformer automatically on an undervoltage signal.	8. A test will be performed to verify that the power supply to each as-built Class 1E panel boardtransfers from its as-built Class 1E UPS unit to its as-built Class 1E I&C power transformer automatically on an undervoltage signal.	8. The results of the test conclude that the power supply to each of the four as-built Class 1E panel boards transfers from its as-built Class 1E UPS unit to its as-built Class 1E I&C power transformer automatically on an undervoltage signal.
9. When ac input power to the Class 1E UPS unit is lost, input to the Class 1E UPS unit is provided by the Class 1E battery without interruption of power supply to the loads.	9. A test will be performed to verify that when ac input power to the as-built Class 1E UPS unit is lost, input to the Class 1E UPS unit is provided by the Class 1E battery without interruption of power supply to the loads.	9. The results of the test conclude that when ac input power to the as-built Class 1E UPS unit is lost, input to the Class 1E UPS unit is provided by the Class 1E battery without interruption of power supply to the loads.

Table 2.6.3-3 I&C Power Supply Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10. The Class 1E I&C power supply system equipment and cables are sized to meet load requirements and provide minimum design basis voltage at load terminals considering derating due to ambient temperature and raceway loading.	10. Type tests and/or analyses will be performed to verify that the Class 1E I&C power supply system equipment and cables are sized to meet load requirements and provide minimum design basis voltage at load terminals considering derating due to ambient temperature and raceway loading.	10. The results of type tests, and/or analyses conclude that the Class 1E I&C power supply system equipment and cables are sized to meet load requirements and provide minimum design basis voltage at load terminals considering derating due to ambient temperature and raceway loading.
11. The Class 1E I&C power supply system circuit breakers and fuses are rated adequately to interrupt the fault currents.	11.i An analysis will be performed to verify the Class 1E I&C power supply system breakers and fuses are rated adequately to interrupt the fault currents.	11.i The Class 1E I&C power supply system breakers and fuses are rated adequately to interrupt the fault currents.
	11.ii An inspection will be performed to verify the interrupting ratings of as-built Class 1E I&C power supply system breakers and fuses bound the requirements of the analysis.	11.ii The interrupting ratings of as-built Class 1E I&C power supply system breakers and fuses bound the requirements of the analysis.
12. The equipment and circuits of each Class 1E I&C power supply system division are uniquely identified.	12. An inspection of each as-built Class 1E I&C equipment and circuits of each Class 1E I&C power supply system division will be performed.	12. The equipment and circuits of each as-built Class 1E I&C power supply system division are uniquely identified.
13. The Class 1E I&C power supply system cables are routed in their respective division through seismic Category I structures and the cables and raceways are identified the same as their Class 1E division.	13. An inspection of the as-built Class 1E I&C power supply system cables routing will be performed.	13. The as-built Class 1E I&C power supply system cables are routed in their respective division through seismic Category I structures and the cables and raceways are identified the same as their Class 1E division.
14. Alarms initiate in the MCR to indicate Class 1E I&C power supply system malfunctions and status conditions.	14. A test will be performed to verify that alarms initiate in the as-built MCR to indicate the as-built Class 1E I&C power supply system malfunctions and status conditions.	14. The results of the test conclude that alarms initiate in the as-built MCR to indicate the as-built Class 1E I&C power supply system malfunctions and status conditions.

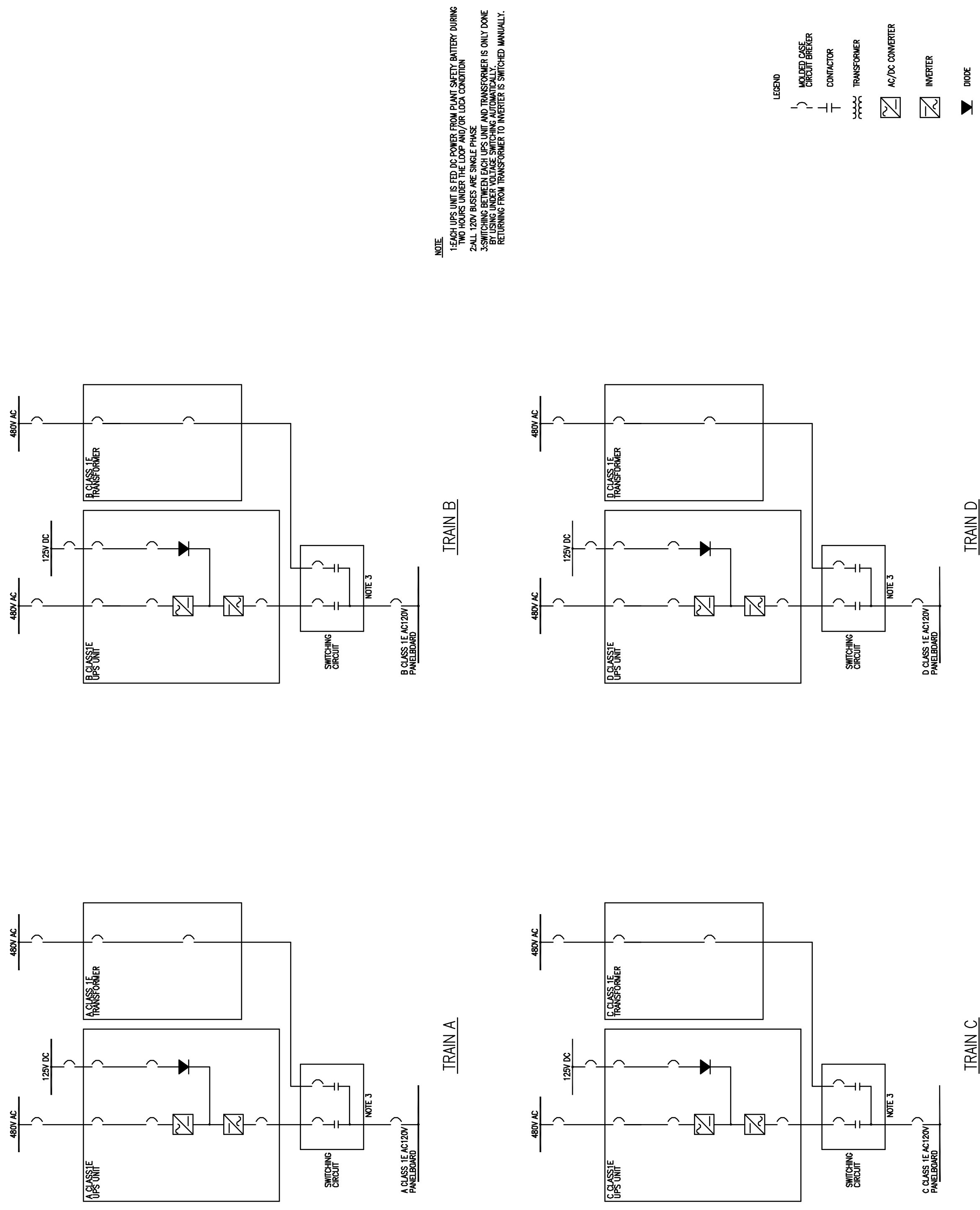


Figure 2.6.3-1 I&C Power Supply Systems

2.6.4 Emergency Power Sources (EPS)

2.6.4.1 EPS Design Description

The emergency power supply to each of the four divisions of the Class 1E power distribution systems is provided by a Class 1E EPS. The Class 1E EPSs are normally in standby mode and provide power to the Class 1E 6.9kV buses upon loss of offsite power sources.

Each Class 1E EPS and its associated equipment are Class 1E and are classified seismic Category I. The support systems that are required for the Class 1E EPS to perform the safety functions of starting and operating the Class 1E EPS are classified ASME Code Section III, Class 3. The Class 1E EPS and the ASME Code Section III, Class 3 portion of the support systems are seismic Category I.

The Class 1E EPSs are sized to provide power to safety-related loads subsequent to a LOOP or a LOOP and concurrent LOCA conditions.

The Class 1E EPS engine intake combustion air is separated from the engine exhaust.

Mechanical and electrical systems are designed so that a single failure affects the operation of only one Class 1E EPS. Separation criteria are applied among any redundant Class 1E EPS and between any Class 1E EPS and non-Class 1E systems.

The Class 1E EPSs are capable of providing power at a set voltage and frequency to the Class 1E 6.9kV buses within 100 seconds from a start signal.

The ECCS actuation signal starts the Class 1E EPSs and sheds the non-accident loads connected to the Class 1E buses. The Class 1E EPS circuit breaker automatically closes if the buses are de-energized. After the breaker closes, the accident loads on the Class 1E buses are started in sequence by the ECCS load sequencer.

A loss of power to a Class 1E bus initiates an automatic start of the respective Class 1E EPS, load shedding of connected loads, and closing of the Class 1E EPS circuit breaker. After the closing of the Class 1E EPS circuit breaker, the LOOP sequencer sequentially starts the required non-accident loads.

All Class 1E EPS protection systems, except for severe failure protection, are bypassed by an ECCS actuation signal.

The Class 1E EPSs are capable of responding to an ECCS actuation signal when running for test purposes.

Each Class 1E EPS can be controlled from the MCR and from the Class 1E EPS room.

Independence is established between each of the four Class 1E EPSs and its associated distribution equipment. Each Class 1E EPS has its own fuel oil storage and transfer, lubrication, starting, and air intake and exhaust systems. Auxiliary power for

Class 1E EPS support systems is provided by the same division of the Class 1E power system. Each Class 1E EPS is located in a separate room in the PS/B.

The stored air starting system is capable of providing starting air to each of the four Class 1E EPSs without requiring replenishment.

2.6.4.2 EPS Support Systems Design Description

Each Class 1E EPS is provided with dedicated and independent fuel oil supply systems, fuel oil day tank and storage tank such that:

- The FOS are safety-related systems.
- The FOS are not shared between the Class 1E EPSs of redundant divisions.
- The FOS are designed to minimize common cause failure of Class 1E EPSs of redundant divisions.

The FOS design features include:

- Four redundant and independent divisions, each dedicated to its respective Class 1E EPS.
- Each fuel oil storage tank provides a seven day supply of fuel oil to its respective Class 1E EPS.
- Each fuel oil day tank provides sufficient fuel for 1.5 hours of Class 1E EPS operation and is elevated above its Class 1E EPS to provide gravity flow.
- The FOS is designed so that a single failure of any active component of the system cannot affect the ability of the system to store and deliver fuel oil.
- The system is designed to remain operational during and after a safe-shutdown earthquake.
- The system contents are protected from the effects of low temperatures.
- Each fuel oil day tank is located inside the associated Class 1E EPS room in the seismic Category I building.
- Two skid mounted transfer pumps serve each Class 1E EPS.

The FOS and the related tank and pump compartments are designed to seismic Category I standards. The system is designed to meet the requirements of the ASME Code, Section III. The tanks and the related piping and valves are made of carbon steel, which is painted for corrosion resistance.

One of the two pumps transfers fuel oil from the fuel oil storage tank to the Class 1E EPS fuel oil day tank. Each transfer pump is capable of supporting EPS operation at continuous rated load while simultaneously increasing day tank level. Sufficient transfer pump NPSH is maintained under all design conditions. Fuel oil in the fuel oil day tank flows by gravity to feed the Class 1E EPS.

Alarms are provided in the MCR for low fuel oil level in the fuel oil storage tanks and low and high level in the fuel oil day tanks.

System logic involves the fuel oil transfer pump starting automatically on a fuel oil day tank low level signal and stopping automatically on a fuel oil day tank high-level signal. There are no system interlocks.

Each fuel oil transfer pump is powered from its respective Class 1E division. Separation is provided between Class 1E divisions and between Class 1E divisions and the non-Class 1E division.

If a safety-related mechanical component in the EPS support systems is not designed to ASME Code Section III, then quality of the component is demonstrated and documented (e.g. seismic design, testing and qualification).

The stored air starting system is capable of providing starting air to each of the four Class 1E EPSs without requiring replenishment.

The safety-related portions of starting air system components are designed to seismic Category I standards. These portions are designed to meet the requirements of the ASME Code. Section III.

Alarms are provided in the MCR for low pressure in air receivers.

Each lubrication oil tank provides a seven day supply of lube oil to its respective Class 1E EPS.

Lubrication oil is circulated by main shaft driven pump during EPS operation.

Alarms are provided in the MCR for low pressure and high temperature of lubrication oil system.

The Class 1E GTG combustion air intake and exhaust system is capable of supplying an adequate quantity of combustion air to the GT and of disposing the exhaust gases without creating an excessive backpressure on the GT when operating at 110% of nameplate rating. The turbine intake and exhaust openings are above the roof of the power source buildings (PS/B), and the portion of the piping/ducts above the roof is protected by a guard structure against precipitation and tornado missiles.

2.6.4.3 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.6.4-1 describes the ITAAC for the Class 1E EPS and the FOS systems.

Table 2.6.4-1 EPS Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 9)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the Class 1E EPS is as described in this Subsection 2.6.4.1	1. An inspection of the functional arrangement of the as-built Class 1E EPS will be performed.	1. The as-built onsite Class 1E EPS conforms to the functional arrangement as described in this Subsection 2.6.4.1
2. Each Class 1E EPS is normally in standby mode and provides power to the Class 1E 6.9kV buses upon loss of offsite power sources.	2. A test of each as-built Class 1E EPS will be performed.	2. The results of the test conclude that each as-built Class 1E EPS is normally in standby mode and provides power to the as-built Class 1E 6.9kV buses upon loss of offsite power sources.
3. Each Class 1E EPS has its own fuel oil storage and transfer, lubrication, starting, and combustion air intake and exhaust systems.	3. An inspection of each as-built Class 1E EPS and support systems will be performed.	3. Each as-built EPS has its own fuel oil storage and transfer, lubrication, starting, and combustion air intake and exhaust systems.
4. The auxiliary power for each Class 1E EPS' support system is provided by the same division of the Class 1E power system.	4.i An inspection of each as-built Class 1E EPS' support system will be performed.	4.i The auxiliary power for each as-built Class 1E EPS' support system is provided by same division of the Class 1E power system.
	4.ii A test of each as-built Class 1E EPS' support system will be performed to verify that auxiliary power is provided by the same division of the Class 1E power system.	4.ii The auxiliary power for each as-built Class 1E EPS' support system is provided by the same division of the Class 1E power system.
5. Deleted.	5. Deleted.	5. Deleted.
6. Each of the four Class 1E EPSs are designed to withstand seismic design basis loads without loss of safety function.	6.i Inspections will be performed to verify that each as-built Class 1E EPS is located in the PS/B.	6.i Each of the four as-built Class 1E EPSs is located in the PS/B.
	6.ii Type tests and/or analyses of each Class 1E EPS will be performed.	6.ii The results of the type tests and/or analyses conclude that each of the four as-built Class 1E EPSs can withstand seismic design basis loads without loss of safety function.
	6.iii An inspection will be performed on each as-built Class 1E EPS including anchorage.	6.iii Each of the four as-built Class 1E EPSs including anchorage is seismically bounded by the tested or analyzed conditions.

Table 2.6.4-1 EPS Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 9)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7.a The ASME Code Section III components for support systems that are required to support safety functions of starting and operating the Class 1E EPS, retain their pressure boundary integrity at their design pressure.	7.a Hydrostatic tests will be performed on the as-built components of the support systems required by the ASME Code Section III to be hydrostatically tested.	7.a The results of the hydrostatic tests of the as-built ASME Code Section III components for support systems that are required to support safety functions of starting and operating the Class 1E EPS conform with the requirements of ASME Code Section III.
7.b The ASME Code Section III piping for support systems that are required to support the safety functions of starting and operating the Class 1E EPS, retain their pressure boundary integrity at their design pressure.	7.b Hydrostatic tests will be performed on the ASME Code Section III portions of the as-built piping of the support systems required by the ASME Code Section III to be hydrostatically tested.	7.b The results of the hydrostatic tests of the as-built ASME Code Section III piping for support systems that are required to support the safety functions of starting and operating the Class 1E EPS conform with the requirements of ASME Code Section III.
8. The ASME Code Section III Class 3 portions of the EPS support systems are designed to withstand seismic design basis loads without loss of safety function.	8.i Inspections will be performed to verify that the ASME Code Section III Class 3 portions of the EPS support systems are located within seismic Category I structures.	8.i Each of the as-built ASME Code Section III, Class 3 portions of the EPS support systems is located within seismic Category I structures.
	8.ii Type tests and/or analyses of the ASME Code Section III Class 3 portion of the EPS support systems will be performed.	8.ii The results of the type tests and/or analyses conclude that each of as-built ASME Code Section III, Class 3 portions of the EPS support systems can withstand seismic design basis loads without loss of safety function.
	8.iii An inspection will be performed on the ASME Code Section III Class 3 portion of the EPS support systems including anchorage.	8.iii Each of the as-built ASME Code Section III, Class 3 portions of the EPS support systems including anchorage is seismically bounded by the tested or analyzed conditions.

Table 2.6.4-1 EPS Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 9)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9. The Class 1E EPSs are sized to provide power to safety-related loads subsequent to a LOOP or a LOOP concurrent with LOCA conditions.	9.i An analysis will be performed to verify the Class 1E EPSs are capable of providing power to safety-related loads subsequent to a LOOP or a LOOP concurrent with LOCA conditions.	9.i The Class 1E EPSs are sized to provide power to safety- related loads subsequent to a LOOP or a LOOP concurrent with LOCA conditions.
	9.ii An inspection will be performed to verify that ratings of as-built Class 1E EPSs bound the size requirements of the analysis.	9.ii The ratings of the as-built Class 1E EPSs bound the size requirements of the analysis.
10. The stored air starting system is capable of providing start of the Class 1E EPS without requiring replenishment.	10. A test of the as-built Class 1E EPS starting system will be performed.	10. The results of the test conclude that the as-built Class 1E EPS stored air starting system is capable of providing three starts of the as-built Class 1E EPS without requiring replenishment.
11. The Class 1E EPS engine combustion air intake portion is separated from the engine exhaust portion.	11. An inspection of the as-built Class 1E EPS engine will be performed.	11. The as-built Class 1E EPS engine combustion air intake portion is separated from the as-built engine exhaust portion.
12. Independence is maintained between each of four Class 1E EPSs	12. An inspection of the as-built Class 1E EPSs will be performed.	12. The as-built Class 1E EPSs are isolated each other.
13. The Class 1E EPS are capable of providing power at the set voltage and frequency to the Class 1E 6.9kV buses within 100 seconds of receiving a start signal.	13. A test will be performed to verify that the as-built Class 1E EPS power sources can reach set voltage and frequency within 100 seconds of receiving a start signal.	13. The results of the test conclude that the as-built Class 1E EPS power reaches the set voltage and frequency within 100 seconds of receiving a start signal.
14.a The ECCS actuation signal starts the Class 1E EPSs under a LOOP concurrent with LOCA conditions.	14.a A test will be performed to verify that the ECCS actuation signal starts the as-built Class 1E EPSs under a simulated LOOP concurrent with LOCA conditions.	14.a The results of the test conclude that the ECCS actuation signal starts the as-built Class 1E EPSs.

Table 2.6.4-1 EPS Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 9)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
14.b Each Class 1E EPS circuit breaker automatically closes and loads are shed if its respective division Class 1E medium voltage bus is de-energized.	14.b A test will be performed to verify operation of each as-built Class 1E EPS circuit breaker and loads.	14.b The results of the test conclude that each as-built Class 1E EPS circuit breaker automatically closes and loads are shed if its respective division Class 1E medium voltage bus is de-energized.
14.c After the breaker closes, the safety-related loads on the same division Class 1E buses are started in sequence by the ECCS load sequencer.	14.c A test will be performed to verify operation that after the breaker closes, the as-built safety-related loads on the same division Class 1E buses are started in sequence by the ECCS load sequencer.	14.c The results of the test conclude that after the breaker closes, the as-built safety-related loads on the same division Class 1E buses are started in sequence by the ECCS load sequencer.
15.a A loss of power to a Class1E bus initiates an automatic start of the respective Class 1E EPS, load shedding of connected loads, and closing of the Class 1E EPS circuit breaker.	15.a A test will be performed to verify operation of the respective Class 1E EPS upon a loss of power to the as-built Class 1E bus.	15.a The results of the test conclude that a loss of power to the as-built Class 1E bus initiates an automatic start of the respective as-built Class 1E EPS, load shedding of connected loads, and closing of the as-built Class 1E EPS circuit breaker.
15.b After the closing of the Class 1E EPS circuit breaker, the LOOP sequencer sequentially starts the required safety-related loads.	15.b A test will be performed to verify operation of the LOOP sequencer after the closing of the as-built Class 1E EPS circuit breaker.	15.b The results of the test conclude that after the closing of the as-built Class 1E EPS circuit breaker, the LOOP sequencer sequentially starts the required safety-related loads.
16. All Class 1E EPS protection systems, except for severe failure protection, are bypassed when the Class 1E EPS is started by an ECCS actuation signal.	16. A test will be performed to verify operation of all the as-built Class 1E EPS protection systems when the Class 1E EPS is started by an ECCS actuation signal.	16. The results of the test conclude that all the as-built Class 1E EPS protection systems, except for severe failure protection, are bypassed when the Class 1E EPS is started by an ECCS actuation signal.
17. The Class 1E EPSs are capable of responding to an automatic start signal when running for test purposes.	17. A test will be performed to verify that the as-built Class 1E EPSs are capable of responding to an automatic start signal.	17. The results of the test conclude that the as-built Class 1E EPSs are capable of responding to an automatic start signal when running for test purposes.

Table 2.6.4-1 EPS Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 9)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
18. Each Class 1E EPS can be controlled from the MCR and from the Class 1E EPS room.	18. A test will be performed to verify control of each as-built Class 1E EPS.	18. The results of the test conclude that each as-built EPS can be controlled from the as-built MCR and from the Class 1E EPS room.
19. The functional arrangement of the Class 1E EPS fuel oil storage and transfer system is as described in this Subsection 2.6.4.2.	19. An inspection of the functional arrangement of the as-built Class 1E EPS fuel oil storage and transfer system will be performed.	19. The as-built onsite Class 1E EPS fuel oil storage and transfer system conforms to the functional arrangement as described in this Subsection 2.6.4.2.
20. The fuel oil storage and transfer system is designed and constructed in accordance with seismic Category I standards and ASME Code Section III requirements.	20. An inspection of the as-built fuel oil storage and transfer system will be performed.	20. The as-built fuel oil storage and transfer system is designed and constructed in accordance with seismic Category I standards and ASME Code Section III.
21. Each fuel oil transfer pump transfers fuel oil from the fuel oil storage tank to the Class 1E EPS day tank at a flow rate to support Class 1E EPS operation at continuous rated load while simultaneously increasing day tank level. Sufficient transfer pump NPSH is maintained under all design conditions.	21.a A test of each as-built Class 1E EPS FOS transfer pump will be performed.	21. Each as-built fuel oil transfer pump is designed to transfer fuel oil from the fuel oil storage tank to the as-built Class 1E EPS day tank, at a flow rate to support Class 1E EPS operation at continuous rated load while simultaneously increasing day tank level.
	21.b An inspection of each division of the as-built Class 1E EPS FOS will be performed.	21.b A report exist and concludes that the as-built FOS is capable of supporting operation of the Class 1E EPS at continuous rated load while simultaneously increasing day tank level and maintaining sufficient NPSH under all design conditions.

Table 2.6.4-1 EPS Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 9)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
22. Each Class 1E EPS FOS day tank's capacity is sufficient to provide fuel oil for 1.5 hours of GTG operation. The fuel oil in each fuel oil day tank flows by gravity to maintain positive pressure at the fuel pumps for each Class 1E EPS.	22. An inspection for the existence of a report for the as-built FOS will be performed.	22. A report exists and concludes that each as-built Class 1E EPS FOS day tank's capacity is sufficient to provide fuel oil for 1.5 hours of GTG operation. The fuel oil in each fuel oil day tank flows by gravity to maintain positive pressure at the fuel pumps for each Class 1E EPS.
23. Alarms are provided in the MCR for EPS support systems as described in Subsection 2.6.4.2.	23. A test will be performed on the as-built EPS support systems by providing simulated status test signals.	23. The results of the test conclude that alarms are provided in the as-built MCR for status condition in the as-built EPS support systems as described in Subsection 2.6.4.2.
24. The system logic involves the fuel oil transfer pump starting automatically on a day tank low level signal and stopping automatically on a fuel oil day tank high-level signal.	24. A test will be performed on the as-built fuel oil storage and transfer system by providing a simulated fuel oil day tank level test signal testing the fuel oil transfer pump.	24. The results of the test conclude that as-built system logic involves the fuel oil transfer pump starting automatically on a fuel oil day tank low level signal and stopping automatically on a fuel oil day tank high-level signal.
25. The fuel oil transfer pumps are powered from their respective Class 1E division.	25. A test will be performed on the as-built fuel transfer pumps by providing a simulated test signal in each Class 1E division.	25. The results of the test conclude that a simulated test signal exists at the as-built fuel oil transfer pumps when the assigned Class 1E division is provided a test signal.

Table 2.6.4-1 EPS Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 7 of 9)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
26.a.i The ASME Code Section III components of the EPS support systems are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	26.a.i An inspection of the as-built ASME Code Section III components of the EPS support systems will be performed.	26.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the EPS support systems are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
26.a.ii The ASME Code Section III components of the EPS support systems are reconciled with the design requirements.	26.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	26.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the EPS support systems are reconciled with the design requirements. The report documents the results of the reconciliation analysis.

Table 2.6.4-1 EPS Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 8 of 9)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
26.b.i The ASME Code Section III piping of the EPS support systems, including supports, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	26.b.i An inspection of the as-built ASME Code Section III piping of the EPS support systems, including supports, will be performed.	26.b.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the EPS support systems, including supports, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
26.b.ii The ASME Code Section III piping of the of the EPS support systems, including supports, is reconciled with the design requirements.	26.b.ii A reconciliation analysis of the piping of the EPS support systems, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	26.b.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the EPS support systems, including supports, is reconciled with the design requirements. The report documents the results of the reconciliation analysis.
27.a Pressure boundary welds in ASME Code Section III components meet ASME Code Section III requirements for non-destructive examination of welds.	27.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	27.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
27.b Pressure boundary welds in ASME Code Section III piping meet ASME Code Section III requirements for non-destructive examination of welds.	27.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	27.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.

Table 2.6.4-1 EPS Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 9 of9)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
28. Quality is demonstrated and documented for each safety-related mechanical component of the EPS support systems that is not designed to ASME Code Section III.	28. An inspection for the existence of a report will be performed.	28. A report exists and documents the quality of each as-built safety-related mechanical component of the EPS support systems that is not designed to ASME Code Section III.
29. Each fuel oil storage tank provides a seven day supply of fuel oil to its respective Class 1E EPS.	29. An inspection for the existence of a report for each as-built fuel oil storage tank for the Class 1E EPS will be performed.	29. A report exists and concludes that each as-built fuel oil storage tank for the Class 1E EPS provides a seven day supply of fuel oil to its respective Class 1E EPS.
30. Each lubrication oil tank provides a seven day supply of lubrication oil to its respective Class 1E EPS.	30. An inspection for the existence of a report for each as-built lubrication oil tank for the Class 1E EPS will be performed.	30. A report exists and concludes that each as-built lubrication oil tank for the Class 1E EPS provides a seven day supply of lubrication oil to its respective Class 1E EPS.
31. Each main shaft driven lubrication oil pump circulates lubrication oil to the engine during EPS operation.	31. An inspection of each as-built main shaft driven lubrication oil pump will be performed.	31. Each as-built main shaft driven lubrication oil pump is designed to circulate lubrication oil to the engine during EPS operation.
32. Each division of the Class 1E GTG combustion air intake and exhaust system is capable of supplying an adequate quantity of combustion air to the GT and of disposing the exhaust gases without creating an excessive backpressure on the GT when operating at 110% of nameplate rating.	32. A test of each division of the as-built Class 1E GTG combustion air intake and exhaust system will be performed.	32. Each division of the as-built Class 1E GTG combustion air intake and exhaust system is capable of supplying an adequate quantity of combustion air to the GT and of disposing the exhaust gases without creating an excessive backpressure on the GT when operating at 110% of nameplate rating.

2.6.5 Alternate AC (AAC) Power Source

2.6.5.1 AAC Design Description

Two AAC power sources are provided to supply AAC power in case there is a complete loss of offsite power and of Class 1E EPSs. AAC power sources supply power to loads required to bring and maintain the plant in a safe shutdown condition for an station blackout (SBO) condition. AAC power sources also provide power to the 6.9kV permanent buses during a LOOP condition. The AAC sources and their connections to Class 1E 6.9kV buses and to non-Class 1E 6.9kV permanent buses are shown on Figure 2.6.1-1. These AAC power sources are non-Class 1E and non-seismic.

The AAC power sources are located in separate dedicated rooms.

AAC power sources are sized to meet load requirements for SBO and LOOP conditions. The generator lead cables are adequately sized to carry the rated output of the AAC power source and withstand the maximum available fault current.

The connection between the Class 1E 6.9kV buses and non-Class 1E AAC power sources are provided through two isolation devices in series which are normally open. One Class 1E circuit breaker is provided at the Class 1E 6.9kV switchgear and the other is a non-Class 1E disconnect switch at the selector circuit.

Circuit breaker panels of the alternate ac system and cables associated with alternate ac power to safety buses in the T/B electrical room are segregated into two groups by qualified fire barriers.

From the onset of an SBO event, one Class 1E 6.9kV switchgear bus is manually connected to an AAC power source within one hour. Loads required for SBO are manually started to allow the plant to achieve and maintain a safe shutdown condition.

The AAC power system is inspected and tested periodically to demonstrate operability and reliability.

The AAC power sources are of different size and have different starting system from the EPSs.

Manual and automatic operation (e.g. start, stop and synchronization) are provided in the MCR. Each AAC power source and each Class 1E 6.9 kV breaker status information is available in the MCR.

The AAC GTGs have enough fuel capacity to supply power to the required SBO loads for 8 hours.

Each AAC power source is capable of providing power at the set voltage and frequency to the non-Class 1E 6.9kV buses within the maximum allowable time from receiving a start signal.

2.6.5.2 AAC Fuel Oil Storage and Transfer Systems (FOS) Design Description

Each AAC power source is provided with dedicated fuel oil supply system, fuel oil day tank and storage tank:

- The AAC FOS are non safety-related systems.
- FOS is not shared by the EPS power sources.

The AAC FOS design features include:

- Each fuel oil day tank provides sufficient fuel for 1.5 hours of AAC power source operation.
- Each fuel oil day tank is located inside the associated AAC power source room in the PS/B.

2.6.5.3 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.6.5.1-1 describes the ITAAC for the AAC power source.

Table 2.6.5-1 AAC Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the AAC power sources are as described in Subsection 2.6.5.1.	1. An inspection of the functional arrangement of the as-built AAC power sources will be performed.	1. The as-built AAC power sources conform to the functional arrangement described in Subsection 2.6.5.1.
2. The AAC power sources are located in separate dedicated rooms.	2. An inspection of the location of the as-built AAC power sources will be performed.	2. The as-built AAC power sources are located in separate dedicated rooms.
3. Each AAC power source is isolated from the Class 1E power supply systems by a non-Class 1E disconnect switch and a Class 1E circuit breaker.	3. An inspection of the as-built non-safety disconnect switch and Class 1E circuit breaker between each AAC power source and the emergency Class 1E power supply systems will be performed.	3. Each as-built AAC power source is isolated from the as-built Class 1E power supply systems by a non-safety disconnect switch and a Class 1E circuit breaker.
4. The Class 1E circuit breakers in Class 1E medium voltage switchgears are connected to disconnect switches (non-Class 1E) in selector circuits which are normally open and do not have any automatic closing function.	4. An inspection of the as-built Class 1E circuit breakers in the Class 1E medium voltage switchgears which are connected to disconnect switches (non-Class 1E) in selector circuits will be performed.	4. The as-built Class 1E circuit breakers in the Class 1E medium voltage switchgears are connected to disconnect switches (non-Class 1E) in selector circuits which are normally open and do not have any automatic closing function.
5. Separate and independent fuel supply systems and onsite fuel storage tanks are provided for Class 1E EPSs and AAC power sources.	5. An inspection of the as-built fuel supply systems and onsite fuel storage tanks for the Class 1E EPSs and the AAC power sources will be performed.	5. Separate and independent fuel supply systems and onsite fuel storage tanks are provided for the as-built Class 1E EPSs and the AAC power sources.
6. The AAC power sources can be started and connected manually to onsite Class 1E medium voltage buses within 60 minutes during SBO conditions.	6. A test will be performed to verify that the as-built AAC power sources can be started and connected manually to the as-built onsite Class 1E medium voltage buses within 60 minutes during SBO conditions.	6. The results of the test conclude that the as-built AAC power sources can be started and connected manually to the as-built onsite Class 1E medium voltage buses within 60 minutes during SBO conditions.
7. The AAC GTGs have enough fuel capacity to supply power to the required SBO loads for 8 hours.	7. An inspection of the as-built AAC power sources will be performed.	7. The as-built AAC GTGs have enough fuel capacity to supply power to the required SBO loads for 8 hours.

Table 2.6.5-1 AAC Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8. The operation (e.g. start, stop and synchronization) of the AAC power sources are provided in the MCR.	8. An inspection of the as-built MCR will be performed.	8. The operation (e.g. start, stop and synchronization) of the AAC power sources are provided in the as-built MCR.
9. Each AAC power source is capable of providing power at the set voltage and frequency to the non Class 1E 6.9kV buses within the maximum allowable time from receiving a start signal.	9. A test will be performed to verify that the as-built AAC power source can reach set voltage and frequency.	9. Each as-built AAC power source is capable of providing power at the set voltage and frequency to the non Class 1E 6.9kV buses within 100 seconds from receiving a start signal.
10. Each AAC power source status and the breaker status of each Class 1E 6.9kV breaker are displayed in the MCR.	10. An inspection of the as-built MCR will be performed.	10. Each as-built AAC power source status and the breaker status of each Class 1E 6.9kV breaker are displayed in the as-built MCR.
11. The functional arrangement of the AAC fuel oil storage and transfer system is as described in Subsection 2.6.5.2.	11. An inspection of the functional arrangement of the as-built AAC fuel oil storage and transfer system will be performed.	11. The as-built AAC fuel oil storage and transfer system conforms to the functional arrangement as described in Subsection 2.6.5.2.
12. The reliability of the AAC power sources meet or exceed 95 percent.	12. An analysis of the reliability of the as-built AAC power sources will be performed.	12. The reliability of the as-built AAC power sources meet or exceed 95 percent.

2.6.6 Plant Lighting Systems

2.6.6.1 Design Description

The plant lighting systems includes normal and emergency lighting systems. The plant lighting systems are non safety-related and non-Class 1E.

The normal plant lighting is provided in all plant indoor and outdoor areas during all normal and emergency modes of plant operation. Normal plant lighting is powered from plant non-Class 1E ac power systems.

The emergency lighting system includes normal/emergency (N/E) lighting system, emergency lighting system being powered by the Class 1E power system, and self-contained battery pack emergency lighting system.

The N/E lighting system is capable of being powered by the non-Class 1E 480 V permanent buses. N/E lighting is provided in all areas of the plant except the areas that have emergency lighting powered by the Class 1E power sources.

Emergency lighting powered by the Class 1E power system in MCR is powered from the redundant Class 1E dc power systems. Emergency lighting powered by the Class 1E power system in areas where emergency operations are performed (e.g. MCR, Remote shutdown console room) is powered by the Class 1E 480V power system.

Self-contained battery pack emergency lighting system is normally powered from the ac power systems and powered from self-contained battery packs if normal ac power is lost. The self-contained battery pack emergency lighting system is provided in areas where emergency operations are performed, to enable safe ingress and egress of personnel.

Emergency lighting system in MCR meets seismic Category I requirements.

Normal and emergency lighting system, together, provide the required illumination levels in each area.

2.6.6.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.6.6-1 describes the ITAAC for the plant lighting systems.

Table 2.6.6-1 Plant Lighting Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The plant lighting systems includes normal, emergency, and security lighting systems.	1. An inspection of the as-built plant lighting systems will be performed.	1. The as-built plant lighting systems includes normal, emergency, and security lighting systems.
2. The emergency lighting system includes normal/emergency lighting system, emergency lighting system powered by Class 1E power system, and self-contained battery pack emergency lighting system.	2. An inspection of the as-built emergency lighting system will be performed.	2. The as-built emergency lighting system includes normal/emergency lighting system, Class 1E emergency lighting system powered by Class 1E power system and self-contained battery pack emergency lighting system.
3. The normal/emergency lighting system is powered from the 480V AAC buses.	3. An inspection of the as-built normal/emergency lighting system will be performed.	3. The as-built normal/emergency lighting system is powered from the 480V AAC buses.
4. The emergency lighting powered by Class 1E power system in the MCR and remote shutdown console room is powered from redundant Class 1E dc systems.	4. An inspection of the as-built emergency lighting powered by the Class 1E power system in the as-built MCR and remote shutdown console room will be performed.	4. The as-built emergency lighting powered by the Class 1E power system in the as-built MCR and remote shutdown console room is powered from redundant Class 1E dc systems.
5. The emergency lighting system in the MCR and remote shutdown console room is designed to withstand seismic design basis loading without loss of safety function.	5.i Inspections will be performed to verify that the as-built equipment is located in the reactor building.	5.i The as-built emergency lighting system in the MCR and remote shutdown console room is located in the reactor building.
	5.ii Type tests and/or analyses of the equipment will be performed.	5.ii The results of the type tests and/or analyses conclude that the emergency lighting system in the MCR and remote shutdown console room can withstand seismic design basis loads without loss of safety function.
	5.iii An inspection will be performed on the as-built equipment including anchorage.	5.iii The as-built emergency lighting system in the MCR and remote shutdown console room including anchorage is seismically bounded by the tested or analyzed conditions.

Table 2.6.6-1 Plant Lighting Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6. The self-contained battery pack lighting system is normally powered from the ac power system and powered from self-contained battery packs if the normal ac power is lost.	6. An inspection of the as-built self-contained battery pack lighting system will be performed.	6. The as-built self-contained battery pack lighting system is normally powered from the ac power system and powered from self-contained battery packs if the normal ac power is lost to support access, egress, and operations activities for a minimum of 8-hours.
7. The dc self-contained battery pack units provide illumination of about 0.5 foot-candles at the floor level for 8-hours.	7. An test of the as-built dc self-contained battery pack units will be performed.	7. The as-built dc self-contained battery pack units provide illumination of about 0.5 foot-candles at the floor level for 8-hours.
8. The emergency lighting in the MCR and remote shutdown consoles provides illumination levels in those areas equal to greater than those recommended by the IESNA for at least 8 hours.	8. An test of the emergency lighting in the MCR and remote shutdown consoles will be performed.	8. The as-built emergency lighting in the MCR and remote shutdown consoles provides illumination levels in those areas equal to greater than those recommended by the IESNA for at least 8 hours.

2.6.7 Grounding and Lightning Protection System

2.6.7.1 Design Description

The grounding and lightning protection system consists of the following:

- Station ground grid
- System neutral grounding
- Equipment grounding
- I&C grounding
- Lightning protection

The station ground grid consists of buried, interconnected bare copper conductors and ground rods forming a plant ground grid matrix.

The system neutral grounding provides grounding of the neutral points of the MG, MT, UATs, RATs, SSTs, Class 1E EPSs and AAC power sources. The neutrals of the MG, Class 1E EPSs and AAC power sources is grounded through grounding transformers providing high-resistance grounding. The MT and SST low voltage neutrals are grounded solidly. The UAT and RAT low voltage winding neutrals are resistance-grounded.

The equipment grounding provides bonding of the equipment enclosures, raceways, metal structures, metallic tanks and ground bus of switchgear, load centers, MCCs, switchboards, panel boards and control cabinets to the station ground grid.

The I&C grounding provides the isolated signal ground required by plant I&C systems. A separate radial grounding system consisting of isolated instrumentation ground buses and insulated cables is provided. The radial grounding systems are connected to the station ground grid and are insulated from all other grounding circuits.

Lightning protection is provided for buildings and exposed structures. Surge arrestors are provided to protect the MT, UATs, RATs, isolated phase busduct and the medium-voltage switchgear from lightning surges. Surge arresters are connected directly to the ground grid in order to provide a low-impedance path to ground for the surges caused or induced by lightning. Thus, fire or damage to the plant from a lightning strike is avoided.

2.6.7.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.6.7-1 describes the ITAAC for the grounding and lightning protection system.

Table 2.6.7-1 Grounding and Lightning Protection System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The following grounding systems connect to the station grounding grid: a. the system neutral grounding of the MG, MT, UATs, RATs, SSTs, Class 1E EPSs and AAC power sources b. the equipment grounding of the equipment enclosures, raceways and metal structures c. the I&C grounding	1. An inspection of the as-built grounding system will be performed to verify: a. the system neutral grounding connects to station grounding grid b. the equipment grounding connects to station grounding grid c. the I&C grounding connects to station grounding grid	1. The following as-built grounding systems connect to the station grounding grid: a. the system neutral grounding of the MG, MT, UATs, RATs, SST, Class 1E EPSs and AAC power sources b. the equipment grounding of the equipment enclosures, raceways and metal structures c. the I&C grounding
2. Lightning protection system is provided for US-APWR buildings and exposed structures.	2. Inspection of the as-built lightning protection system will be performed.	2. The as-built lightning protection system for plant buildings and exposed structures exist.

2.6.8 Containment Electrical Penetration Assemblies (EPAs)

2.6.8.1 Design Description

Electric power, control and instrumentation circuits pass through the containment vessel boundary wall via EPAs.

EPAs are classified as seismic Category I and qualified for postulated environmental conditions.

Separation is maintained between redundant divisions of EPAs containing Class 1E circuits and between EPAs containing Class 1E circuit and EPAs containing non-Class 1E circuits.

Separate penetrations are provided for medium voltage and low voltage power, control, and instrumentation functions.

The primary circuit protection device for each EPA circuit is sized to ensure electrical integrity of the circuit for postulated overload and short-circuit conditions.

The back up circuit protection device for each EPA circuit is sized to ensure mechanical integrity of the EPA for postulated overload and short-circuit conditions, during normal and accident conditions.

2.6.8.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.6.8-1 describes the ITAAC for the EPAs.

Table 2.6.8-1 Containment Electrical Penetration Assemblies Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The electric power, control and instrumentation circuits pass through the containment vessel boundary wall via electrical penetration assemblies (EPAs).	1. An inspection of the as-built electric power, control and instrumentation circuits pass through the as-built containment vessel boundary wall will be performed.	1. The as-built electric power, control and instrumentation circuits pass through the as-built containment vessel boundary wall via the as-built EPAs.
2. Each EPA is designed to withstand seismic design basis loads without loss of safety function.	2.i Inspections will be performed to verify that each as-built EPA is located in the reactor building and containment vessel.	2.i Each as-built EPA is located in the reactor building and containment vessel.
	2.ii Type tests and/or analyses of each EPA will be performed.	2.ii The results of the type tests and/or analyses conclude that each EPA can withstand seismic design basis loads without loss of safety function.
	2.iii An inspection will be performed on each as-built EPA including anchorage.	2.iii Each as-built EPA including anchorage is seismically bounded by the tested or analyzed conditions.
3. Separation is maintained between redundant divisions of EPAs containing Class 1E circuits and between EPAs containing Class 1E circuit and EPAs containing non-Class 1E circuits.	3. An inspection of the as-built EPAs containing the Class 1E circuit and the as-built EPAs containing the non-Class 1E circuits will be performed.	3. The separation is maintained between the as-built redundant divisions of EPAs containing the Class 1E circuits and between the as-built EPAs containing the Class 1E circuit and the as-built EPAs containing the non-Class 1E circuits.
4. Separate penetrations are provided for medium voltage and low voltage power, control, and instrumentation functions.	4. An inspection of the as-built penetrations for the medium voltage and low voltage power, control, and instrumentation functions will be performed.	4. The as-built separate penetrations are provided for the medium voltage and low voltage power, control, and instrumentation functions.
5. The primary circuit protection device for each EPA circuit is sized to ensure electrical integrity of the circuit for postulated overload and short-circuit conditions.	5.i An analysis will be performed to verify the primary circuit protection device for each EPA circuit is sized to ensure electrical integrity of the circuit for postulated overload and short-circuit conditions.	5.i The primary circuit protection device for each EPA circuit is sized to ensure electrical integrity of the circuit for postulated overload and short-circuit conditions.
	5.ii An inspection will be performed to verify the ratings of the as-built primary circuit protection device for each EPA circuit bound the requirements of the analysis.	5.ii The ratings of the as-built primary circuit protection device for each EPA circuit bound the requirements of the analysis.

Table 2.6.8-1 Containment Electrical Penetration Assemblies Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6. The back up circuit protection device for each EPA circuit is sized to ensure mechanical integrity of the EPA for postulated overload and short-circuit conditions, during normal and accident conditions.	6.i An analysis will be performed to verify the back up circuit protection device for each EPA circuit is sized to ensure mechanical integrity of the EPA for postulated overload and short-circuit conditions, during normal and accident conditions.	6.i The back up circuit protection device for each EPA circuit is sized to ensure mechanical integrity of the EPA for postulated overload and short-circuit conditions, during normal and accident conditions.
	6.ii An inspection will be performed to verify ratings of the back-up circuit protection device for each as-built EPA circuit bound the requirements of the analysis.	6.ii The ratings of the back-up circuit protection device for each as-built EPA circuit bound the requirements of the analysis.
7. Each EPA as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	7.i Type tests and/or analyses will be performed on the EPAs located in a harsh environment.	7.i The results of the type tests and/or analyses conclude that each EPA as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	7.ii Inspection will be performed on each as-built EPA located in a harsh environment.	7.ii Each as-built EPA as being qualified for a harsh environment is bounded by type tests and/or analyses.

2.7 PLANT SYSTEMS

2.7.1 Power Generation Systems

2.7.1.1 Turbine Generator (T/G)

2.7.1.1.1 Design Description

System Purpose and Functions

The T/G is non safety-related system. The T/G provides capability to convert energy in the main steam to electrical energy at the generator output.

Location and Functional Arrangement

The T/G is located within the T/B, and consists of:

- One double-flow high-pressure turbine
- Three double-flow low pressure turbines
- A generator / exciter
- Two sets of external moisture separator/reheaters
- Associated piping, valves, control system
- Auxiliary subsystems

Key Design Features

The turbine is an 1800 rpm, tandem compound, six exhaust flow, reheat unit. Two external moisture separator/reheaters (MS/R) with two stages of reheating are located on each side of the T/G centerline. The generator is a direct-driven, three-phase, 60 Hz, four-pole synchronous generator with water-cooled stator and hydrogen-cooled rotor.

The turbine rotors, valves and control/protection system are designed to minimize the possibility of turbine missile generation less than 1.0E-5 per year. Orientation of the T/G is such that a high-energy missile to be directed at an approximately 90 degree angle away from safety-related structures, systems, and components. On the top of this, any safety-related systems, structures and components are located outside the low-trajectory missile strike zones, which are defined by ±25-degree lines emanating from the centers of the first and last low-pressure turbines wheels as measured from the plane of the wheels. For the purpose to keep the probability equal or less than the above, turbine rotor integrity is provided by the integrated combination of rotor design, fracture toughness requirements, tests, and inspections.

Inspections and tests of the as-built low-pressure turbine (LPT) rotors are conducted to verify that as-built test data and calculated toughness curves satisfy the material properties assumptions in the turbine rotor analysis, which determines the turbine maintenance program and inspection interval to meet the requirements of the turbine missile probability analysis.

Seismic and ASME Code Classifications

The T/G is non-seismic category and is not designed to ASME code specifications.

System Operation

Steam flow is controlled by turbine megawatt and valve position. Under normal conditions, the turbine requests a certain megawatt load target. Through a coordinated mode of control, the turbine valves adjust the steam flow to the turbine.

Alarms, Displays, and Controls

Instruments, controls, and protective devices are provided to confirm reliable operation. Redundant, fast actuating controls are installed to prevent damage to the T/G resulting from overspeed and/or full load rejection. The control system initiates turbine trip upon reactor trip.

Logic

There is no logic needed for direct safety functions related to the T/G.

Interlocks

There are no interlocks needed for direct safety functions related to the T/G.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.1.1.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.1.1-1 describes the ITAAC for the T/G.

Table 2.7.1.1-1 Turbine Generator Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the turbine generator is as described in Subsection 2.7.1.1.1.	1. An inspection of the as-built system will be performed.	1. The as-built turbine generator conforms to the functional arrangement as described in Subsection 2.7.1.1.1.
2.a The probability of turbine missile generation is less than 1.0E-5 per year.	2.a Inspections and tests of the as-built LPT rotors will be performed.	2.a The as-built LPT rotor material conforms to the specified requirements as described in Subsection 2.7.1.1.1.
2.b The turbine generator trips in response to actual or simulated signal from mechanical or electrical overspeed trip system.	2.b Testing will be performed on the main turbine using mechanical or electrical overspeed trip system.	2.b The main turbine trips after receiving a signal.
2.c The MTSV, MTCV, RSV and IV move smoothly to a fully closed position in the event of emergency.	2.c Valve testing will be performed during the main turbine operation.	2.c Each valve moves smoothly to a fully closed position.
3. The turbine generator trips on a reactor trip.	3. A test of the as-built system will be performed.	3. The as-built control logic provides a simulated turbine generator trip on a simulated reactor trip.

2.7.1.2 Main Steam Supply System (MSS)

2.7.1.2.1 Design Description

System Purpose and Functions

The MSS is provided with safety-related main steam isolation valves (MSIVs) and associated main steam bypass isolation valves (MSBIVs) in each main steam line. These valves isolate the secondary side of the steam generators (SGs) to prevent the uncontrolled blowdown of more than one SG and isolate non safety-related portions of the system.

The main function of the MSS is to transport steam from the SGs to the high-pressure turbine and to the moisture separator/reheater (MS/R) over a range of flows and pressures covering the entire operating range from system warmup to valve wide open (VWO) turbine conditions.

MSS also supplies steam to the gland seal system, the emergency feedwater pump turbines, deaerator heater, and so on. The system also dissipates heat generated by the nuclear steam supply system (NSSS) by means of turbine bypass valves to the condenser or to the atmosphere through air-operated main steam relief valves (MSRVs) or motor-operated main steam depressurization valves (MSDVs) or spring-loaded main steam safety valves (MSSVs) when either the turbine, generator, or the condenser is unavailable.

The MSS provides the containment isolation function, as described in Section 2.11.2, of the MSS lines penetrating the containment.

Location and Functional Arrangement

MSS piping and components are located within the containment, in the reactor building, and the turbine building. Figure 2.7.1.2-1 illustrates the MSS, showing the arrangement of the MSS components including the MSIVs. Table 2.7.1.2-1 also provides a tabulation of the location of MSS equipment.

Key Design Features

Six MSSVs are provided per main steam line. MSSVs with sufficient rated capacity are provided to prevent the steam pressure from exceeding 110 percent of the MSS design pressure.

One air-operated MSRV is installed on the MSS piping from each SG. The primary function of the MSRVs is to prevent an unnecessary lifting of the MSSVs.

One motor-operated MSDV is installed on the main steam piping from each SG. MSDV provides controlled removal of reactor decay heat (in conjunction with the emergency feedwater system) during safe shutdown, after plant transient, accident condition, and emergency condition.

One MSIV is provided on each main steam piping to limit uncontrolled steam release from one SG in the event of steam line break.

One main steam check valve (MSCV) is provided downstream of the MSIVs on each main steam piping to prevent blowdown of the SGs by reverse flow in the event the break is upsteam of a MSIV.

The safety-related portions of the MSS are designed to withstand the effects of a safe-shutdown earthquake (SSE), and to perform its intended functions during normal conditions, adverse environmental occurrences and accident conditions, including loss of offsite power, with a single malfunction or failure of an active component.

The MSS is designed to provide containment isolation of the MSS lines penetrating the containment.

Each mechanical division of the main steam supply system is physically separated from the other divisions by a structural barrier, which also serves as a fire barrier. The piping, components of reactor building exterior and components inside the containment are exceptions.

Seismic and ASME Code Classifications

The seismic category and ASME Code Section III requirements are identified in Tables 2.7.1.2-2 and 2.7.1.2-3 for safety-related MSS components and piping, respectively.

System Operation

The MSS transports and distributes steam from the SGs to the main turbine during power generation and directly to the main condenser when the main turbine is not available. Four main steam lines, one from each SG, supply steam to the turbine generator (T/G). The main steam lines from the SGs are connected to an equalization piping. A portion of the steam from the equalization piping flows to steam seals, the moisture separator reheaters, and deaerator heating, with the high pressure turbine receiving balance of the flow via four individual lines with a set of turbine stop and control valves.

Alarms, Displays, and Controls

The valves identified in Table 2.7.1.2-2 as having PSMS control perform an active safety function after receiving a signal from PSMS.

Table 2.7.1.2-4 identifies alarms, displays, and controls associated with the MSS that are located in the main control room (MCR). MSS equipment and instrumentation that is required for remote shutdown and that is available at the remote shutdown console (RSC) is also shown on Table 2.7.1.2-4.

Logic

Closure of the MSIV is initiated by following:

- High-high containment pressure
- Low main steam line pressure
- High main steam line pressure negative rate
- Manual actuation

Interlocks

There are no interlocks needed for direct safety functions related to the MSS.

Class 1E Electrical Power Sources and Divisions

The safety-related MSS equipment identified in Table 2.7.1.2-2 as Class 1E is powered from their respective Class 1E division. Separation is provided between these Class 1E divisions and between non-Class 1E divisions and non-Class 1E electrical cable.

Equipment to be Qualified for Harsh Environments

The safety-related MSS equipment identified in Table 2.7.1.2-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITAAC acceptance criteria in Table 2.7.1.2-5. Key parameters of the MSS design that are used in the safety analysis and which are included in the Table 2.7.1.2-5 are over-pressurization protection and isolation of MSS.

2.7.1.2.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.1.2-5 describes the ITAAC for the MSS.

The ITAAC associated with the MSS equipment, components, and piping and that comprise a portion of the CIS are described in Table 2.11.2-2 and Table 2.7.1.2-5 Items 8.b and 14.

Table 2.7.1.2-1 Main Steam Supply System Location of Equipment and Piping

System and Components	Location
Main Steam Isolation Valves	Reactor Building
Main Steam Bypass Isolation Valves	Reactor Building
Main Steam Safety Valves	Reactor Building
Main Steam Relief Valves	Reactor Building
Main Steam Depressurization Valves	Reactor Building
Main Steam Relief Valve Block Valves (MSRVBVs)	Reactor Building
Main Steam Drain Line Isolation Valves (MSDIVs)	Reactor Building
Main Steam Check Valves	Reactor Building
Main steam piping in the PCCV	Containment
Piping in the reactor building including branch piping from main steam piping up to and including the following valves; MSIV, MSBIV, MSSV, MSRV, MSDV, MSRVBV, MSDIV	Reactor Building
Branch lines from the main steam piping to the emergency feedwater pump turbine steam isolation valve excluding this valve	Reactor Building
Main steam drain piping located in the reactor building downstream MSDIV and excluding the MSDIV	Reactor Building
MSS piping downstream of MSIV and MSBIV up to and including the first restraint located between the reactor building and the turbine building	Reactor Building
Discharge piping of the MSSV in the reactor building	Reactor Building
Discharge piping of the MSRV and MSDV in the reactor building	Reactor Building

Table 2.7.1.2-2 Main Steam Supply System Equipment Characteristics (Sheet 1 of 2)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Main Steam Isolation Valves	MSS-SMV-515A,B,C,D	2	Yes	Yes	Yes/Yes	Main steam line isolation Remote Manual	Transfer Closed	Closed
Main Steam Bypass Isolation Valves (air-operated valves)	MSS-HCV-565 MSS-HCV-575 MSS-HCV-585 MSS-HCV-595	2	Yes	Yes	Yes/Yes	Main steam line isolation Remote Manual	Transfer Closed	Closed
Main Steam Safety Valves	MSS-SRV-509A,B,C,D MSS-SRV-510A,B,C,D MSS-SRV-511A,B,C,D MSS-SRV-512A,B,C,D MSS-SRV-513A,B,C,D MSS-SRV-514A,B,C,D	2	Yes	No	-/-	-	Transfer Open Transfer Closed	-
Main Steam Relief Valves	MSS-PCV-515 MSS-PCV-525 MSS-PCV-535 MSS-PCV-545	2	Yes	Yes	Yes/Yes	-	-	Closed
Main Steam Depressurization Valves	MSS-MOV-508A,B,C,D	2	Yes	Yes	Yes/Yes	Remote Manual	Transfer Open Transfer Closed	As Is
Main Steam Relief Valve Block Valves	MSS-MOV-507A,B,C,D	2	Yes	Yes	Yes/Yes	Remote Manual	Transfer Closed	As Is

Table 2.7.1.2-2 Main Steam Supply System Equipment Characteristics (Sheet 2 of 2)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Main Steam Drain Line Isolation Valves	MSS-MOV-701A,B,C,D	2	Yes	Yes	Yes/Yes	Remote Manual	Transfer Closed	As Is
Main Steam Check Valves	MSS-VLV-516A,B,C,D	3	Yes	No	-/-	-	Transfer Closed	-
Main Steam Line Pressure	MSS-PT-515, 516, 517, 518, 525, 526, 527, 528, 535, 536, 537, 538, 545, 546, 547, 548	-	Yes	-	Yes/No	-	-	-
Turbine Inlet Pressure	MSS-PT-555, 556, 557, 558	-	No	-	Yes/No	-	-	-

Note: Dash (-) indicates not applicable

Table 2.7.1.2-3 Main Steam Supply System Piping Characteristics

Pipe Line Name	ASME Code Section III Class	Leak Before Break	Seismic Category I
Main steam piping in the PCCV	2	Yes	Yes
Piping in the reactor building including branch piping from main steam piping up to and including the following valves; MSIV, MSBIV, MSSV, MSRV, MSDV, MSRVBV, MSDIV	2	No	Yes
Branch lines from the main steam piping to the emergency feedwater pump turbine steam isolation valve excluding this valve	2	No	Yes
Main steam drain piping located in the reactor building downstream MSDIV and excluding the MSDIV	3	No	Yes
MSS piping downstream of MSIV and MSBIV up to and including the first restraint located between the reactor building and the turbine building	3	No	Yes
Discharge piping of the MSSV in the reactor building	3	No	Yes
Discharge piping of the MSRV and MSDV in the reactor building	3	No	Yes

Table 2.7.1.2-4 Main Steam Supply System Equipment Alarms, Displays, and Control Functions

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Main Steam Isolation Valves (MSS-SMV-515A, B, C, D)	No	Yes	Yes	Yes
Main Steam Bypass Isolation Valve (MSS-HCV-565, 575, 585, 595)	No	Yes	Yes	Yes
Main Steam Safety Valve (Position Indication) (MSS-SRV-509A,B,C,D MSS-SRV-510A,B,C,D MSS-SRV-511A,B,C,D MSS-SRV-512A,B,C,D MSS-SRV-513A,B,C,D MSS-SRV-514A,B,C,D)	No	Yes	No	Yes
Main Steam Relief Valve (MSS-PCV-515, 525, 535, 545)	No	Yes	No	Yes
Main Steam Depressurization Valves (MSS-MOV-508A. B, C, D)	No	Yes	Yes	Yes
Main Steam Relief Valve Block Valves (MSS-MOV-507A, B, C, D)	No	Yes	Yes	Yes
Main Steam Drain Line Isolation Valve (MSS-MOV-701A, B, C, D)	No	Yes	Yes	Yes
Main Steam Line Pressure (MSS-PT-515, 516, 517, 518, 525, 526, 527, 528, 535, 536, 537, 538, 545, 546, 547, 548)	Yes	Yes	No	Yes
Turbine Inlet Pressure (MSS-PT-555, 556, 557, 558)	Yes	Yes	No	Yes

Table 2.7.1.2-5 Main Steam Supply System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a The functional arrangement of the MSS is as described in Subsection 2.7.1.2.1 Design Description and as shown in Figure 2.7.1.2-1.	1.a An inspection of the as-built system will be performed.	1.a The as-built MSS conforms with the functional arrangement as described in the Design Description of this Subsection 2.7.1.2.1 and as shown in Figure 2.7.1.2-1.
1.b Each mechanical division of the MSS except for piping (Division A&B and C&D pairs) is physically separated from the other divisions with the exception of reactor building exterior and inside the containment.	1.b Inspection of the as-built MSS will be performed.	1.b Each mechanical division of the as-built MSS except for piping is physically separated from other mechanical divisions of the system by structural barriers with the exception of reactor building exterior and inside the containment.
2.a.i The ASME Code Section III components of the MSS, identified in Table 2.7.1.2-2, are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.a.i An inspection of the as-built ASME Code Section III components of the MSS will be performed.	2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the MSS identified in Table 2.7.1.2-2 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.a.ii The ASME Code Section III components of the MSS identified in Table 2.7.1.2-2 are reconciled with the design requirements.	2.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the MSS identified in Table 2.7.1.2-2 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.

Table 2.7.1.2-5 Main Steam Supply System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.b.i The ASME Code Section III piping of the MSS, including supports, identified in Table 2.7.1.2-3, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.b.i An inspection of the as-built ASME Code Section III piping of the MSS, including supports, will be performed.	2.b.i The ASME code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the MSS, including supports, identified in Table 2.7.1.2-3 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.b.ii The ASME Code Section III piping of the MSS, including supports, identified in Table 2.7.1.2-3 is reconciled with the design requirements.	2.b.ii A reconciliation analysis of the piping of the MSS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.b.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the MSS, including supports, identified in Table 2.7.1.2-3 is reconciled with the design requirements. The report documents the results of the reconciliation analysis.
3.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.7.1.2-2, meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
3.b Pressure boundary welds in ASME Code Section III piping, identified in Table 2.7.1.2-3, meet ASME Code Section III requirements for non-destructive examination of welds.	3.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
4.a The ASME Code Section III components, identified in Table 2.7.1.2-2, retain their pressure boundary integrity at their design pressure.	4.a Hydrostatic tests will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	4.a The results of the hydrostatic tests of the as-built components identified in Table 2.7.1.2-2 as ASME Code Section III conform with the requirements of the ASME Code Section III.

Table 2.7.1.2-5 Main Steam Supply System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4.b The ASME Code Section III piping, identified in Table 2.7.1.2-3, retains its pressure boundary integrity at its design pressure.	4.b Hydrostatic tests will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the hydrostatic tests of the as-built piping identified in Table 2.7.1.2-3 as ASME Code Section III conform with the requirements of the ASME Code Section III.
4.b The ASME Code Section III piping, identified in Table 2.7.1.2-3, retains its pressure boundary integrity at its design pressure.	4.b Hydrostatic tests will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the hydrostatic tests of the as-built piping identified in Table 2.7.1.2-3 as ASME Code Section III conform with the requirements of the ASME Code Section III.
5.a The seismic Category I equipment, identified in Table 2.7.1.2-2, is designed to withstand seismic design basis loads without loss of safety function.	5.a.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.7.1.2-2 is located in the containment and reactor building.	5.a.i The seismic Category I as-built equipment identified in Table 2.7.1.2-2 is located in the containment and reactor building.
	5.a.ii Type tests and/or analyses of the seismic Category I equipment will be performed.	5.a.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.a.iii Inspections will be performed on the as-built equipment including anchorage.	5.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.
5.b Each of the seismic Category I piping, including supports, identified in Table 2.7.1.2-3 is designed to withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table 2.7.1.2-3 are supported by a seismic Category I structure(s).	5.b.i Reports(s) document that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.1.2-3 is supported by a seismic Category I structure(s).

Table 2.7.1.2-5 Main Steam Supply System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	5.b.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, identified in Table 2.7.1.2-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.1.2-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.
6.a The Class 1E equipment identified in Table 2.7.1.2-2 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.a.i Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	6.a.i The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.7.1.2-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	6.a.ii Inspections will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.7.1.2-2 as being qualified for a harsh environment are bounded by type tests and/or analyses.
6.b The Class 1E equipment, identified in Table 2.7.1.2-2, is powered from their respective Class 1E division.	6.b A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.7.1.2-2 under test.
6.c Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	6.c Inspections of the as-built Class 1E divisional cables will be performed.	6.c Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.
7. Deleted.	7. Deleted.	7. Deleted.

Table 2.7.1.2-5 Main Steam Supply System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8.a Controls exist in the MCR to open and close the remotely operated valves identified in Table 2.7.1.2-2.	8.a Tests will be performed on the as-built remotely operated valves listed in Table 2.7.1.2-2 using controls in the as-built MCR.	8.a Controls exist in the as-built MCR to open and close the as-built remotely operated valves listed in Table 2.7.1.2-2.
8.b The valves identified in Table 2.7.1.2-2 as having PSMS control perform an active safety function after receiving a signal from PSMS.	8.b Tests will be performed on the as-built remotely operated valves listed in Table 2.7.1.2-2 using simulated signals.	8.b The as-built remotely-operated valves identified in Table 2.7.1.2-2 as having PSMS control perform the active function identified in the table after receiving a simulated signal.
9.a The motor-operated valves, identified in Table 2.7.1.2-2, perform an active safety function to change position as indicated in the table.	9.a.i Tests or type tests of motor-operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	9.a.i Each motor-operated valve changes position as indicated in Table 2.7.1.2-2 under design conditions.
	9.a.ii Tests of the as-built motor-operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	9.a.ii Each as-built motor-operated valve changes position as indicated in Table 2.7.1.2-2 under pre-operational test conditions.
9.b The air-operated valves, identified in Table 2.7.1.2-2, perform an active safety function to change position as indicated in the table.	9.b.i Tests or type tests of air-operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	9.b.i Each air-operated valve changes position as indicated in Table 2.7.1.2-2 under design conditions.
	9.b.ii Tests of the as-built air-operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	9.b.ii Each as-built air-operated valve changes position as indicated in Table 2.7.1.2-2 under pre-operational test conditions.
9.c The check valves, identified in Table 2.7.1.2-2, perform an active safety function to change position as indicated in the table.	9.c Tests of the as-built check valves with active safety functions identified in Table 2.7.1.2-2 will be performed under pre-operational test pressure, temperature, and fluid flow conditions.	9.c Each as-built check valve changes position as indicated in Table 2.7.1.2-2.

Table 2.7.1.2-5 Main Steam Supply System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9.d After loss of motive power, the remotely operated valves, identified in Table 2.7.1.2-2, assume the indicated loss of motive power position.	9.d Tests of the as-built valves will be performed under the conditions of loss of motive power.	9.d Upon loss of motive power, each as-built remotely operated valve identified in Table 2.7.1.2-2 assumes the indicated loss of motive power position.
9.e The MSIVs identified in Table 2.7.1.2-2 perform an active safety function to change position as indicated in the table.	9.e.i Tests or type tests of the MSIVs will be performed to demonstrate the capability of the valve to operate under its design conditions.	9.e.i Each MSIV changes position as indicated in Table 2.7.1.2-2 under design conditions.
	9.e.ii Tests of the as-built MSIVs will be performed under pre-operational flow, differential pressure, and temperature conditions.	9.e.ii Each as-built MSIV changes position as indicated in Table 2.7.1.2-2 under pre-operational test conditions.
10. MCR alarms and displays of the parameters identified in Table 2.7.1.2-4 can be retrieved in the MCR.	10. Inspections will be performed for retrievability of the MSS parameters in the as-built MCR.	10. The MCR alarms and displays identified in Table 2.7.1.2-4 can be retrieved in the as-built MCR.
11. RSC alarms, displays, and controls are identified in Table 2.7.1.2-4.	11. Inspections of the as-built RSC alarms, displays and controls will be performed.	11. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.7.1.2-4.
12. Each of the as-built piping identified in Table 2.7.1.2-3 as designed for leak before break (LBB) meets the LBB criteria, or an evaluation is performed of the protection from the dynamic effects of a rupture of the line.	12. Inspections of the as-built piping will be performed based on the evaluation report for LBB or the protection from dynamic effects of a pipe break, as specified in Section 2.3.	12. The LBB acceptance criteria are met by the as-built piping and pipe materials, or the protection is provided for the dynamic effects of the piping break.

Table 2.7.1.2-5 Main Steam Supply System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 7 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
13.a The MSSVs provide overpressure protection for the secondary side of the steam generators and for pressure boundary components in the MSS.	13.a.i Inspections will be performed to confirm that the value of the vendor code plate rating of the as-built MSSV is greater than or equal to system relief requirements.	13.a.i The sum of the rated capacities recorded on the valve ASME Code plates of the as-built MSSVs exceeds 21,210,000 lb/hr.
	13.a.ii Tests and analyses in accordance with ASME Code Section III will be performed to confirm set pressure.	13.a.ii The results of the tests and analyses conform with the following as-built safety valves set pressure: First stage: 1185 psig ± 1% Second stage: 1215 psig ± 1% Third stage: 1244 psig ± 1%
13.b During design basis events, the MSS limits SG blowdown.	13.b.i Tests will be performed to demonstrate that the as-built remotely operated MSIV close within the required response times. See item 14 in this table.	13.b.i See item 14 in this table.
	13.b.ii Inspections will be performed on the area of the as-built flow restrictor within the SG main steam outlet nozzle will limit releases to the containment.	13.b.ii The as-built flow restrictor within the SG main steam line discharge nozzle does not exceed 1.4 sq. ft.
14. The MSIVs and MSBIVs will close within the required response time.	14. Tests will be performed to demonstrate that as-built MSIVs and MSBIVs close within the required response time.	14. The as-built valves close within the following times after receiving a simulated signal: The as-built MSIVs close within 5 seconds. The as-built MSBIVs close within 5 seconds.

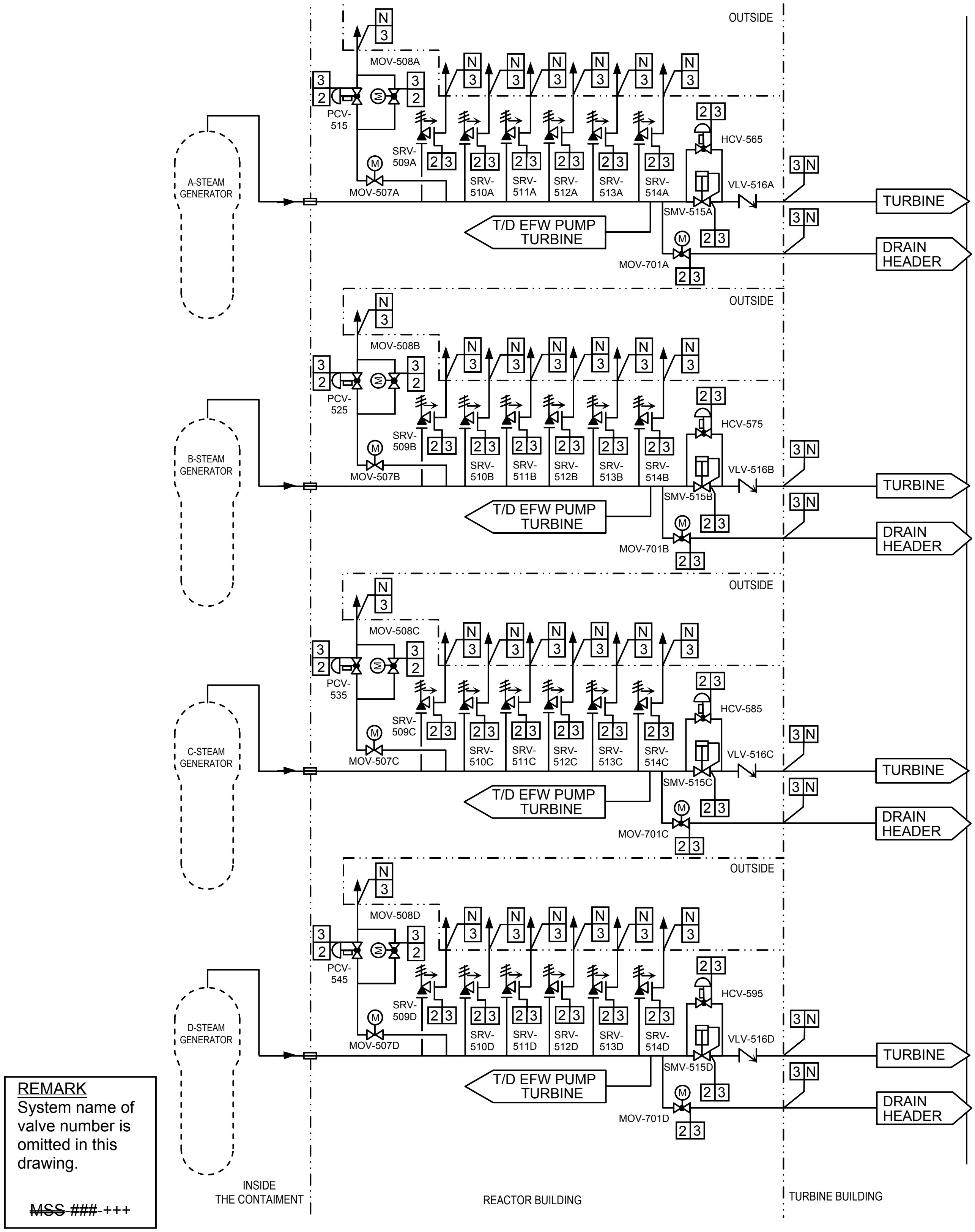


Figure 2.7.1.2-1 Main Steam Supply System

2.7.1.3 Main Condenser

2.7.1.3.1 Design Description

System Purpose and Functions

The main condenser is non safety-related system. The main condenser functions to condense and deaerate the exhaust steam from the main turbine and provide a heat sink for the turbine bypass system.

Location and Functional Arrangement

The main condenser is located in the turbine building. The main condenser contains three shells, and each shell is located beneath its respective low-pressure turbine.

Key Design Features

The main condenser is designed to receive and condense the rated power exhaust steam flow from the low-pressure turbines and to function as a reservoir for vents and drains from various components.

Seismic and ASME Code Classifications

The main condenser is non-seismic category and is not designed to ASME code specifications.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the main condenser.

Interlocks

There are no interlocks needed for direct safety functions related to the main condenser.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.1.3.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.1.3-1 describes the ITAAC for the Main Condenser.

Table 2.7.1.3-1 Main Condenser Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the main condenser is as described in Subsection 2.7.1.3.1 Design Description.	1. Inspections of the as-built system will be performed.	1. The as-built condenser conforms with the functional arrangement as described in Subsection 2.7.1.3.1 Design Description

2.7.1.4 Main Condenser Evacuation System (MCES)

2.7.1.4.1 Design Description

System Purpose and Functions

The MCES is non safety-related system. The MCES removes noncondensable gases from the main condenser during plant startup and normal operation, and establishes and maintains a vacuum in the main condenser.

Location and Functional Arrangement

The MCES is located in the turbine building. The MCES consists of the condenser vacuum pumps, piping, valves, and instrumentation.

Key Design Features

The MCES is designed to remove noncondensable gases from the main condenser during plant startup and normal operation, and to exhaust them to the environment.

Seismic and ASME Code Classifications

The MCES is non-seismic category and is not designed to ASME code specifications.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the MCES.

Interlocks

There are no interlocks needed for direct safety functions related to the MCES.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.1.4.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.1.4-1 describes the ITAAC for the MCES.

Table 2.7.1.4-1 Main Condenser Evacuation System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the main condenser evacuation system is as described in Subsection 2.7.1.4.1 Design Description.	1. Inspections of the as-built system will be performed.	1. The as-built main condenser evacuation system conforms to the functional arrangement as described in the Design Description of this Subsection 2.7.1.4.1.

2.7.1.5 Gland Seal System (GSS)

2.7.1.5.1 Design Description

System Purpose and Functions

The GSS is non safety-related system. The gland seal system prevents air leakage into and steam leakage out of the casings of the turbine generator (T/G).

Location and Functional Arrangement

GSS components and piping are located in the T/B. The GSS consists of:

- A gland steam condenser with motor driven exhaust fans
- The seal pressure regulator
- Sealing steam header
- The associated piping, valves, and controls

Key Design Features

Sealing steam is supplied to the turbine shaft seals from either the ASSS, or the MSS extracted from main steam header. The system returns the steam-air mixture from the turbine glands to the gland steam condenser and exhausts non-condensable gases into the atmosphere.

Seismic and ASME Code Classifications

The GSS is non-seismic category and is not designed to ASME code specifications.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the GSS.

Interlocks

There are no interlocks needed for direct safety functions related to the GSS.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.1.5.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.1.5-1 describes the ITAAC for the GSS.

Table 2.7.1.5-1 Gland Seal System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the gland seal system is as described in Subsection 2.7.1.5.1 Design Description.	1. Inspections of the as-built system will be performed.	1. The as-built turbine gland seal system conforms to the functional arrangement as described in the Design Description of this Subsection 2.7.1.5.1.

2.7.1.6 Turbine Bypass System (TBS)

2.7.1.6.1 Design Description

System Purpose and Functions

The TBS is non safety-related system. The TBS is part of the MSS and provides capability to send the main steam flow from the steam generators to the main condenser bypassing the main turbine.

Location and Functional Arrangement

TBS is located in the turbine building.

Key Design Features

The TBS is designed to sustain a 100% load rejection (electrical load), without generating a reactor trip, and not requiring actuation of main steam relief valve, main steam safety valve and pressurizer safety valve.

Seismic and ASME Code Classifications

The TBS is non-seismic category and is not designed to ASME code specifications.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the TBS.

Interlocks

There are no interlocks needed for direct safety functions related to the TBS.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.1.6.2 Inspections, Tests, Analyses, and Acceptance Criteria.

Table 2.7.1.6-1 describes the ITAAC for the TBS.

Table 2.7.1.6-1 Turbine Bypass System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the TBS is as described in Subsection 2.7.1.6.1 Design Description.	1. An inspection of the as-built system will be performed.	1. The as-built TBS conforms with the functional arrangement as described in the Design Description of this Subsection 2.7.1.6.1.

2.7.1.7 Circulating Water System (CWS)

2.7.1.7.1 Design Description

System Purpose and Functions

The CWS is non safety-related system. The CWS supplies cooling water to remove heat from the main condenser under varying conditions of power plant operation and site environmental conditions.

Location and Functional Arrangement

The CWS is located partly outside and partly in the turbine building. The CWS consists of:

- Circulating water pumps
- The main condenser
- Associated piping, instrumentation, and controls

Key Design Features

The CWS removes plant heat during startup, normal operation, shutdown, transient condition, or turbine trip, when a portion of the main steam is bypassed to the main condenser via the turbine bypass valves (TBVs).

Seismic and ASME Code Classifications

The CWS is non-seismic category and is not designed to ASME code specifications.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the CWS.

Interlocks

There are no interlocks needed for direct safety functions related to the CWS.

Class 1E electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.1.7.2 Inspections, Tests, Analyses, and Acceptance Criteria.

Table 2.7.1.7-1 describes the ITAAC for the CWS.

Table 2.7.1.7-1 Circulating Water System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the circulating water system is as described in Subsection 2.7.1.7.1 Design Description.	1. Inspections of the as-built system will be performed.	1. The as-built circulating water system conforms to the functional arrangement as described in the Design Description of this Subsection 2.7.1.7.1.

2.7.1.8 Condensate Polishing System (CPS)

2.7.1.8.1 Design Description

System Purpose and Functions

The CPS is non safety-related system. The CPS removes dissolved ionic solids and impurities from the condensate.

Location and Functional Arrangement

The CPS is located in the T/B. The CPS consists of:

- Condensate prefilters, polishing vessels and their resin traps
- A spent resin holding vessel
- A portable resin addition hopper and eductor
- A resin mixing and holding vessel
- Interconnecting piping, instrumentation, and controls

Key Design Features

The CPS is designed to remove dissolved ionic solids and impurities from the condensate and assists in the removal of corrosion products.

Seismic and ASME Code Classifications

The CPS is non-seismic category and is not designed to ASME code specifications.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the CPS.

Interlocks

There are no interlocks needed for direct safety functions related to the CPS.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.1.8.2 Inspections, Tests, Analyses, and Acceptance Criteria.

Table 2.7.1.8-1 describes the ITAAC for the CPS.

Table 2.7.1.8-1 Condensate Polishing System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the condensate polishing system is as described in Subsection 2.7.1.8.1 Design Description.	1. Inspections of the as-built system will be performed.	1. The as-built condensate polishing system conforms to the functional arrangement as described in the Design Description of this Subsection 2.7.1.8.1.

2.7.1.9 Condensate and Feedwater System (CFS)

2.7.1.9.1 Design Description

System Purpose and Functions

The safety-related function of the CFS is to provide containment and feedwater isolation following a design basis accident. The containment isolation function is described in section 2.11.2. The CFS provides feedwater at the required temperature, pressure, and flow rate to the SGs.

Location and Functional Arrangement

CFS equipment and piping are located in the containment, the reactor building and the turbine building. Figure 2.7.1.9-1 illustrates the main feedwater lines, showing the arrangement of the safety-related CFS components. Table 2.7.1.9-1 also provides a tabulation of the location of CFS equipment. The CFS is composed of the condensate system (CDS) and the feedwater system (FWS).

Key Design Features

The CFS is designed with the capability of automatically providing the required flow to the SGs during startup, shutdown at power levels up to the rated power and during the plant design transients without interruption of operation or damage to equipment.

The system provides main feedwater isolation valves (MFIVs), main feedwater regulatory valves (MFRVs), main feedwater bypass regulation valves (MFBRVs) and steam generator water filling control valves (SGWFCVs) for the main feedwater lines routed into containment. The MFIVs, MFRVs, MFBRVs and SGWFCVs close after receipt of an isolation signal in sufficient time to limit the mass and energy release to containment consistent with the containment analysis.

Each mechanical division of the condensate and feedwater system is physically separated from the other divisions by a structural barrier, which also serves as a fire barrier. The piping, components of reactor building exterior and components inside the containment are exceptions.

Seismic and ASME Classifications

The seismic category and ASME Code Section III requirements are identified in Tables 2.7.1.9-2 and 2.7.1.9-3 for safety-related CFS components and piping, respectively.

System Operation

The CFS supplies the SGs with heated feedwater in a closed steam cycle using regenerative feedwater heating

The CDS takes suction from the main condenser hotwell and pumps condensate forward to the deaerator utilizing the condensate pumps. The FWS takes suction from the deaerator and pumps feedwater forward to the SGs utilizing the feedwater booster/main feedwater pumps.

Alarms, Displays, and Controls

Table 2.7.1.9-4 identifies alarms, displays, and controls associated with the CFS that are located in the MCR. CFS equipment and instrumentation that is required for remote shutdown and that is available at the remote shutdown console (RSC) is also shown on Table 2.7.1.9-4.

Logic

Engineered safety features actuation signal for main feedwater isolation functions when any of the following signals are present:

- Manual actuation
- ECCS actuation
- High-high SG water level

The CFS is not required to supply feedwater under accident conditions to affect plant shutdown or to mitigate the consequences of an accident.

Interlocks

There are no interlocks needed for direct safety functions related to the CFS.

Class 1E Electrical Power Sources and Divisions

The safety-related CFS equipment identified in Table 2.7.1.9-2 as Class 1E is powered from their respective Class 1E division. Separation is provided between these Class 1E divisions and between non-Class 1E divisions and non-Class 1E electrical cable.

Equipment to be Qualified for Harsh Environments

The safety-related CFS equipment identified in Table 2.7.1.9-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITAAC acceptance criteria in Table 2.7.1.9-5. Key parameters of the CFS design that are used in the safety analysis and which are included in the Table 2.7.1.9-5 are main feedwater isolation.

2.7.1.9.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.1.9-5 describes the ITAAC for the CFS.

The ITAAC associated with the CFS equipment, components and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.7.1.9-1 Condensate and Feedwater System Location of Equipment and Piping

System and Components	Location
Main Feedwater Isolation Valves	Reactor Building
Main Feedwater Regulation Valves	Reactor Building
Main Feedwater Bypass Regulation Valves	Reactor Building
Steam Generator Water Filling Control Valves	Reactor Building
Main Feedwater Check Valves	Reactor Building
The portion of the FWS piping from the SGs inlets outward through the containment up to and including the MFIVs.	Containment and Reactor Building
The piping upstream of MFIVs to the first piping restraint at the interface between the reactor building and turbine building.	Reactor Building

Table 2.7.1.9-2 Condensate and Feedwater System Equipment Characteristics (Sheet 1 of 2)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Main Feedwater Isolation Valves	FWS-SMV-512 A,B,C,D	2	Yes	Yes	Yes/Yes	Main Feedwater Isolation Remote Manual	Transfer Closed	Closed
Main Feedwater Regulation Valves	FWS-FCV-510, 520, 530, 540	3	Yes	Yes	Yes/Yes	Main Feedwater Isolation Remote Manual	Transfer Closed	Closed
Main Feedwater Bypass Regulation Valves	FWS-FCV-511, 521, 531, 541	3	Yes	Yes	Yes/Yes	Main Feedwater Isolation Remote Manual	Transfer Closed	Closed
Steam Generator Water Filling Control Valves	FWS-LCV-610, 620, 630, 640	3	Yes	Yes	Yes/Yes	Main Feedwater Isolation Remote Manual	Transfer Closed	Closed
Main Feedwater Check Valves	FWS-VLV-511 A,B,C,D	3	Yes	No	-	-	Transfer Closed	-

Table 2.7.1.9-2 Condensate and Feedwater System Equipment Characteristics (Sheet 2 of 2)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Steam Generator Water Level (Narrow Range)	FWS-LT-510, 511, 512, 513, 520, 521, 522, 523, 530, 531, 532, 533, 540, 541, 542, 543,	-	Yes	-	Yes/ Yes	-	-	-
Steam Generator Water Level (Wide Range)	FWS-LT-514, 524, 534, 544	-	Yes	-	Yes/ Yes	-	-	-

Note: Dash (-) indicates not applicable

Table 2.7.1.9-3 Condensate and Feedwater System Piping Characteristics

Pipe Line Name	ASME Code Section III Class	Leak Before Break	Seismic Category I
The portion of the FWS piping from the SGs inlets outward through the containment up to and including the MFIVs.	2	No	Yes
The piping upstream of MFIVs to the first piping restraint at the interface between the reactor building and turbine building.	3	No	Yes

Table 2.7.1.9-4 Condensate and Feedwater System Equipment Alarms, Displays, and Control Functions

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Main Feedwater Isolation Valves (FWS-SMV-512A, B, C, D)	No	Yes	Yes	Yes
Main Feedwater Regulation Valves (FWS-FCV-510, 520, 530, 540)	No	Yes	Yes	Yes
Main Feedwater Bypass Regulation Valves (FWS-FCV-511, 521, 531, 541)	No	Yes	Yes	Yes
Steam Generator Water Filling Control Valves (FWS-LCV-610, 620, 630, 640)	No	Yes	Yes	Yes
Steam Generator Water Level (Wide Range) (FWS-LT-514, 524, 534, 544)	Yes	Yes	No	Yes
Steam Generator Water Level (Narrow Range) (FWS-LT-510, 511, 512, 513, 520, 521, 522, 523, 530, 531, 532, 533, 540, 541, 542, 543)	Yes	Yes	No	Yes

Table 2.7.1.9-5 Condensate and Feedwater System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a The functional arrangement of the CFS is as described in Subsection 2.7.1.9.1 Design Description and as shown in Figure 2.7.1.9-1.	1.a An Inspection of the as-built CFS will be performed.	1.a The as-built CFS conforms with the functional arrangement as described in the Design Description of this Subsection 2.7.1.9.1 and as shown in Figure 2.7.1.9-1.
1.b Each mechanical division of the CFS except for piping (Division A & B and C & D pairs) is physically separated from the other divisions with the exception of reactor building exterior and inside the containment.	1.b Inspection of the as-built CFS will be performed.	1.b Each mechanical division of the as-built CFS except for piping is physically separated from other mechanical divisions of the system by structural barriers with the exception of reactor building exterior and inside the containment.
2.a.i The ASME Code Section III components of the CFS, identified in Table 2.7.1.9-2, are fabricated , installed, and inspected in accordance with ASME Code Section III requirements.	2.a.i An inspection of the as-built ASME Code Section III components of the CFS will be performed.	2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the CFS identified in Table 2.7.1.9-2 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.a.ii The ASME Code Section III components of the CFS identified in Table 2.7.1.9-2 are reconciled with the design requirements.	2.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the CFS identified in Table 2.7.1.9-2 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.

Table 2.7.1.9-5 Condensate and Feedwater System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.b.i The ASME Code Section III piping of the CFS, including supports, identified in Table 2.7.1.9-3, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.b.i An inspection of the as-built ASME Code Section III piping of the CFS, including supports, will be performed.	2.b.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the CFS, including supports, identified in Table 2.7.1.9-3 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.b.ii The ASME Code Section III piping of the CFS, including supports, identified in Table 2.7.1.9-3 is reconciled with the design requirements.	2.b.ii A reconciliation analysis of the piping of the CFS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.b.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping system of the CFS identified in Table 2.7.1.9-3 is reconciled with the design requirements. The report documents the results of the reconciliation analysis.
3.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.7.1.9-2, meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
3.b Pressure boundary welds in ASME Code Section III piping, identified in Table 2.7.1.9-3, meet ASME Code Section III requirements for non-destructive examination of welds.	3.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.

Table 2.7.1.9-5 Condensate and Feedwater System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4.a The ASME Code Section III components, identified in Table 2.7.1.9-2, retain their pressure boundary integrity at their design pressure.	4.a Hydrostatic tests will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	4.a The results of the hydrostatic tests of the as-built components identified in Table 2.7.1.9-2 as ASME Code Section III conform with the requirements of the ASME Code Section III.
4.b The ASME Code Section III piping, identified in Table 2.7.1.9-3, retains its pressure boundary integrity at its design pressure.	4.b Hydrostatic tests will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the hydrostatic tests of the as-built piping identified in Table 2.7.1.9-3 as ASME Code Section III conform with the requirements of the ASME Code Section III.
5.a The seismic Category I equipment, identified in Table 2.7.1.9-2, is designed to withstand seismic design basis loads without loss of safety function.	5.a.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.7.1.9-2 is located in the reactor building.	5.a.i The seismic Category I as-built equipment identified in Table 2.7.1.9-2 is located in the reactor building.
	5.a.ii Type tests and/or analyses of the seismic Category I equipment will be performed.	5.a.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.a.iii Inspections will be performed on the as-built equipment including anchorage.	5.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.

Table 2.7.1.9-5 Condensate and Feedwater System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 6)

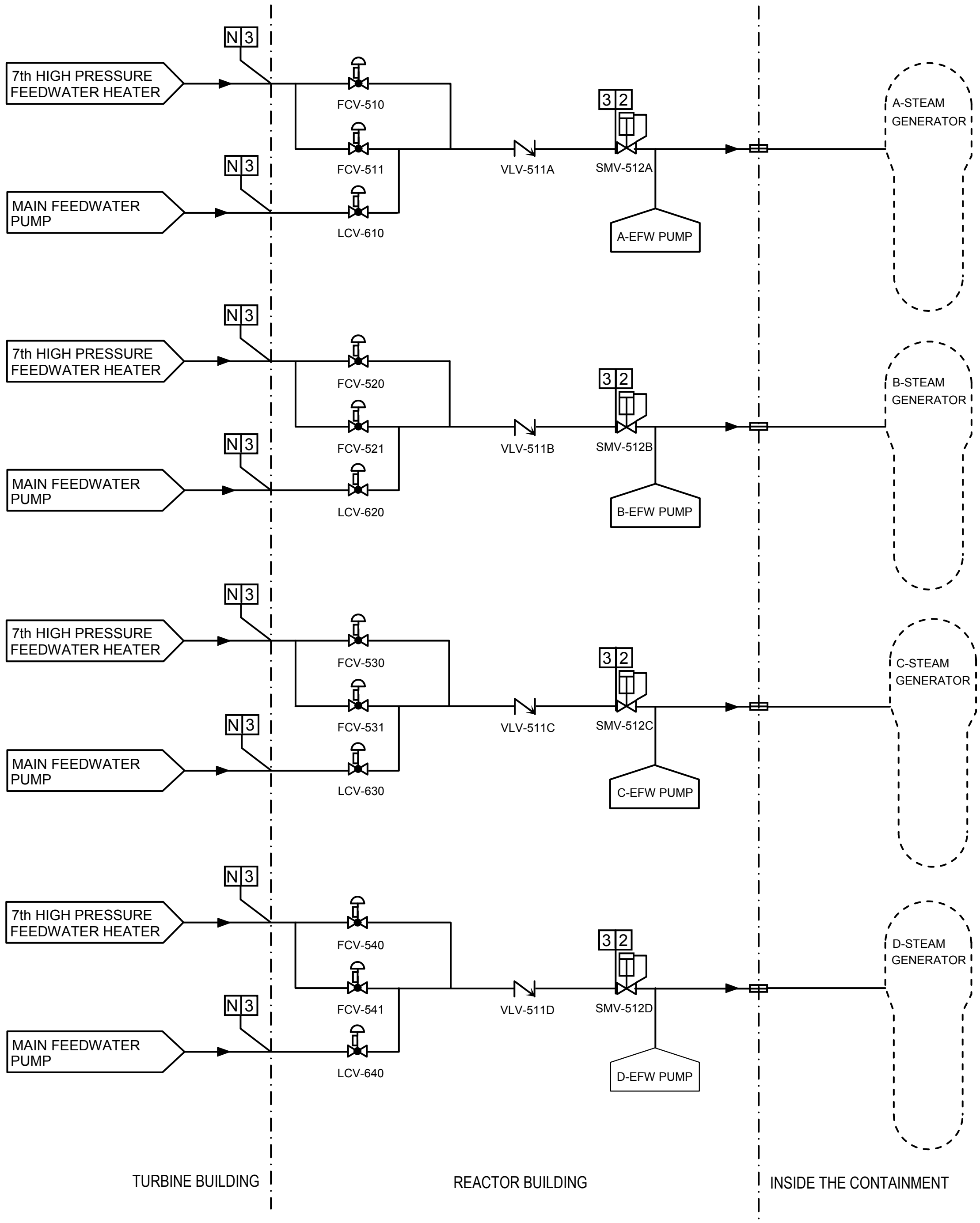
Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5.b Each of the seismic Category I piping, including supports, identified in Table 2.7.1.9-3 is designed to withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table 2.7.1.9-3 are supported by a seismic Category I structure(s).	5.b.i Reports(s) document that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.1.9-3 is supported by a seismic Category I structure(s).
	5.b.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, identified in Table 2.7.1.9-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.1.9-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.
6.a The Class 1E equipment identified in Table 2.7.1.9-2 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.a.i Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	6.a.i The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.7.1.9-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	6.a.ii Inspections will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.7.1.9-2 as being qualified for a harsh environment are bounded by type tests and/or analyses.

Table 2.7.1.9-5 Condensate and Feedwater System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6.b The Class 1E equipment, identified in Table 2.7.1.9-2, is powered from their respective Class 1E division.	6.b A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.7.1.9-2 under test.
6.c Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	6.c Inspections of the as-built Class 1E divisional cables will be performed.	6.c Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.
7. Deleted.	7. Deleted.	7. Deleted.
8.a Controls exist in the MCR to open and close the remotely operated valves identified in Table 2.7.1.9-2.	8.a Tests will be performed on the as-built remotely operated valves listed in Table 2.7.1.9-2 using controls in the as-built MCR.	8.a Controls exist in the as-built MCR to open and close the as-built remotely operated valves listed in Table 2.7.1.9-2.
8.b The valves identified in Table 2.7.1.9-2 as having PSMS control perform an active safety function after receiving a signal from PSMS.	8.b.i Tests will be performed on the as-built remotely operated valves listed in Table 2.7.1.9-2 using simulated signals.	8.b.i The as-built remotely-operated valves identified in Table 2.7.1.9-2 as having PSMS control perform the active function identified in the table after receiving a simulated signal.
	8.b.ii Tests will be performed to demonstrate that remotely operated as-built MFIVs, MFRVs, MFBRVs and SGWFCVs close within the required response time under preoperational conditions.	8. b.ii The as-built valves close within the following times after receipt of an actuation signal. The as-built MFIVs, MFRVs, MFBRVs and SGWFCVs close within 5 seconds.

Table 2.7.1.9-5 Condensate and Feedwater System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9.a The valves, identified in Table 2.7.1.9-2 perform an active safety function to change position as indicated in the table.	9.a.i Tests or type tests of air operated valves and MFIVs will be performed that demonstrate the capability of the valve to operate under its design conditions.	9.a.i Each air operated valve and each MFIV changes position as indicated in Table 2.7.1.9-2 under design condition.
	9.a.ii Tests of the as-built air operated valves and MFIVs will be performed under pre-operational flow, differential pressure, and temperature conditions.	9.a.ii Each as-built air operated valve and each as-built MFIV changes position as indicated in Table 2.7.1.9-2 under the pre-operational test conditions.
	9.a.iii Tests of the as-built check valves with active safety functions identified in Table 2.7.1.9-2 will be performed under preoperational test pressure, temperature, and fluid flow conditions.	9.a.iii Each as-built check valve changes position as indicated in Table 2.7.1.9-2.
9.b After loss of motive power, the remotely operated valves, identified in Table 2.7.1.9-2, assume the indicated loss of motive power position.	9.b Tests of the as-built valves will be performed under the conditions of loss of motive power.	9.b Upon loss of motive power, each as-built remotely operated valves identified in Table 2.7.1.9-2 assumes the indicated loss of motive power position.
10. MCR alarms and displays of the parameters identified in Table 2.7.1.9-4 can be retrieved in the MCR.	10. Inspections will be performed for retrievability of the CFS parameters in the as-built MCR.	10. MCR alarms and displays identified in Table 2.7.1.9-4 can be retrieved in the as-built MCR.
11. RSC alarms, displays and controls are identified in Table 2.7.1.9-4.	11. Inspections of the as-built RSC alarms displays and controls will be performed.	11. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.7.1.9-4.



REMARK
System name of valve number is omitted in this drawing.

FWS-###-+++

Figure 2.7.1.9-1 Feedwater System

2.7.1.10 Steam Generator Blowdown System (SGBDS)

2.7.1.10.1 Design Description

System Purpose and Functions

The SGBDS has a safety-related function of isolating the secondary side of the SG using two isolation valves in series in the blowdown line from each SG. This provides a heat sink for a safe shutdown or to mitigate the consequences of a design basis accident.

The SGBDS assists in maintaining secondary side water chemistry within acceptable limits during normal plant operation and during anticipated operational occurrences (AOO) due to main condenser in leakage or primary to secondary steam generator tube leakage.

The SGBDS provides the containment isolation function, as described in Section 2.11.2, of the SGBDS lines penetrating the containment.

Location and Functional Arrangement

The SGBDS equipment and piping are located in the containment, the R/B, the A/B and the T/B. Seismic Category I piping identified in Table 2.7.1.10-2 is located in the containment and the R/B. Figure 2.7.1.10-1 illustrates the SGBDS, showing the arrangement of the SGBDS components.

Key Design Features

One blowdown line per SG is provided. The blowdown line from each steam generator is provided with two flow paths: (1) purify and recovery line for normal plant operation and (2) line discharging to the condenser, the liquid waste management system and waste water system used during startup and abnormal water conditions.

The blowdown water is drawn from each SG from a location above the tube sheet where impurities are expected to accumulate. The blowdown from each SG is depressurized by a throttle valve located downstream of the isolation valves. The throttle valves can be manually adjusted to control blowdown rate.

Impurity removal includes filters and demineralizers. These demineralizers include cation demineralizers and mix bed demineralizers.

The radiation monitor provided downstream of the demineralizers and the radiation monitor provided in the blowdown sampling line measure the radiation level. The blowdown water samples provide the information about impurities in blowdown water.

The SGBDS is designed to provide containment isolation of the SGBDS lines penetrating the containment.

Each mechanical division of the Steam Generator Blowdown System is physically separated from the other divisions by a structural barrier, which also serves as a fire barrier. The piping, components of reactor building exterior and components inside the containment are the exceptions.

Seismic and ASME Code Classifications

The seismic category and ASME Code Section III requirements are identified in Tables 2.7.1.10-1 and 2.7.1.10-2 for safety-related SGBDS components and piping, respectively.

System Operation

The SG blowdown water flows to a flash tank, where water and flashing vapor are separated. During plant startup, when the pressure in the flash tank is low, the vapor flows to the condenser. During normal plant operation, the vapor flows to the deaerator and the water is transferred to regenerative and non-regenerative heat exchangers for further cooling. The condensate feedwater system provides cooling in the regenerative heat exchanger(s) to recover thermal energy. The impurities from the cooled blowdown water are removed in the filters and demineralizers. The purified water is returned to the condenser. If this processed water exceeds the allowable limit of radiation level, this water is directed to the liquid waste management system for further processing.

Alarms, Displays, and Controls

Table 2.7.1.10-3 identifies alarms, displays, and controls associated with the SGBDS that are located in the main control room.

Logic

The isolation valves close automatically upon receipt of the blowdown line isolation signals:

In addition, the containment isolation valve closes automatically upon receipt of a containment isolation signal. The containment isolation valve in the blowdown sample line close automatically upon receipt of the blowdown sampling line isolation signals:

Interlocks

There are no interlocks needed for direct safety functions related to the SGBDS.

Class 1E Electrical Power Sources and Divisions

The safety-related SGBDS equipment identified in Table 2.7.1.10-1 as Class 1E is powered from their respective Class 1E division. Separation is provided between these Class 1E divisions and between non-Class 1E divisions and non-Class 1E electrical cable.

Equipment to be Qualified for Harsh Environments

The safety-related SGBDS equipment identified in Table 2.7.1.10-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.1.10.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.1.10-4 describes the ITAAC for the SGBDS.

The ITAAC associated with the SGBDS equipment, components, and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.7.1.10-1 Steam Generator Blowdown System Equipment Characteristics

System Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
SG blowdown isolation valves	SGS-AOV-001 A,B,C,D	2	Yes	Yes	Yes/Yes	Containment Isolation Phase A and Emergency Feedwater Actuation	Transfer Closed	Closed
SG blowdown isolation valves	SGS-AOV-002 A,B,C,D	3	Yes	Yes	Yes/Yes	Emergency Feedwater Actuation	Transfer Closed	Closed
SG Blowdown sampling line isolation valves	SGS-AOV-031 A,B,C,D	2	Yes	Yes	Yes/Yes	Containment Isolation Phase A	Transfer Closed	Closed

Table 2.7.1.10-2 Steam Generator Blowdown System Piping Characteristics

Pipe Line Name	ASME Section III Class	Seismic Category I
The piping and valves up to and including the first containment isolation valve outside the containment.	2	Yes
The SGBDS piping and valves from the outlet of the first containment isolation valve up to and including pipe anchors located in the main steam piping room wall.	3	Yes

Table 2.7.1.10-3 Steam Generator Blowdown System Equipment Alarms, Displays and Control Functions

Equipment Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
SG blowdown Isolation valves (SGS-AOV-001 A,B,C,D)	No	Yes	Yes	Yes
SG blowdown Isolation valves (SGS-AOV-001 A,B,C,D)	No	Yes	Yes	Yes
SG Blowdown sampling line Isolation valves (SGS-AOV-031 A,B,C,D)	No	Yes	Yes	Yes

Table 2.7.1.10-4 Steam Generator Blowdown System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the steam generator blowdown system is as described in the Design Description of this Subsection 2.7.1.10, and shown on Figure 2.7.1.10-1.	1. An inspection of the as-built system will be performed.	1. The as-built steam generator blowdown system conforms to the functional arrangement as described in the Design Description of this Subsection 2.7.1.10, and shown on Figure 2.7.1.10-1.
2.a.i The ASME Code Section III components of the SGBDS, identified in Table 2.7.1.10-1, are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.a.i An inspection of the as-built ASME Code Section III components of the SGBDS will be performed.	2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the SGBDS identified in Table 2.7.1.10-1 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.a.ii The ASME Code Section III components of the SGBDS identified in Table 2.7.1.10-1 are reconciled with the design requirements.	2.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the SGBDS identified in Table 2.7.1.10-1 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.

Table 2.7.1.10-4 Steam Generator Blowdown System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.b.i The ASME Code Section III piping of the SGBDS, including supports, identified in Table 2.7.1.10-2, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.b.i An inspection of the as-built ASME Code Section III piping of the SGBDS, including supports, will be performed.	2.b.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the SGBDS, including supports, identified in Table 2.7.1.10-2 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.b.ii The ASME Code Section III piping of the SGBDS, including supports, identified in Table 2.7.1.10-2 is reconciled with the design requirements.	2.b.ii A reconciliation analysis of the piping of the SGBDS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.b.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the SGBDS, including supports, identified in Table 2.7.1.10-2 is reconciled with the design requirements. The report documents the results of the reconciliation analysis.
3.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.7.1.10-1, meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.

Table 2.7.1.10-4 Steam Generator Blowdown System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3.b Pressure boundary welds in ASME Code Section III piping, identified in Table 2.7.1.10-2, meet ASME Code Section III requirements for non-destructive examination of welds.	3.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
4.a The ASME Code Section III components, identified in Table 2.7.1.10-1, retain their pressure boundary integrity at their design pressure.	4.a A hydrostatic test will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	4.a The results of the pressure test of the as-built components identified in Table 2.7.1.10-1 as ASME Code Section III conform with the requirements of the ASME Code Section III.
4.b The ASME Code Section III piping, identified in Table 2.7.1.10-2, retains its pressure boundary integrity at its design pressure.	4.b A hydrostatic test will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the pressure test of the as-built piping identified in Table 2.7.1.10-2 as ASME Code Section III conform with the requirements of the ASME Code Section III.
5.a The seismic Category I equipment identified in Table 2.7.1.10-1 is designed to withstand seismic design basis loads without loss of safety function.	5.a.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.7.1.10-1 is located in the reactor building.	5.a.i The seismic Category I as-built equipment identified in Tables 2.7.1.10-1 is located in the reactor building.
	5.a.ii Type tests and/or analyses of the seismic Category I equipment will be performed.	5.a.ii The results of the type tests and /or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.a.iii Inspections will be performed on the as-built equipment including anchorage.	5.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.

Table 2.7.1.10-4 Steam Generator Blowdown System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5.b Each of the seismic Category I piping, including supports, identified in Table 2.7.1.10-2 is designed to withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table 2.7.1.10-2 are supported by a seismic Category I structure(s).	5.b.i Reports(s) document that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.1.10-2 is supported by a seismic Category I structure(s).
	5.b.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, identified in Table 2.7.1.10-2 can withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.1.10-2 can withstand combined normal and seismic design basis loads without a loss of its safety function.
6. The Class 1E equipment, identified in Table 2.7.1.10-1, is powered from their respective Class 1E division.	6. A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	6. The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.7.1.10-1 under test.
7. Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E equipment.	7. Inspections of the as-built Class 1E divisional cables will be performed.	7. Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.
8. After loss of motive power, the air-operated valves, identified in Table 2.7.1.10-1, assume the indicated loss of motive power position.	8. Tests of the as-built valves will be performed under the conditions of loss of motive power.	8. Upon loss of motive power, each as-built remotely operated valves identified in Table 2.7.1.10-1 assumes the indicated loss of motive power position.
9. Each mechanical division of the SGBDS except for piping (Division A&B and C&D pairs) is physically separated from the other divisions with the exception of reactor building exterior and inside the containment.	9. Inspections of the as-built SGBDS will be performed.	9. Each mechanical division of the as-built SGBDS except for piping is physically separated from other mechanical divisions of the as-built SGBDS by structural barriers with the exception of reactor building exterior and inside the containment.
10. MCR alarms and displays of the parameters identified in Table 2.7.1.10-3 can be retrieved in the MCR.	10. Inspections will be performed for retrievability of the SGBDS parameters in the as-built MCR.	10. The MCR alarms and displays identified in Table 2.7.1.10-3 can be retrieved in the as-built MCR.
11. RSC alarms, displays and controls are identified in Table 2.7.1.10-3.	11. Inspections of the as-built RSC alarms, displays and controls will be performed.	11. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.7.1.10-3.

Table 2.7.1.10-4 Steam Generator Blowdown System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
12. The Class 1E equipment identified in Table 2.7.1.10-1 as being qualified for a harsh environment are designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	12.i Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	12.i The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.7.1.10-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	12.ii Inspections will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	12.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.7.1.10-1 as being qualified for a harsh environment are bounded by type tests and/or analyses.
13.a Controls exist in the MCR to open and close the remotely operated valves identified in Table 2.7.1.10-3.	13.a Tests will be performed on the as-built remotely operated valves listed in Table 2.7.1.10-3 using controls in the as-built MCR.	13.a Controls exist in the as-built MCR to open and close the as-built remotely operated valves listed in Table 2.7.1.10-3.
13.b The valves identified in Table 2.7.1.10-1 as having PSMS control perform an active safety function after receiving a signal from PSMS.	13.b Test will be performed on the as-built remotely operated valves listed in Table 2.7.1.10-1 using simulated signals.	13b The as-built remotely operated valves identified in Table 2.7.1.10-1 as having PSMS control perform the active safety function identified in the table after receiving a simulated signal.

Table 2.7.1.10-4 Steam Generator Blowdown System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
14. The valves, identified in Table 2.7.1.10-1 perform an active safety function to change position as indicated in the table.	14.i Tests or type tests of air operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	14.i Each air operated valve changes position as indicated in Table 2.7.1.10-1 under design condition.
	14.ii Tests of the as-built air operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	14.ii Each as-built air operated valve changes position as indicated in Table 2.7.1.10-1 under the pre-operational test conditions.

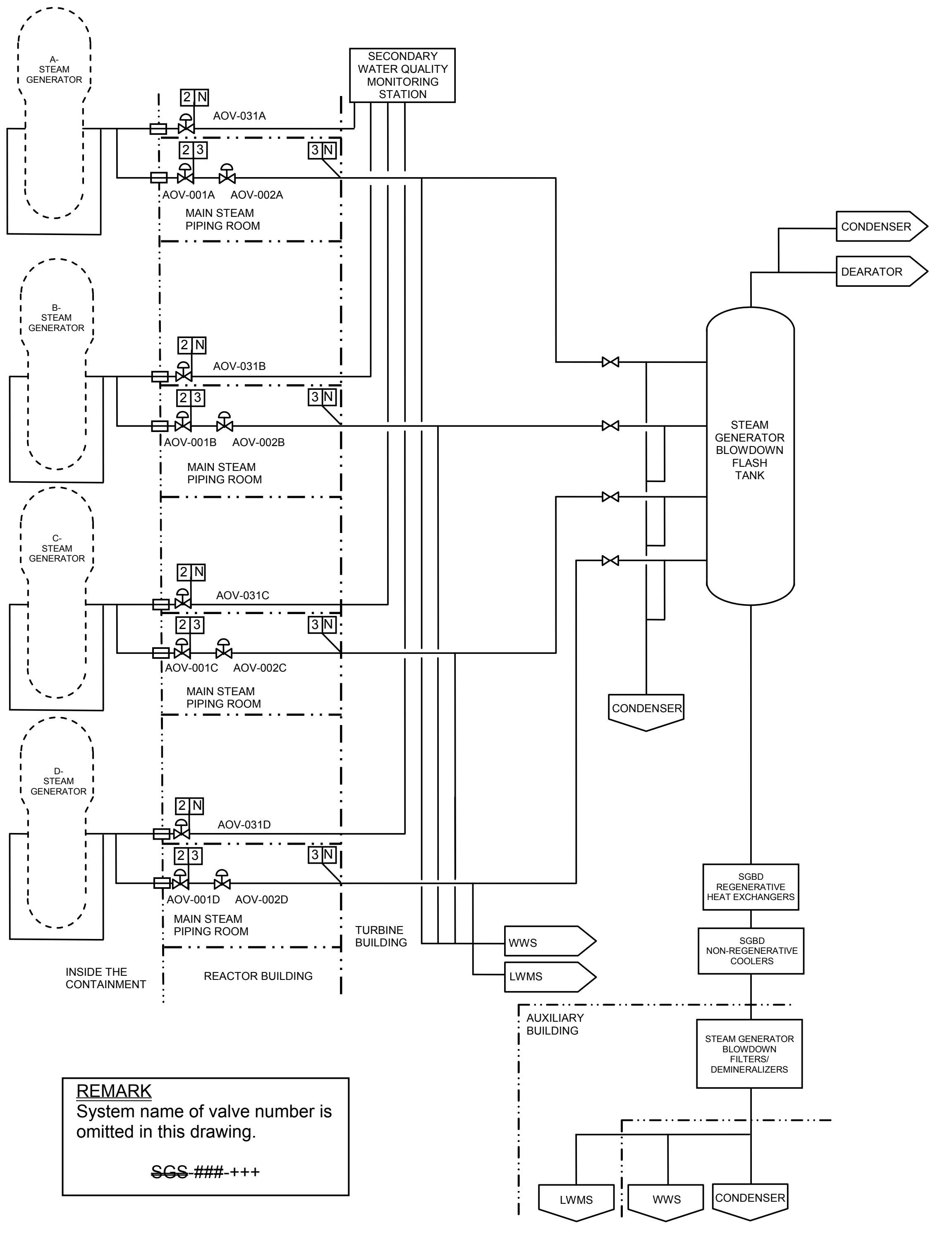


Figure 2.7.1.10-1 Steam Generator Blowdown System

2.7.1.11 Emergency Feedwater System (EFWS)

2.7.1.11.1 Design Description

System Purpose and Functions

The EFWS is a safety-related system. The EFWS is designed to supply feedwater to the steam generators (SGs) when the main feedwater system is not in operation for transient conditions or postulated accidents.

The EFWS provides the containment isolation function, as described in Section 2.11.2, of the EFWS lines penetrating the containment.

Location and Functional Arrangement

The EFWS components are located in the reactor building. Figure 2.7.1.11-1 illustrates the arrangement of the EFWS components. Table 2.7.1.11-1 also provides a tabulation of the location of EFWS equipment.

Key Design Features

The EFWS consists of two motor-driven emergency feedwater (EFW) pumps, two turbine-driven EFW pumps, two EFW pits, piping, valves and associated instrumentation. Each EFW pump has 50 percent capacity.

Each EFW pump discharge line connects to a tie line with motor-operated isolation valves. During normal plant operation, all the isolation valves are closed to provide separation of the four trains. When one of the EFW pumps is not available because of an outage or maintenance or failure during normal plant operation, all the tie isolation valves are kept open to supply specified EFW flow to the SGs following a transient or accident condition.

The flow recirculation line from each EFW pump discharge back to its associated EFW pit provides required EFW pump minimum flow and permits testing each EFW pump at full flow.

The EFWS is designed to remove reactor core decay heat and sensible heat of the reactor coolant system through the SGs following transient conditions or postulated accidents such as:

- Reactor trip
- Loss of offsite power (LOOP)
- Loss of main feedwater
- Small break loss of coolant accident (small break LOCA)
- Feedwater line break (FLB)

- Main steam line break (MSLB)
- Station blackout (SBO)
- Anticipated transient without scram (ATWS)
- SG tube rupture (SGTR)

The EFWS is capable of automatically initiating flow upon receipt of a system actuation signal.

The EFWS design is provided with the capability to automatically terminate EFW flow to a depressurized (faulty) SG and to automatically provide feedwater to the intact SGs.

Each EFW pump is designed to develop adequate head to supply the design flow to a SG, when the SG pressure is equivalent to the set pressure of the first stage of main steam safety valve plus three percent.

The EFWS has the capability to permit operation at hot shutdown for eight hours followed by six hours of cooldown to the initiation temperature of residual heat removal system.

The EFWS is designed such that in the unlikely event that the main control room must be evacuated, the EFWS can be operated from the remote shutdown console (RSC) outside the main control room (MCR).

The EFWS is designed to provide containment isolation of the EFWS lines penetrating the containment.

EFW pumps are physically separated into divisions A, B, C and D. EFW isolation valves and EFW control valves are physically separated into divisions A&B and C&D. EFW pump actuation valves and EFW pump main steam line steam isolation valves of A-EFW pump are physically separated from those of D-EFW pump.

Seismic and ASME Code Classifications

The seismic category and ASME Code Section III requirements are identified in Tables 2.7.1.11-2 and 2.7.1.11-3 for safety-related EFWS components and piping, respectively.

System Operation

The EFWS is not used during plant startup and shutdown.

The EFWS is capable of automatically initiating flow upon receipt of an EFW actuation signal and is provided with the capability to automatically terminate EFW flow to a faulty SG and to provide EFW to the intact SGs.

To maintain the adequate range of water level in SGs, EFW flow rate is manually controlled by the operator from the MCR.

Alarms, Displays, and Controls

Table 2.7.1.11-4 identifies alarms, displays, and controls associated with the EFWS that are located in the MCR. EFWS equipment and instrumentation that is required for remote shutdown and that is available at the RSC is also shown on Table 2.7.1.11-4.

Logic

The EFWS automatically initiates flow upon receipt of an EFW actuation signal, such as:

- Low SG water level
- ECCS actuation signal
- LOOP signal
- MFW pumps trip
- Manual actuation

The EFWS is provided with the capability to automatically terminate by signal, such as:

- Low main steam line pressure
- High SG water level

Interlocks

There are no interlocks needed for direct safety functions related to the EFWS.

Class 1E Electrical Power Sources and Divisions

The safety-related EFWS equipment identified in Table 2.7.1.11-2 as Class 1E is powered from their respective Class 1E division. Separation is provided between these Class 1E divisions and between non-Class 1E divisions and non-Class 1E electrical cable.

Equipment to be Qualified for Harsh Environments

The safety-related EFWS equipment identified in Table 2.7.1.11-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITAAC acceptance criteria in Table 2.7.1.11-5. Key parameters of the EFWS design that are used in the safety analysis and which are included in the Table 2.7.1.11-5 are activation of the EFWS, its ability to deliver EFW to SGs and termination of EFW to a faulty SG.

2.7.1.11.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.1.11-5 describes the ITAAC for the EFWS.

The ITAAC associated with the EFWS equipment, components, and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.7.1.11-1 Emergency Feedwater System Location of Equipment and Piping (Sheet 1 of 3)

System and Components	Location
A, B-Emergency feedwater pits	Reactor Building
A-emergency feedwater pump (turbine-driven)	Reactor Building
B-emergency feedwater pump (motor-driven)	Reactor Building
C-emergency feedwater pump (motor-driven)	Reactor Building
D-emergency feedwater pump (turbine–driven)	Reactor Building
A-emergency feedwater control valve	Reactor Building
B-emergency feedwater control valve	Reactor Building
C-emergency feedwater control valve	Reactor Building
D-emergency feedwater control valve	Reactor Building
A-emergency feedwater isolation valve	Reactor Building
B-emergency feedwater isolation valve	Reactor Building
C-emergency feedwater isolation valve	Reactor Building
D-emergency feedwater isolation valve	Reactor Building
A-emergency feedwater pump (turbine driven) actuation valve	Reactor Building
A-emergency feedwater pump (turbine driven) A-main steam line steam isolation valve	Reactor Building
A-emergency feedwater pump (turbine driven) B-main steam line steam isolation valve	Reactor Building
D-emergency feedwater pump (turbine driven) actuation valve	Reactor Building
D-emergency feedwater pump (turbine driven) C-main steam line steam isolation valve	Reactor Building
D-emergency feedwater pump (turbine driven) D-main steam line steam isolation valve	Reactor Building
A-emergency feedwater pump discharge tie line isolation valve	Reactor Building
B-emergency feedwater pump discharge tie line isolation valve	Reactor Building
C-emergency feedwater pump discharge tie line isolation valve	Reactor Building
D-emergency feedwater pump discharge tie line isolation valve	Reactor Building
EFW pump suction tie line	Reactor Building
EFW pump suction line from EFW pit to A-EFW pump	Reactor Building
EFW pump suction line from EFW pit to B-EFW pump	Reactor Building
EFW pump suction line from EFW pit to C-EFW pump	Reactor Building
EFW pump suction line from EFW pit to D-EFW pump	Reactor Building

Table 2.7.1.11-1 Emergency Feedwater System Location of Equipment and Piping (Sheet 2 of 3)

System and Components	Location
EFW pump discharge tie line	Reactor Building
A-EFW pump discharge line up to and excluding EFW isolation valve (EFS-MOV-019A)	Reactor Building
B-EFW pump discharge line up to and excluding EFW isolation valve (EFS-MOV-019B)	Reactor Building
C-EFW pump discharge line up to and excluding EFW isolation valve (EFS-MOV-019C)	Reactor Building
D-EFW pump discharge line up to and excluding EFW isolation valve (EFS-MOV-019D)	Reactor Building
A and B-EFW pump mini-flow and full-flow line to EFW pit	Reactor Building
C and D-EFW pump mini-flow and full-flow line to EFW pit	Reactor Building
A-EFW pump turbine steam inlet line from A-main steam line up to and excluding ESF-MOV-101A	Reactor Building
A-EFW pump turbine steam inlet line from B-main steam line up to and excluding ESF-MOV-101B	Reactor Building
D-EFW pump turbine steam inlet line from C-main steam line up to and excluding ESF-MOV-101C	Reactor Building
D-EFW pump turbine steam inlet line from D-main steam line up to and excluding ESF-MOV-101D	Reactor Building
EFW pump turbine steam inlet drain lines up to and including ESF-VLV-109A	Reactor Building
EFW pump turbine steam inlet drain lines up to and including ESF-VLV-109D	Reactor Building

Table 2.7.1.11-1 Emergency Feedwater System Location of Equipment and Piping (Sheet 3 of 3)

System and Components	Location
A-EFW pit discharge check valve	Reactor Building
B-EFW pit discharge check valve	Reactor Building
A-emergency feedwater pump (turbine-driven) discharge check valve	Reactor Building
B-emergency feedwater pump (motor-driven) discharge check valve	Reactor Building
C-emergency feedwater pump (motor-driven) discharge check valve	Reactor Building
D-emergency feedwater pump (turbine-driven) discharge check valve	Reactor Building
A-emergency feedwater pump (turbine-driven) minimum flow line check valve	Reactor Building
B-emergency feedwater pump (motor-driven) minimum flow line check valve	Reactor Building
C-emergency feedwater pump (motor-driven) minimum flow line check valve	Reactor Building
D-emergency feedwater pump (turbine-driven) minimum flow line check valve	Reactor Building
A-emergency feedwater check valve (between EFW control valve and EFW isolation valve)	Reactor Building
B-emergency feedwater check valve (between EFW control valve and EFW isolation valve)	Reactor Building
C-emergency feedwater check valve (between EFW control valve and EFW isolation valve)	Reactor Building
D-emergency feedwater check valve (between EFW control valve and EFW isolation valve)	Reactor Building
A-EFW pump turbine steam inlet line from A-main steam line check valve	Reactor Building
A-EFW pump turbine steam inlet line from B-main steam line check valve	Reactor Building
D-EFW pump turbine steam inlet line from C-main steam line check valve	Reactor Building
D-EFW pump turbine steam inlet line from D-main steam line check valve	Reactor Building
A-EFW pump turbine steam inlet drain line check valve	Reactor Building
D-EFW pump turbine steam inlet drain line check valve	Reactor Building

Table 2.7.1.11-2 Emergency Feedwater System Equipment Characteristics (Sheet 1 of 11)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
A-emergency feedwater pump (turbine driven, for inside electrical components)	EFS-MPP-001A	3	Yes	-	Yes/No	Emergency Feedwater Actuation	Start	-
						Remote Manual		
B-emergency feedwater pump (motor driven)	EFS-MPP-001B	3	Yes	-	Yes/No	Emergency Feedwater Actuation	Start	-
C-emergency feedwater pump (motor driven)	EFS-MPP-001C	3	Yes	-	Yes/No	Emergency Feedwater Actuation	Start	-
D-emergency feedwater pump (turbine driven, for inside electrical components)	EFS-MPP-001D	3	Yes	-	Yes/No	Emergency Feedwater Actuation	Start	-
A-emergency feedwater control valve	EFS-MOV-017A	3	Yes	Yes	Yes/Yes	Emergency Feedwater Actuation	Transfer Open	As Is
						Emergency Feedwater Isolation	Transfer Closed	
						Remote Manual	Transfer Open Transfer Closed	

Table 2.7.1.11-2 Emergency Feedwater System Equipment Characteristics (Sheet 2 of 11)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
B-emergency feedwater control valve	EFS-MOV-017B	3	Yes	Yes	Yes/Yes	Emergency Feedwater Actuation	Transfer Open	As Is
						Emergency Feedwater Isolation	Transfer Closed	
						Remote Manual	Transfer Open Transfer Closed	
C-emergency feedwater control valve	EFS-MOV-017C	3	Yes	Yes	Yes/Yes	Emergency Feedwater Actuation	Transfer Open	As Is
						Emergency Feedwater Isolation	Transfer Closed	
						Remote Manual	Transfer Open Transfer Closed	
D-emergency feedwater control valve	EFS-MOV-017D	3	Yes	Yes	Yes/Yes	Emergency Feedwater Actuation	Transfer Open	As Is
						Emergency Feedwater Isolation	Transfer Closed	
						Remote Manual	Transfer Open Transfer Closed	

Table 2.7.1.11-2 Emergency Feedwater System Equipment Characteristics (Sheet 3 of 11)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
A-emergency feedwater isolation valve	EFS-MOV-019A	2	Yes	Yes	Yes/Yes	Emergency Feedwater Actuation	Transfer Open	As Is
						Emergency Feedwater Isolation	Transfer Closed	
						Remote Manual	Transfer Open Transfer Closed	
B-emergency feedwater isolation valve	EFS-MOV-019B	2	Yes	Yes	Yes/Yes	Emergency Feedwater Actuation	Transfer Open	As Is
						Emergency Feedwater Isolation	Transfer Closed	
						Remote Manual	Transfer Open Transfer Closed	

Table 2.7.1.11-2 Emergency Feedwater System Equipment Characteristics (Sheet 4 of 11)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
C-emergency feedwater isolation valve	EFS-MOV-019C	2	Yes	Yes	Yes/Yes	Emergency Feedwater Actuation	Transfer Open	As Is
						Emergency Feedwater Isolation	Transfer Closed	
						Remote Manual	Transfer Open Transfer Closed	
D-emergency feedwater isolation valve	EFS-MOV-019D	2	Yes	Yes	Yes/Yes	Emergency Feedwater Actuation	Transfer Open	As Is
						Emergency Feedwater Isolation	Transfer Closed	
						Remote Manual	Transfer Open Transfer Closed	

Table 2.7.1.11-2 Emergency Feedwater System Equipment Characteristics (Sheet 5 of 11)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
A-emergency feedwater pump actuation valve	EFS-MOV-103A	3	Yes	Yes	Yes/Yes	Emergency Feedwater Actuation	Transfer Open	As Is
						Remote Manual	Transfer Closed	
A-emergency feedwater pump A-main steam line steam isolation valve	EFS-MOV-101A	2	Yes	Yes	Yes/Yes	Remote Manual	Transfer Closed	As Is
A-emergency feedwater pump B-main steam line steam isolation valve	EFS-MOV-101B	2	Yes	Yes	Yes/Yes	Remote Manual	Transfer Closed	As Is
D-emergency feedwater pump actuation valve	EFS-MOV-103D	3	Yes	Yes	Yes/Yes	Emergency Feedwater Actuation	Transfer Open	As Is
						Remote Manual	Transfer Closed	

Table 2.7.1.11-2 Emergency Feedwater System Equipment Characteristics (Sheet 6 of 11)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
D-emergency feedwater pump C-main steam line steam isolation valve	EFS-MOV-101C	2	Yes	Yes	Yes/Yes	Remote Manual	Transfer Closed	As Is
D-emergency feedwater pump D-main steam line steam isolation valve	EFS-MOV-101D	2	Yes	Yes	Yes/Yes	Remote Manual	Transfer Closed	As Is
Emergency feedwater flow	EFS-FT-016, 026, 036, 046	-	Yes	-	Yes/ No	-	-	-
Emergency feedwater pit water level	EFS-LT-060, 061, 070, 071	-	Yes	-	Yes/ No	-	-	-
Emergency feedwater pump discharge pressure	EFS-PT-050, 051, 052, 053	-	Yes	-	Yes/ No	-	-	-

Table 2.7.1.11-2 Emergency Feedwater System Equipment Characteristics (Sheet 7 of 11)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
A-EFW pit discharge check valve	EFS-VLV-008A	3	Yes	No	-	-	Transfer Open Transfer Closed	-
B-EFW pit discharge check valve	EFS-VLV-008B	3	Yes	No	-	-	Transfer Open Transfer Closed	-
A-emergency feedwater pump (turbine-driven) discharge check valve	EFS-VLV-012A	3	Yes	No	-	-	Transfer Open Transfer Closed	-
B-emergency feedwater pump (motor-driven) discharge check valve	EFS-VLV-012B	3	Yes	No	-	-	Transfer Open Transfer Closed	-
C-emergency feedwater pump (motor-driven) discharge check valve	EFS-VLV-012C	3	Yes	No	-	-	Transfer Open Transfer Closed	-
D-emergency feedwater pump (turbine-driven) discharge check valve	EFS-VLV-012D	3	Yes	No	-	-	Transfer Open Transfer Closed	-

Table 2.7.1.11-2 Emergency Feedwater System Equipment Characteristics (Sheet 8 of 11)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
A-emergency feedwater pump (turbine-driven) minimum flow line check valve	EFS-VLV-020A	3	Yes	No	-	-	Transfer Open Transfer Closed	-
B-emergency feedwater pump (motor-driven) minimum flow line check valve	EFS-VLV-020B	3	Yes	No	-	-	Transfer Open Transfer Closed	-
C-emergency feedwater pump (motor-driven) minimum flow line check valve	EFS-VLV-020C	3	Yes	No	-	-	Transfer Open Transfer Closed	-
D-emergency feedwater pump (turbine-driven) minimum flow line check valve	EFS-VLV-020D	3	Yes	No	-	-	Transfer Open Transfer Closed	-

Table 2.7.1.11-2 Emergency Feedwater System Equipment Characteristics (Sheet 9 of 11)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
A-emergency feedwater check valve (between EFW control valve and EFW isolation valve)	EFS-VLV-018A	3	Yes	No	-	-	Transfer Open Transfer Closed	-
B-emergency feedwater check valve (between EFW control valve and EFW isolation valve)	EFS-VLV-018B	3	Yes	No	-	-	Transfer Open Transfer Closed	-
C-emergency feedwater check valve (between EFW control valve and EFW isolation valve)	EFS-VLV-018C	3	Yes	No	-	-	Transfer Open Transfer Closed	-
D-emergency feedwater check valve (between EFW control valve and EFW isolation valve)	EFS-VLV-018D	3	Yes	No	-	-	Transfer Open Transfer Closed	-

Table 2.7.1.11-2 Emergency Feedwater System Equipment Characteristics (Sheet 10 of 11)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
A-EFW pump turbine steam inlet line from A-main steam line check valve	EFS-VLV-102A	3	Yes	No	-	-	Transfer Open Transfer Closed	-
A-EFW pump turbine steam inlet line from B-main steam line check valve	EFS-VLV-102B	3	Yes	No	-	-	Transfer Open Transfer Closed	-
D-EFW pump turbine steam inlet line from C-main steam line check valve	EFS-VLV-102C	3	Yes	No	-	-	Transfer Open Transfer Closed	-
D-EFW pump turbine steam inlet line from D-main steam line check valve	EFS-VLV-102D	3	Yes	No	-	-	Transfer Open Transfer Closed	-

Table 2.7.1.11-2 Emergency Feedwater System Equipment Characteristics (Sheet 11 of 11)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
A-EFW pump turbine steam inlet drain line check valve	EFS-VLV-109A	3	Yes	No	-	-	Transfer Open Transfer Closed	-
D-EFW pump turbine steam inlet drain line check valve	EFS-VLV-109D	3	Yes	No	-	-	Transfer Open Transfer Closed	-
A, B-Emergency feedwater pits	MPT-001A, B	-	Yes	-	-/-	-	-	-

Note: Dash (-) indicates not applicable

Table 2.7.1.11-3 Emergency Feedwater System Piping Characteristics

Pipe Line Name	ASME Code Section III Class	Leak Before Break	Seismic Category I
EFW pump suction tie line	3	No	Yes
EFW pump suction line from EFW pit to A-EFW pump	3	No	Yes
EFW pump suction line from EFW pit to B-EFW pump	3	No	Yes
EFW pump suction line from EFW pit to C-EFW pump	3	No	Yes
EFW pump suction line from EFW pit to D-EFW pump	3	No	Yes
EFW pump discharge tie line	3	No	Yes
A-EFW pump discharge line up to and excluding EFW isolation valve (EFS-MOV-019A)	3	No	Yes
B-EFW pump discharge line up to and excluding EFW isolation valve (EFS-MOV-019B)	3	No	Yes
C-EFW pump discharge line up to and excluding EFW isolation valve (EFS-MOV-019C)	3	No	Yes
D-EFW pump discharge line up to and excluding EFW isolation valve (EFS-MOV-019D)	3	No	Yes
A and B-EFW pump mini-flow and full-flow line to EFW pit	3	No	Yes
C and D-EFW pump mini-flow and full-flow line to EFW pit	3	No	Yes
A-EFW pump turbine steam inlet line from A-main steam line up to and excluding ESF-MOV-101A	3	No	Yes
A-EFW pump turbine steam inlet line from B-main steam line up to and excluding ESF-MOV-101B	3	No	Yes
D-EFW pump turbine steam inlet line from C-main steam line up to and excluding ESF-MOV-101C	3	No	Yes
D-EFW pump turbine steam inlet line from D-main steam line up to and excluding ESF-MOV-101D	3	No	Yes
EFW pump turbine steam inlet drain lines up to and including ESF-VLV-109A	3	No	Yes
EFW pump turbine steam inlet drain lines up to and including ESF-VLV-109D	3	No	Yes

Table 2.7.1.11-4 Emergency Feedwater System Equipment Alarms, Displays, and Control Functions

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Emergency feedwater pump (EFS-MPP-001A, B, C, D)	No	Yes	Yes	Yes
Emergency feedwater control valves (EFS-MOV-017A, B, C, D)	No	Yes	Yes	Yes
Emergency feedwater isolation valves (EFS-MOV-019A, B, C,D)	No	Yes	Yes	Yes
Emergency feeedwater pump actuation valve (EFS-MOV-103A, D)	No	Yes	Yes	Yes
A-EFW pump main steam line steam isolation valve (EFS-MOV-101A, B)	No	Yes	Yes	Yes
D-EFW pump main steam line steam isolation valve (EFS-MOV-101C, D)	No	Yes	Yes	Yes
Emergency feedwater pit water level (EFS-LT-060, 061, 070, 071)	Yes	Yes	No	Yes
Emergency feedwater flow (EFS-FT-016, 026, 036, 046)	No	Yes	No	Yes
Emergency feedwater pump discharge pressure (EFS-PI-050, 051, 052, 053)	No	Yes	No	Yes

Table 2.7.1.11-5 Emergency Feedwater System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a The functional arrangement of the EFWS is as described in Subsection 2.7.1.11.1 Design Description and as shown in Figure 2.7.1.11-1.	1.a An inspection of the as-built system will be performed.	1.a The as-built EFWS conforms with the functional arrangement as described in the Design Description of this Subsection 2.7.1.11.1 and as shown in Figure 2.7.1.11-1.
1.b Following components are physically separated into divisions A, B, C and D: EFW pumps	1.b Inspections of as-built EFWS will be performed.	1.b Following components are physically separated into divisions A, B, C and D by structural barriers: EFW pumps
1.c Following components are physically separated into divisions A&B and C&D: EFW isolation valves EFW control valves	1.c Inspections of as-built EFWS will be performed.	1.c Following components are physically separated into division A&B and C&D by structural barriers: EFW isolation valves EFW control valves
1.d Following components of A-EFW pump are physically separated from those of D-EFW pump: EFW pump actuation valves EFW pump main steam line steam isolation valves	1.d Inspections of as-built EFWS will be performed.	1.d Following components of A-EFW pump are physically separated from those of D-EFW pump by structural barriers: EFW pump actuation valves EFW pump main steam line steam isolation valves
2.a.i The ASME Code Section III components of the EFWS, identified in Table 2.7.1.11-2, are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.a.i An inspection of the as-built ASME Code Section III components of the EFWS will be performed.	2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the EFWS identified in Table 2.7.1.11-2 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

Table 2.7.1.11-5 Emergency Feedwater System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.a.ii The ASME Code Section III components of the EFWS identified in Table 2.7.1.11-2 are reconciled with the design requirements.	2.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the EFWS identified in Table 2.7.1.11-2 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.
2.b.i The ASME Code Section III piping of the EFWS, including supports, identified in Table 2.7.1.11-3, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.b.i An inspection of the as-built ASME Code Section III piping of the EFWS, including supports, will be performed.	2.b.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the EFWS, including supports, identified in Table 2.7.1.11-3 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.b.ii The ASME Code Section III piping of the EFWS, including supports, identified in Table 2.7.1.11-3 is reconciled with the design requirements.	2.b.ii A reconciliation analysis of the piping of the EFWS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.b.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the EFWS, including supports, identified in Table 2.7.1.11-3 is reconciled with the design requirements. The report documents the results of the reconciliation analysis.

Table 2.7.1.11-5 Emergency Feedwater System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.7.1.11-2, meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
3.b Pressure boundary welds in ASME Code Section III piping, identified in Table 2.7.1.11-3, meet ASME Code Section III requirements for non-destructive examination of welds.	3.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
4.a The ASME Code Section III components, identified in Table 2.7.1.11-2, retain their pressure boundary integrity at their design pressure.	4.a Hydrostatic tests will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	4.a The results of the hydrostatic tests of the as-built components identified in Table 2.7.1.11-2 as ASME Code Section III conform with the requirements of the ASME Code Section III.
4.b The ASME Code Section III piping, identified in Table 2.7.1.11-3, retains its pressure boundary integrity at its design pressure.	4.b Hydrostatic tests will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the hydrostatic tests of the as-built piping identified in Table 2.7.1.11-3 as ASME Code Section III conform with the requirements of the ASME Code Section III.
5.a The seismic Category I equipment, identified in Table 2.7.1.11-2, is designed to withstand seismic design basis loads without loss of safety function.	5.a.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.7.1.11-2 is located in the reactor building.	5.a.i The seismic Category I as-built equipment identified in Table 2.7.1.11-2 is located in the reactor building.
	5.a.ii Type tests and/or analyses of the seismic Category I equipment will be performed.	5.a.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.

Table 2.7.1.11-5 Emergency Feedwater System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	5.a.iii Inspections will be performed on the as-built equipment including anchorage.	5.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.
5.b Each of the seismic Category I piping, including supports, identified in Table 2.7.1.11-3 is designed to withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table 2.7.1.11-3 are supported by a seismic Category I structure(s).	5.b.i Reports(s) document that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.1.11-3 is supported by a seismic Category I structure(s).
	5.b.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, identified in Table 2.7.1.11-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.1.11-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.
6.a The Class 1E equipment identified in Table 2.7.1.11-2 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.a.i Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	6.a.i The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.7.1.11-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	6.a.ii Inspections will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.7.1.11-2 as being qualified for a harsh environment are bounded by type tests and/or analyses.

Table 2.7.1.11-5 Emergency Feedwater System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6.b The Class 1E equipment, identified in Table 2.7.1.11-2, is powered from their respective Class 1E division.	6.b A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.7.1.11-2 under test.
6.c Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	6.c Inspections of the as-built Class 1E divisional cables will be performed.	6.c Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.
7. Deleted.	7. Deleted.	7. Deleted.
8.a Controls exist in the MCR to open and close the remotely operated valves identified in Table 2.7.1.11-2.	8.a Tests will be performed on the as-built remotely operated valves listed in Table 2.7.1.11-2 using controls in the as-built MCR.	8.a Controls exist in the as-built MCR to open and close the as-built remotely operated valves listed in Table 2.7.1.11-2.
8.b The valves identified in Table 2.7.1.11-2 as having PSMS control perform an active safety function after receiving a signal from PSMS.	8.b.i Tests will be performed on the as-built remotely operated valves listed in Table 2.7.1.11-2 using simulated signals.	8.b.i The as-built remotely-operated valves identified in Table 2.7.1.11-2 as having PSMS control perform the active function identified in the table after receiving a signal.
	8.b.ii Tests will be performed to demonstrate that remotely operated as-built EFW control valves and EFW isolation valves close within the required response time under preoperational condition.	8.b.ii These as-built valves close within the following times after receipt of an actuation signal. The as-built EFW control valves close within 20 seconds. The as-built EFW isolation valves close within 20 seconds.

Table 2.7.1.11-5 Emergency Feedwater System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9.a The motor-operated valves and check valves, identified in Table 2.7.1.11-2, perform an active safety function to change position as indicated in the table.	9.a.i Tests or type tests of motor-operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	9.a.i Each motor-operated valve changes position as indicated in Table 2.7.1.11-2 under design conditions.
	9.a.ii Tests of the as-built motor-operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	9.a.ii Each as-built motor-operated valve changes position as indicated in Table 2.7.1.11-2 under pre-operational test conditions.
	9.a.iii Tests of the as-built check valves with active safety functions identified in Table 2.7.1.2-2 will be performed under pre-operational test pressure, temperature, and fluid flow conditions.	9.a.iii Each as-built check valve changes position as indicated in Table 2.7.1.11-2.
9.b After loss of motive power, the remotely operated valves, identified in Table 2.7.1.11-2, assume the indicated loss of motive power position.	9.b. Tests of the as-built valves will be performed under the conditions of loss of motive power.	9.b Upon loss of motive power, each as-built remotely operated valve identified in Table 2.7.1.11-2 assumes the indicated loss of motive power position.
10. MCR alarms and displays of the parameters identified in Table 2.7.1.11-4 can be retrieved in the MCR.	10. Inspections will be performed for retrievability of the EFWS parameters in the as-built MCR.	10. MCR alarms and displays identified in Table 2.7.1.11-4 can be retrieved in the as-built MCR.
11. RSC alarms, displays and controls are identified in Table 2.7.1.11-4.	11. Inspections of the as-built RSC alarms, displays and controls will be performed.	11. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.7.1.11-4.
12. Each EFW pump delivers at least the minimum flow required for removal of core decay heat using the SGs against a SG pressure up to the set pressure of the first stage of main steam safety valve plus 3 percent.	12 A test of each as-built EFW pump will be performed to determine system flow vs. SG pressure under preoperational condition. Analyses will be performed to convert the test results to the design conditions.	12 From the result of analyses, any two of the as-built EFW pumps deliver at least 705 gpm to the any of the two SGs against a SG pressure up to the set pressure of the first stage of main steam safety valve plus 3 percent.
13. Each EFW pit has a volume to permit plant cooldown from hot standby to hot shutdown condition (residual heat removal system initiation temperature) following the most limiting design basis event.	13. Inspections will be performed to verify the as-built EFW pits include sufficient volume of water.	13. The water volume of the each as-built EFW pit is greater than or equal to 204,850 gallons.

Table 2.7.1.11-5 Emergency Feedwater System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 7 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
14. The EFW pumps have sufficient net positive suction head (NPSH).	14 Tests to measure the as-built EFW pump suction pressure will be performed. Inspections and analysis to determine NPSH available to each pump will be performed.	14 The as-built system meets the design, and the analysis confirms that the NPSH available exceeds the required NPSH.
15. The EFW control valves limit maximum flow to each SG to less than the value assumed as the EFW pump design and the input value to the MSLB mass and energy release analysis, core performance analysis or SGTR steam generator overfill analysis.	15. A test of each as-built EFW pump will be performed to determine system flow vs. SG pressure under preoperational condition. Analyses will be performed to convert the test results to the design conditions.	15. From the result of the analyses, the EFW control valve pre-set open position sets the piping resistance of each train from EFW pit to steam generator through EFW pump so that the EFW flow rate to the steam generator is 400 gpm (91m^3/h) with the steam generator pressure 1221 psig (85.8 kg/cm^2 [gage]).
16. The flow recirculation line from each EFW pump discharge back to its associated EFW pit permits testing each EFW pump at full flow.	16. Testing of each EFW pump in the full flow test modes will be conducted with flow directed to the EFW pit through the pump's recirculation lines.	16. Full flow from a M/D-EFW pump at least 450 gpm is returned to the EFW pit. Full flow from a T/D-EFW pump at least 550 gpm is returned to the EFW pit.
17. Each pump identified in Table 2.7.1.11-2 as having PSMS control performs its active safety function in response to the PSMS control signal.	17. Tests will be performed for each as-built pump identified in Table 2.7.1.11-2 using simulated signals.	17. Each as-built pump identified in Table 2.7.1.11-2 as having PSMS control performs its active safety function after receiving a simulated signal.
18. Controls exist in the MCR to start and stop the pumps identified in Table 2.7.1.11-4.	18. Tests will be performed on the as-built pumps in Table 2.7.1.11-4 using controls in the as-built MCR.	18. Controls exist in the as-built MCR to start and stop the as-built pumps listed in Table 2.7.1.11-4.

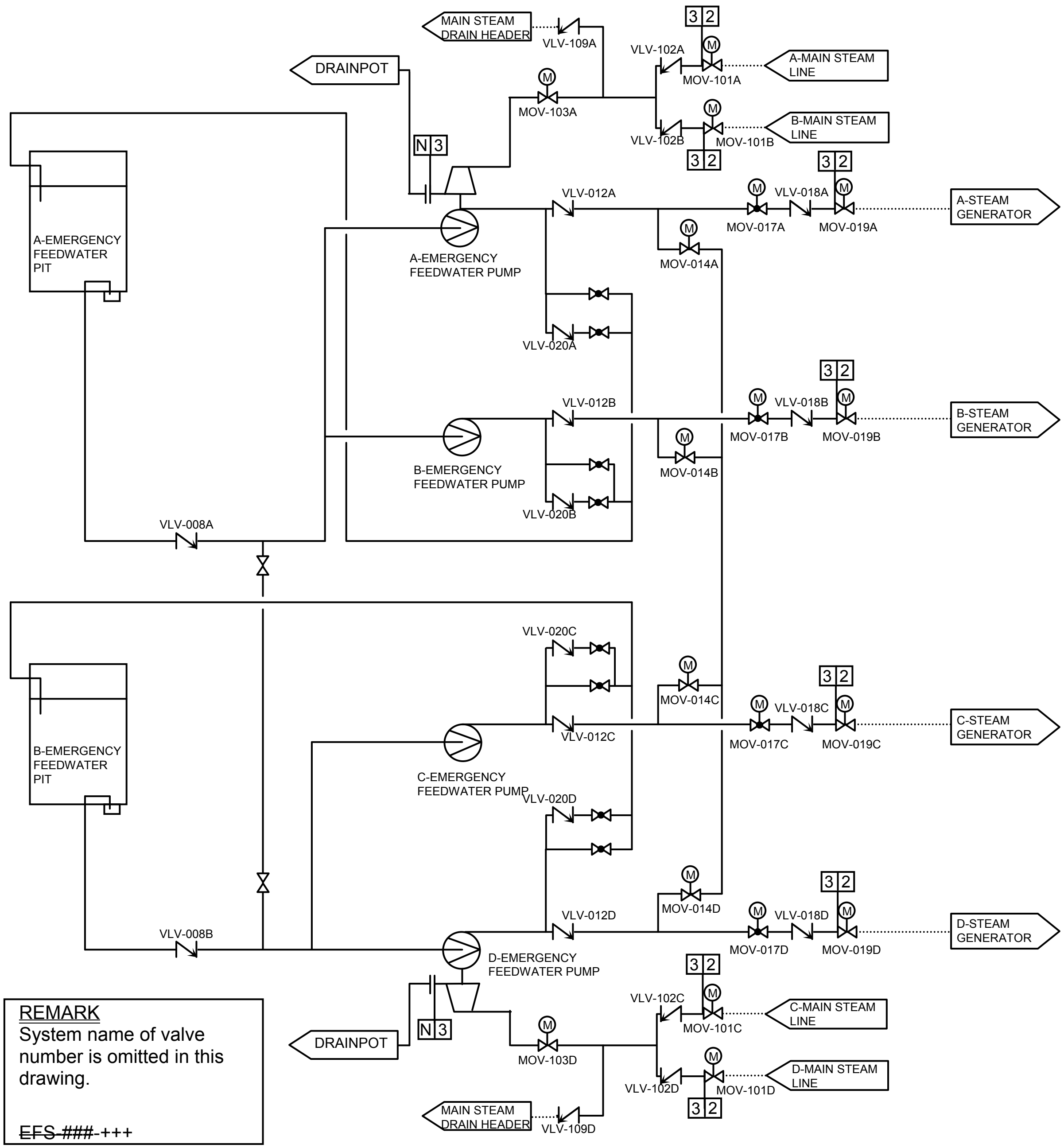


Figure 2.7.1.11-1 Emergency Feedwater System

2.7.1.12 Secondary Side Chemical Injection System (SCIS)

2.7.1.12.1 Design Description

System Purpose and Functions

The SCIS is non safety-related system. The SCIS is designed to maintain noncorrosive conditions within the secondary loop.

Location and Functional Arrangement

The SCIS components are located partly in the turbine building and partly outdoors. The SCIS includes the chemical addition tanks, injection pumps, bulk chemical system, piping and instrumentation.

Key Design Features

The SCIS feeds required chemicals to control pH and dissolved oxygen content of the feedwater, condensate and steam generator secondary side water.

Seismic and ASME Code Classifications

The SCIS is non-seismic category and is not designed to ASME code specifications.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the SCIS.

Interlocks

There are no interlocks needed for direct safety functions related to the SCIS.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.1.12.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.1.12-1 describes the ITAAC for the SCIS.

Table 2.7.1.12-1 Secondary Side Chemical Injection System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the chemical injection system is as described in Subsection 2.7.1.12.1 Design Description.	1. Inspections of the as-built system will be performed.	1. The as-built chemical injection system conforms to the functional arrangement as described in the Design Description of this Subsection 2.7.1.12.1.

2.7.1.13 Auxiliary Steam Supply System (ASSS)

2.7.1.13.1 Design Description

System Purpose and Functions

The ASSS is non safety-related system. The ASSS is designed to provide the steam required for plant use during plant startup, shutdown, and normal operation.

Location and Functional Arrangement

The auxiliary boiler and associated equipment are located outside, and the common equipment is located in the auxiliary building.

Key Design Features

Steam is supplied from either the auxiliary boiler, main steam or turbine extracting steam.

Seismic and ASME Code Classifications

The ASSS is non-seismic category and is not designed to ASME code specifications.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the ASSS.

Interlocks

There are no interlocks needed for direct safety functions related to the ASSS.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.1.13.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.1.13-1 describes the ITAAC for the ASSS.

Table 2.7.1.13-1 Auxiliary Steam Supply System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the auxiliary steam system is as described in the Design Description of Subsection 2.7.1.13.	1. Inspections of the as-built system will be performed.	1. The as-built auxiliary steam system conforms to the functional arrangement as described in the Design Description of this Subsection 2.7.1.13.1 .

2.7.2 Compressed Air and Gas Systems (CAGS)

2.7.2.1 Design Description

System Purpose and Functions

The purpose of the CAGS and its three subsystems – the instrument air system (IAS), the station service air system (SSAS), and the compressed gas system – is to supply compressed air and gas to various plant components. The individual subsystem functions are as follows:

- The IAS provides compressed air to air-operated valves; to heating, ventilation, and air conditioning (HVAC) air-operated dampers; and to pneumatic instruments and controls.

- The SSAS supplies compressed air for air-operated tools, air operated pumps, and breathing air filtration units.

- The compressed gas system provides various gases needed for purging, diluting, and creating an inert atmosphere.

The CAGS is designed to provide containment isolation of the piping penetrating the containment. The containment isolation function is described in Section 2.11.2. The portions of the CAGS that serve that function are safety-related; other portions of the system are not safety-related.

Location and Functional Arrangement

The major components of the CAGS are located in the turbine building, with some piping within the reactor building and the containment. Gas is stored outside the power block. The component locations of the CAGS are as shown in Table 2.7.2-1. The functional arrangements of the three subsystems are as follows:

- The IAS consists of two compressor packages, with each package consisting of an inlet air filter/silencer, a compressor, an intercooler, an aftercooler, a moisture separator, an air receiver, a drier and associated controls. The functional arrangement of this subsystem is as described in the Design Description of this Subsection 2.7.2, with the safety related portions being addressed in Subsection 2.11.2.

- The SSAS consists of three 50-percent capacity compressor divisions, each consisting of an inlet air filter/silencer, a compressor, an intercooler, an aftercooler, and a moisture separator. These divisions share two receivers and two dryers which connect to a common station air distribution header downstream of the air dryers.

- The compressed gas system is comprised of the high pressure nitrogen gas subsystem, the low pressure nitrogen gas subsystem, the hydrogen gas subsystem, the carbon dioxide gas system, and the oxygen gas system. These subsystems provide distributions headers, piping, and valves used to transport gas supplied by combined license (COL) applicant.

Lines penetrating the containment incorporate valves and piping that meet containment isolation criteria as discussed in Subsection 2.11.2.

Key Design Features

The key design features of the system are addressed under “system purpose and functions” and under “location and functional arrangement.”

Seismic and ASME Code Classifications

Containment penetration piping and the related isolation valves meet seismic Category I requirements. Other portions of the system do not. Containment penetration piping and the related isolation valves comply with requirements of ASME Code Section III Class 2. Other portions of the system do not.

System Operation

The important aspects of system operation are specified under “logic”.

Alarms, Displays, and Controls

Table 2.7.2-2 identifies alarms, displays, and controls related to the CAGS that are located in the main control room (MCR).

Logic

The containment isolation valves in the CAGS operate properly with receipt of a containment isolation signal as described in Subsection 2.11.2.

Interlocks

There are no interlocks needed for direct safety functions related to the CAGS.

Class 1E Electrical Power Sources and Divisions

There are no Class 1E electrical power sources for the CAGS except the containment isolation valves.

Equipment to be Qualified for Harsh Environments

The safety-related portions of the CAGS to be qualified for harsh environments are identified in Subsection 2.11.2.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.2.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.2-3 describes ITAAC for the CAGS.

The ITAAC associated with the CAGS equipment, components, and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.7.2-1 Compressed Air and Gas System Component Location

Component Name	Component Location
A-Instrument Air Compressor Package	Turbine Building
B- Instrument Air Compressor Package	Turbine Building
A-Service Air Compressor Package	Turbine Building
B-Service Air Compressor Package	Turbine Building
C-Service Air Compressor Package	Turbine Building

Tale 2.7.2-2 Compressed Air and Gas System Equipment Alarms, Displays and Control Functions

Equipment Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Instrument air pressure	Yes	Yes	No	Yes

Table 2.7.2-3 Compressed Air and Gas System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests Analyses	Acceptance Criteria
1. The functional arrangement of the CAGS is as described in the design description.	1. An inspection of the as-built system will be performed.	1. The as-built CAGS conforms to the functional arrangement as described in the Design Description of this Subsection 2.7.2.1.
2. Deleted.	2. Deleted.	2. Deleted.
3. MCR alarms and displays of the parameters identified in Table 2.7.2-1 can be retrieved in the MCR.	3. Inspection will be performed for the retrievability of the CAGS parameters in the MCR.	3. The MCR alarms and displays identified in Table 2.7.2-1 can be retrieved in the as-built MCR.
4. RSC alarm and display are identified in Table 2.7.2-1.	4. Inspections of the as-built RSC alarm and display will be performed.	4. Alarm and display exist on the as-built RSC as identified in Table 2.7.2-1.

2.7.3 Cooling Water Systems

2.7.3.1 Essential Service Water System (ESWS)

2.7.3.1.1 Design Description

System Purpose and Functions

The essential service water system (ESWS), safety-related system provides cooling water to the component cooling water heat exchangers and the essential chiller units. The ESWS transfers the heat from these components to the ultimate heat sink (UHS).

Location and Functional Arrangement

Figure 2.7.3.1-1 shows the functional arrangement of the ESWS. Table 2.7.3.1-1 provides the location for the ESWS equipment and piping. Table 2.7.3.1-2 provides information on design characteristics of system equipment.

Key Design Features

The ESWS consists of four independent divisions with each division providing fifty percent (50%) of cooling capacity required for design basis accident and for safe shutdown. The ESWS performs its safety function assuming that one division is out of service for maintenance coincident with the loss of offsite power and any single failure. Each ESW pump discharge line is provided with two (2) 100% capacity strainers. A clogged strainer is taken out of service by placing the standby strainer in operation.

Each mechanical division of the essential service water system is physically separated from the other divisions by a structural barrier, which also serves as a fire barrier.

Seismic and ASME Code Classification

The seismic classifications for system components are identified in Table 2.7.3.1-2. The ASME Code Section III requirements for system components are also identified in Table 2.7.3.1-2. Table 2.7.3.1-3 provides this information for system piping.

System Operation

The ESWS provides cooling water required for the component cooling water heat exchangers and the essential chiller during all plant operating conditions, including normal plant operating, abnormal and accident conditions.

Alarms, Displays, and Controls

Table 2.7.3.1-4 identifies alarms, displays, and controls associated with the ESWS that are located in the main control room (MCR).

Logic

Upon the receipt of ECCS actuation signal, all essential service water pumps (ESWPs) automatically start or continue to operate.

Interlocks

Upon the receipt of an ESWP start signal, the essential service water discharge valve opens automatically. The motor operated valve at the discharge of each pump is interlocked to close when the pump is not running or is tripped. This interlock prevents the pump from starting if the valve is not closed. The valve starts to open after the respective pump starts.

Class 1E Electrical Power Sources and Divisions

The ESWS equipment identified in Table 2.7.3.1-2 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

Not applicable

Interface Requirements

UHS is a safety-related system and is not within the scope of the certified design. The maximum supply water temperature is 95 ºF under the peak heat loads condition to provide sufficient cooling capacity to ESWS.

The UHS keeps the water level at a net positive suction head (NPSH) greater than the pump's required NPSH.

Combined License applicant referencing the certified design is responsible to assure that the site-specific design meets the interface requirement and verify the conformance in the ITAAC process that are similar to those provided in the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITAAC acceptance criteria in Table 2.7.3.1-5.

2.7.3.1.2 Inspections, Tests, Analysis, and Acceptance Criteria

Table 2.7.3.1-5 describes the ITAAC for the ESWS.

Table 2.7.3.1-1 Essential Service Water System Location of Equipment and Piping

System and Components	Location
Essential service water pumps	Ultimate heat sink related structures
Essential service water supply header piping and valves	Ultimate heat sink related structures and essential service water pipe tunnel
Essential service water return header piping and valves	Ultimate heat sink related structures and essential service water pipe tunnel
Essential service water supply line piping and valves to component cooling water heat exchangers	Reactor Building and essential service water pipe tunnel
Essential service water return line piping and valves from component cooling water heat exchangers	Reactor Building and essential service water pipe tunnel
Essential service water supply line piping and valves to essential chiller units	Power Source Building and essential service water pipe tunnel
Essential service water return line piping and valves from essential chiller units	Power Source Building and essential service water pipe tunnel
Essential service water pump motor cooling water piping and valves	Ultimate heat sink related structures

Table 2.7.3.1-2 Essential Service Water System Equipment Characteristics

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Essential service water pumps	EWS-MPP-001 A, B, C, D	3	Yes	-	Yes/No	ECCS Actuation	Start	-
						LOOP sequence	Start	
						Remote Manual	Start	
Essential service water pump discharge valves	EWS-MOV-503 A, B, C, D	3	Yes	Yes	Yes/No	ESW pump start	Transfer Open	As Is
Component Cooling Water Heat Exchanger Essential Service Water Flow	EWS-FT-034, 035, 036, 037	-	Yes	-	Yes/ No	-	-	-
Essential Service Water Header Pressure	EWS-PT-015, 016, 017, 018	-	Yes	-	Yes/ No	-	-	-
Essential Service Water Pump Discharge Check Valves	EWS-VLV-502A, 502B, 502C, 502D	3	Yes	-	-/-	-	Transfer Open/ Transfer Closed	-
Essential Service Pump Motor Cooling Water Supply Line Check Valves	EWS-VLV-602A, 602B, 602C, 602D	3	Yes	-	-/-	-	Transfer Open/ Transfer Closed	-

NOTE:
Dash (-) indicates not applicable

Table 2.7.3.1-3 Essential Service Water System Piping Characteristics

Pipe Line Name	ASME Code Section III Class	Seismic Category I
Essential service water supply header piping and valves	3	Yes
Essential service water return header piping and valves	3	Yes
Essential service water supply line piping and valves to component cooling water heat exchangers	3	Yes
Essential service water return line piping and valves from component cooling water heat exchangers	3	Yes
Essential service water supply line piping and valves to essential chiller units	3	Yes
Essential service water return line piping and valves from essential chiller units	3	Yes
Essential service water pump motor piping and valves	3	Yes

Table 2.7.3.1-4 Essential Service Water System Equipment Alarms, Displays, and Control Functions

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Essential service water pumps EWS-MPP-001A, B, C, D	No	Yes	Yes	Yes
Essential service water pump discharge valves EWS-MOV-503A, B, C, D	No	Yes	Yes	Yes
Essential service water header pressure EWS-PT-015, 016, 017, 018	Yes	Yes	No	Yes
Component cooling water heat exchanger essential service water flow EWS-FT-034, 035, 036, 037	Yes	Yes	No	Yes

Table 2.7.3.1-5 Essential Service Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 5)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a The functional arrangement of the ESWS is as described in the Design Description of Subsection 2.7.3.1 and as shown in Figure 2.7.3.1-1.	1.a An inspection of the as-built ESWS will be performed.	1.a The as-built ESWS conforms to the functional arrangement as described in the Design Description of Subsection 2.7.3.1 and as shown in Figure 2.7.3.1-1.
1.b Each mechanical division of the ESWS (Division A, B, C & D) except for piping is physically separated from the other divisions with the exception of the components in the ESWS piping tunnel.	1.b Inspections of the as-built ESWS will be performed.	1.b Each mechanical division of the as-built ESWS (Division A, B, C & D) except for piping is physically separated from the other divisions of the system by structural barriers divisions with the exception of the components in the ESWS piping tunnel.
2.a.i The ASME Code Section III components of the ESWS, identified in Table 2.7.3.1-2, are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.a.i An inspection of the as-built ASME Code Section III components of the ESWS will be performed.	2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the ESWS identified in Table 2.7.3.1-2 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.a.ii The ASME Code Section III components of the ESWS identified in Table 2.7.3.1-2 are reconciled with the design requirements.	2.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the ESWS identified in Table 2.7.3.1-2 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.

Table 2.7.3.1-5 Essential Service Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 5)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.b.i The ASME Code Section III piping of the ESWS, including supports, identified in Table 2.7.3.1-3, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.b.i An inspection of the as-built ASME Code Section III piping of the ESWS, including supports, will be performed.	2.b.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the ESWS, including supports, identified in Table 2.7.3.1-3 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.b.ii The ASME Code Section III piping of the ESWS, including supports, identified in Table 2.7.3.1-3 is reconciled with the design requirements.	2.b.ii A reconciliation analysis of the piping of the ESWS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.b.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the ESWS, including supports, identified in Table 2.7.3.1-3 is reconciled with the design requirements. The report documents the results of the reconciliation analysis.
3.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.7.3.1-2, meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
3.b Pressure boundary welds in ASME Code Section III piping, identified in Table 2.7.3.1-3, meet ASME Code Section III requirements for non-destructive examination of welds.	3.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
4.a The ASME Code Section III components, identified in Table 2.7.3.1-2, retain their pressure boundary integrity at their design pressure.	4.a A hydrostatic test will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	4.a The results of the hydrostatic test of the as-built components identified in Table 2.7.3.1-2 as ASME Code Section III conform to the requirements of the ASME Code Section III.

Table 2.7.3.1-5 Essential Service Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 5)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4.b The ASME Code Section III piping, identified in Table 2.7.3.1-3, retains its pressure boundary integrity at its design pressure.	4.b A hydrostatic test will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the hydrostatic test of the as-built piping identified in Table2.7.3.1-2 as ASME Code Section III conform to the requirements of the ASME Code Section III.
5.a The seismic Category I equipment identified in Table 2.7.3.1-2 is designed to withstand seismic design basis loads without loss of safety function.	5.a.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.7.3.1-2 is installed in the location identified in Table 2.7.3.1-1.	5.a.i The seismic Category I as-built equipment identified in Table 2.7.3.1-2 is installed in the location identified in Table 2.7.3.1-1.
	5.a.ii Type tests and/or analyses of the seismic Category I equipment will be performed.	5.a.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.a.iii Inspections will be performed on the as-built equipment including anchorage.	5.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.
5.b Each of the seismic Category I piping, including supports, identified in Table 2.7.3.1-3 is designed to withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table 2.7.3.1-3 are supported by a seismic Category I structure(s).	5.b.i Reports(s) document that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.3.1-3 is supported by a seismic Category I structure(s).
	5.b.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, identified in Table 2.7.3.1-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.3.1-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.
6.a The Class 1E equipment identified in Table 2.7.3.1-2 is powered from their respective Class 1E division.	6.a A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	6.a The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.7.3.1-2 under test.

Table 2.7.3.1-5 Essential Service Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 5)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6.b Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	6.b Inspections of the as-built Class 1E divisional cables will be performed.	6.b Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.
7. The ESWS components identified in Table 2.7.3.1-2 provide adequate cooling water to the CCW heat exchangers and the essential chiller units of the ECWS during all plant operating conditions, including normal plant operating, abnormal and accident conditions.	7.i An inspection for the existence of a report that determines the capability of the as-built ESWS will be performed.	7.i A report exists and concludes that the as-built ESWS provides adequate cooling water to the CCW heat exchangers and the essential chiller units of the ECWS during all plant operating conditions, including normal plant operating, abnormal and accident conditions.
	7.ii Tests will be performed to confirm that the as-built ESWS pumps can provide flow to the CCW heat exchangers and the essential chiller units of the ECWS.	7.ii The as-built ESWS pumps identified in Table 2.7.3.1-2 are capable of achieving their design flow rate.
8. Controls exist in the MCR to open and close the remotely operated valves identified in Table 2.7.3.1-2.	8. Tests will be performed on the as-built remotely operated valves listed in Table 2.7.3.1-2 using controls in the as-built MCR.	8. Controls exist in the as-built MCR to open and close the as-built remotely operated valves listed in Table 2.7.3.1-2.
9.a The remotely operated and check valves, identified in Table 2.7.3.1-2, perform an active safety function to change position as indicated in the table.	9.a.i Tests or type tests of the remotely operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	9.a.i Each remotely operated valve changes position as indicated in Table 2.7.3.1-2 under design conditions.
	9.a.ii Tests of the as-built remotely operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	9.a.ii Each as-built remotely operated valve changes position as indicated in Table 2.7.3.1-2 under pre-operational test conditions.

Table 2.7.3.1-5 Essential Service Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 5)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	9.a.iii Tests of the as-built check valves will be performed under preoperational flow, differential pressure, and temperature conditions.	9.a.iii Each as-built check valve changes position as indicated in Table 2.7.3.1-2.
9.b Upon the receipt of an ESWP start signal, the essential service water discharge valve opens automatically. Each pump's discharge valve is interlocked to close when the pump is not running or is tripped. The valve starts to open after the respective pump starts.	9.b A test of each as-built interlock for the essential service water discharge valve will be performed using a simulated test signal.	9.b The ESW discharge valve closes when its respective pump is not running. Upon the receipt of a simulated ESWP start signal, the as-built discharge valve for the respective pump starts to open automatically after the pump starts. The valve closes when the pump is tripped.
9.c After loss of motive power, the remotely operated valves, identified in Table 2.7.3.1-2, assume the indicated loss of motive power position.	9.c Tests of the as-built valves will be performed under the conditions of loss of motive power.	9.c Upon loss of motive power, each as-built remotely operated valve identified in Table 2.7.3.1-2 assumes the indicated loss of motive power position.
10.a Controls exist in the MCR to start and stop the pumps identified in Table 2.7.3.1-4.	10.a Tests will be performed on the as-built pumps listed in Table 2.7.3.1-4 using controls in the as-built MCR.	10.a Controls exist in the as-built MCR to start and stop the as-built pumps listed in Table 2.7.3.1-4.
10.b The pumps identified in Table 2.7.3.1-2 as having PSMS control perform an active safety function after receiving a signal from PSMS.	10.b Tests will be performed on the as-built pumps listed in Table 2.7.3.1-2 using simulated signals.	10.b The as-built pumps identified in Table 2.7.3.1-2 as having PSMS control perform the active safety function identified in the table after receiving a simulated signal.
11. MCR alarms and displays of the parameters identified in Table 2.7.3.1-4 can be retrieved in the MCR.	11. Inspections will be performed for retrievability of the ESWS parameters in the as-built MCR.	11. The MCR alarms and displays identified in Table 2.7.3.1-4 can be retrieved in the as-built MCR.
12. RSC alarms, displays, and controls are identified in Table 2.7.3.1-4.	12. Inspections of the as-built RSC alarms, displays and controls will be performed.	12. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.7.3.1-4.

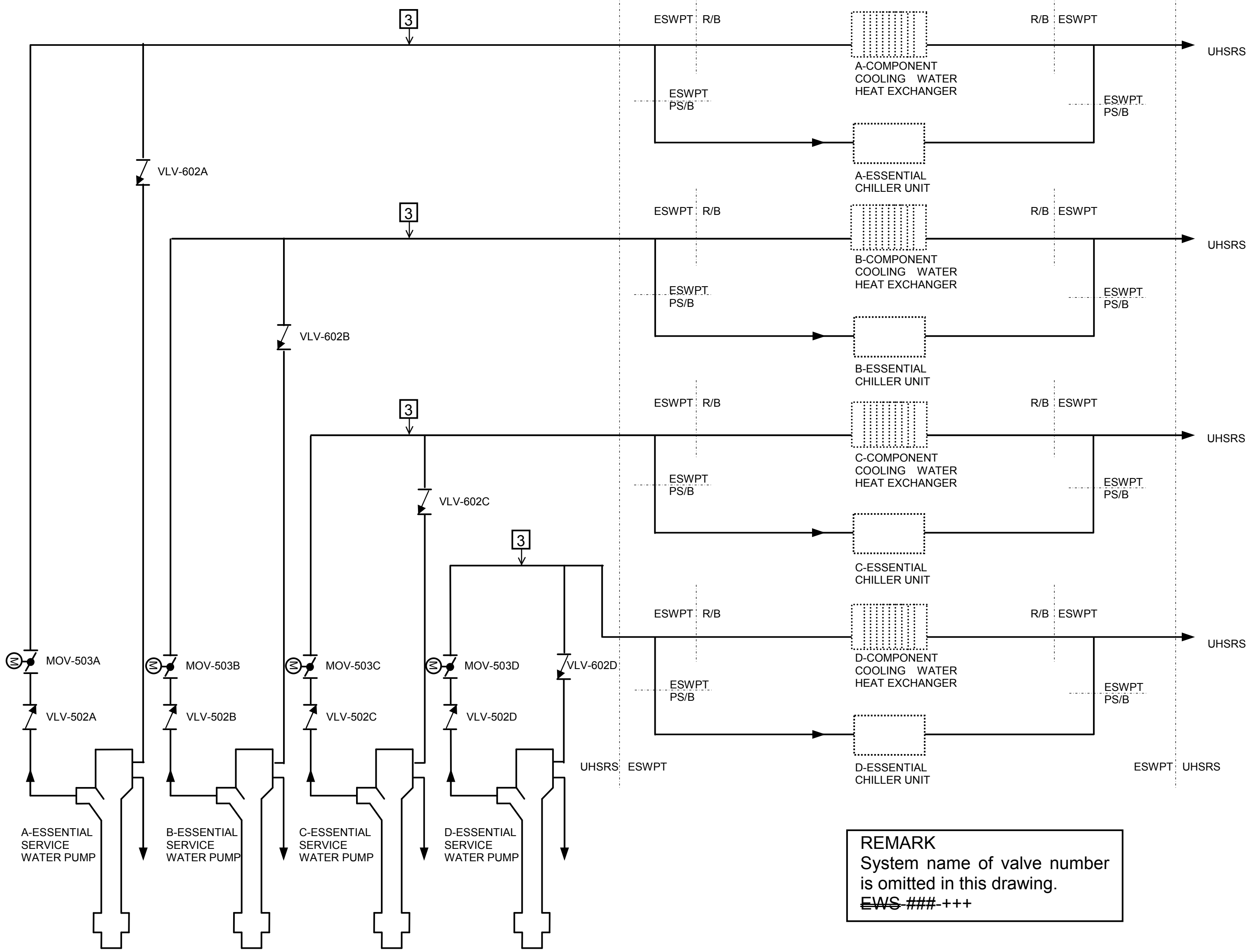


Figure 2.7.3.1-1 Essential Service Water System

2.7.3.2 Non- Essential Service Water System

2.7.3.2.1 Design Description:

System Purpose and Function

The non-essential service water system (Non-ESW system) is a non safety-related system, that provides cooling water to remove heat from the turbine component cooling water system (TCS). The heat is removed via turbine component cooling water heat exchanger and discharged to the heat sink via the circulating water system.

Location and Functional Arrangement

The major components of the Non-ESW system are located in the turbine building.

Key Design Features

The non-ESW system provides cooling water to the TCS heat exchangers and transfers heat rejected by the TCS to the CWS during all modes of normal plant operation.

Seismic and ASME Code Classifications

The non-ESW system is non-seismic category and is not designed to ASME code specifications.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the Non-ESW system.

Interlocks

There are no interlocks needed for direct safety functions related to the Non-ESW system.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.3.2.2 Inspections, Tests, Analysis, and Acceptance Criteria

Table 2.7.3.2-1 describes the ITAAC for the non-ESW system.

Table 2.7.3.2-1 Non-Essential Service Water System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the non-ESW system is as described in the Design Description of Subsection 2.7.3.2.1	1. Inspection of the as-built non-ESW system will be performed.	1. The as-built non-ESW system conforms to the functional arrangement described in the Design Description of this Subsection 2.7.3.2.1

2.7.3.3 Component Cooling Water System

2.7.3.3.1 Design Description

System Purpose and Functions

The component cooling water system (CCWS), safety-related system provides cooling water to the various components including non safety-related components. The CCWS is the intermediate cooling system that transfers heat from the various components to the essential service water system.

The CCWS provides the containment isolation function, as described in Section 2.11.2, of the CCWS lines penetrating the containment.

Location and Functional Arrangement

The functional arrangement of the CCWS is shown in Figure 2.7.3.3-1. Table 2.7.3.3-1 provides the location for the CCWS equipment and piping. Table 2.7.3.3-2 provides information on design characteristics of system equipment.

Key Design Features

Key design features of the CCWS are provided below:

- The CCWS consists of four divisions (Division A, B, C & D). Each division has one component cooling water pump and one component cooling water heat exchanger and provides 50% of the cooling capacity required for safety function. Each division provides cooling water for safety injection pump, CS/RHR pump and other safety-related components shown in Figure 2.7.3.3-1. Header tie lines between division A and B, and division C and D are provided respectively. A common header for division A1 & A2 branches out from the tie line between division A and B. Similarly, A common header for division C1 & C2 branches out from the tie line between division C and D. Division A1 and C1 provides cooling water for charging pump, SFP heat exchanger and other safety-related components shown in Figure 2.7.3.3-1. Division A2 and C2 provides cooling water for instrument air system and other non-safety-related components shown in Figure 2.7.3.3-1.

- The CCWS performs its safety function assuming that one division is out of service for maintenance coincident with the loss of offsite power and any single failure.

- Isolation valves are provided on header tie lines to separate division A and B, and division C and D into the independent division during abnormal and accident conditions.

- Isolation valves are provided on the component cooling water line for the components located in the non-seismic Category I buildings.

- Containment isolation valves are provided on the component cooling water lines penetrating containment.
- Each mechanical division of the component cooling water system is physically separated from the other divisions by a structural barrier, which also serves as a fire barrier. That portion of the system that is Division A2 and C2 is the exception.
- A1 to C1 cross tie valves function to supply cooling water to the RCPs of header A1 (or C1) in the event cooling is lost due to a single failure during on-line maintenance of a CCW pump.

Seismic and ASME Code Classification

The seismic classifications for system components are identified in Table 2.7.3.3-2. The ASME Code Section III requirements for system components are also identified in Table 2.7.3.3-2. Table 2.4.3.3-3 provides this information for system piping.

System Operation

The CCWS provides cooling water required for the various components during all plant operating conditions, including normal plant operating, abnormal and accident conditions. During abnormal and accident conditions, the header tie line isolation valves are automatically closed and the CCWS is separated into four individual divisions.

Alarms, Displays, and Controls

Table 2.7.3.3-4 identifies alarms, displays, and controls associated with the CCWS that are located in the main control room.

Logic

Upon the receipt of ECCS actuation signal, the component cooling water pumps automatically start or continue to operate.

Header tie line isolation valves automatically close upon the receipt of following signals:

- Low- low water level signal of the component cooling water surge tank
- ECCS actuation signal and under voltage signal
- Containment spray actuation signal

The containment isolation valves automatically close upon receipt of an isolation signal.

Isolation valves, provided on the component cooling water supply line for the components located in the turbine building and the auxiliary building, automatically close upon the receipt of isolation signals.

Isolation valves, provided on the component cooling water return line from the RCP thermal barrier heat exchanger, automatically close upon the receipt of an isolation signal.

Interlocks

Standby pump automatically starts upon the receipt of low pressure signal of header pressure.

Containment spray/residual heat removal heat exchanger component cooling water outlet valve automatically opens upon the receipt of ECCS actuation signal and the start signal of the component cooling water pump of respective division.

Class 1E Electrical Power Sources and Divisions

The CCWS equipment identified in Table 2.7.3.3-2 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

The equipment identified in Table 2.7.3.3-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITAAC acceptance criteria in Table 2.7.3.3-5.

2.7.3.3.2 Inspections, Tests, Analysis, and Acceptance Criteria

Table 2.7.3.3-5 describes the ITAAC for the CCWS.

The ITAAC associated with the CCWS equipment, components, and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.7.3.3-1 Component Cooling Water System Location of Equipment and Piping (Sheet 1 of 2)

System and Components	Location
Component cooling water heat exchangers	Reactor Building
Component cooling water pumps	Reactor Building
Component cooling water surge tank	Reactor Building
Component cooling water supply, return lines piping and valves excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033A and 034A	Reactor Building
Component cooling water supply, return lines piping and valves excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033B and 034B	Reactor Building
Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033A and 034A, excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water system piping and valves between and including the valve NCS-AOV-661A and NCS-VLV-671A Component cooling water system piping and valves between and including the valve NCS-AOV-601 and NCS-VLV-653	Reactor Building
Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033B and 034B, excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water system piping and valves between and including the valve NCS-AOV-661B and NCS-VLV-671B	Reactor Building
Component cooling water system piping and valves related to the excess letdown heat exchanger inside containment between and including the valves NCS-MOV-511,517, SRV-513	Containment Reactor Building
Component cooling water system piping and valves related to the letdown heat exchanger inside containment between and including the valves NCS-MOV-531,537, SRV-533	Containment Reactor Building
Component cooling water system piping and valves between and including the containment isolation valves NCS-MOV-402A,436A,438A,445A,447A,448A and NCS-VLV-403A,437A	Containment Reactor Building

Table 2.7.3.3-1 Component Cooling Water System Location of Equipment and Piping (Sheet 2 of 2)

System and Components	Location
Component cooling water piping and valves between and including the containment isolation valves NCS-MOV-402B,436B,438B,445B,447B,448B and NCS-VLV-403B,437B	Containment Reactor Building
Component cooling water system piping and valves related to components installed in A/B from and excluding isolation valve NCS-AOV-602 up to and excluding stop valve NCS-VLV-651	Auxiliary Building Reactor Building
Component cooling water system piping and valves related to components installed in T/B from and excluding isolation valves NCS-AOV-662A,B up to and excluding stop valves NCS-VLV-669A,B	Turbine Building Reactor Building
Component cooling water system piping and valves related to reactor coolant pumps between the containment isolation valves NCS-MOV-436A,447A (excluding) and NCS-VLV-403A,437A (excluding) and the valves NCS-SRV-406A,B,435A (including)	Containment
Component cooling water system piping and valves related to reactor coolant pumps between the containment isolation valves NCS-MOV-436B,447B (excluding) and NCS-VLV-403B,437B (excluding) and the valves NCS-SRV-406C,D,435B (including)	Containment
Component cooling water system piping and valves between and including the valves NCS-AOV-601 and 602	Reactor Building
Component cooling water system piping and valves between and including the valves NCS-VLV-651 and 653	Reactor Building
Component cooling water system piping and valves between and including the valves NCS-AOV-661A,B and 662A,B	Reactor Building
Component cooling water system piping and valves between and including the valves NCS-VLV-669A,B and 671A,B	Reactor Building
Component cooling water surge tank surge line piping	Reactor Building

Table 2.7.3.3-2 Component Cooling Water System Equipment Characteristics (Sheet 1 of 7)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Component cooling water (CCW) heat exchangers	NCS-MHX-001 A, B, C, D	3	Yes	-	-/-	-	-	-
Component cooling water pumps	NCS-MPP-001 A, B, C, D	3	Yes	-	Yes/No	ECCS Actuation	Start	-
						LOOP sequence	Start	
						Low CCW header pressure	Start	
Component cooling water surge tanks	NCS-MTK-001 A, B	3	Yes	-	-/-	-	-	-
Component cooling water pump discharge check valves	NCS-VLV-016 A, B, C, D	3	Yes	-	-/-	-	Transfer Open	-
CCW supply header tie line isolation valves	NCS-MOV-020 A, B, C, D	3	Yes	Yes	Yes/No	ECCS Actuation and undervoltage signal	Transfer Closed	As Is
						Containment Spray	Transfer Closed	
						Low-low CCW surge tank water level	Transfer Closed	
						Remote Manual	Transfer Open/ Transfer Closed	

Table 2.7.3.3-2 Component Cooling Water System Equipment Characteristics (Sheet 2 of 7)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir	PSMS Control	Active Safety Function	Loss of Motive Power Position
CCW return header tie line isolation valves	NCS-MOV-007 A, B, C, D	3	Yes	Yes	Yes/No	ECCS Actuation and undervoltage signal	Transfer Closed	As Is
						Containment Spray	Transfer Closed	
						Low-low CCW surge tank water level	Transfer Closed	
						Remote Manual	Transfer Open/ Transfer Closed	
CS/RHR heat exchanger CCW outlet valves	NCS-MOV-145 A, B, C, D	3	Yes	Yes	Yes/No	ECCS Actuation and CCW pump start	Transfer Open	As Is
						Remote Manual	Transfer Open/ Transfer Closed	
RCP CCW supply line outside containment isolation valves	NCS-MOV-402 A, B	2	Yes	Yes	Yes/No	Containment Isolation Phase B	Transfer Closed	As Is
						Remote Manual	Transfer Open/ Transfer Closed	

Table 2.7.3.3-2 Component Cooling Water System Equipment Characteristics (Sheet 3 of 7)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
RCP CCW supply line inside containment check valves	NCS-VLV-403 A, B	2	Yes	-	-/-	-	Transfer Open/ Transfer Closed	-
Reactor coolant pump thermal barrier heat exchanger component cooling water supply check valves	NCS-VLV-405 A, B, C, D	3	Yes	-	-/-	-	Transfer Open/ Transfer Closed	-
RCP CCW supply line outside containment isolation valve bypass valves	NCS-MOV-445 A, B	2	Yes	Yes	Yes/No	Remote Manual	Transfer Open/ Transfer Closed	As Is
RCP CCW return line inside containment isolation valves	NCS-MOV-436 A, B	2	Yes	Yes	Yes/Yes	Containment Isolation Phase B	Transfer Closed	As Is
						Remote Manual	Transfer Open/ Transfer Closed	
RCP CCW return line inside containment check valves	NCS-VLV-437 A, B	2	Yes	-	-/-	-	Transfer Closed	-
Reactor coolant pump component cooling water return line check valves	NCS-VLV-439 A, B	3	Yes	-	-/-	-	Transfer Open/ Transfer Closed	-
RCP CCW return line inside containment isolation valve bypass valves	NCS-MOV-447 A, B	2	Yes	Yes	Yes/Yes	Remote Manual	Transfer Open/ Transfer Closed	As Is

Table 2.7.3.3-2 Component Cooling Water System Equipment Characteristics (Sheet 4 of 7)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
RCP CCW return line outside containment isolation valves	NCS-MOV-438 A, B	2	Yes	Yes	Yes/No	Containment Isolation Phase B Remote Manual	Transfer Closed Transfer Open/ Transfer Closed	As Is
RCP CCW return line outside containment isolation valve bypass valves	NCS-MOV-448 A, B	2	Yes	Yes	Yes/No	Remote Manual	Transfer Open/ Transfer Closed	As Is
RCP motor CCW supply line isolation valves	NCS-MOV-446 A, B,C,D	3	Yes	Yes	Yes/Yes	Remote Manual	Transfer Closed	As Is
RCP CCW supply line tie line isolation valves	NCS-MOV-232 A, B	3	Yes	Yes	Yes/No	Remote Manual	Transfer Open	As Is
RCP CCW return line tie line isolation valves	NCS-MOV-233 A, B	3	Yes	Yes	Yes/No	Remote Manual	Transfer Open	As Is
RCP CCW return line isolation valve	NCS-MOV-234 A, B	3	Yes	Yes	Yes/No	Remote Manual	Transfer Closed	As Is
RCP CCW supply line isolation valves	NCS-MOV-401 A, B	3	Yes	Yes	Yes/No	Containment Isolation Phase B Remote Manual	Transfer Closed Transfer Open/ Transfer Closed	As Is
Letdown heat exchanger CCW supply line outside containment isolation valve	NCS-MOV-531	2	Yes	Yes	Yes/No	Containment Isolation Phase A	Transfer Closed	As Is
Letdown heat exchanger CCW return line outside containment isolation valve	NCS-MOV-537	2	Yes	Yes	Yes/No	Containment Isolation Phase A	Transfer Closed	As Is

Table 2.7.3.3-2 Component Cooling Water System Equipment Characteristics (Sheet 5 of 7)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Excess letdown heat exchanger CCW supply line outside containment isolation valve	NCS-MOV-511	2	Yes	Yes	Yes/No	Containment Isolation Phase A	Transfer Closed	As Is
Excess letdown heat exchanger CCW return line outside containment isolation valve	NCS-MOV-517	2	Yes	Yes	Yes/No	Containment Isolation Phase A	Transfer Closed	As Is
Auxiliary building CCW supply line first isolation valve	NCS-AOV-601	3	Yes	Yes	Yes/No	ECCS Actuation	Transfer Closed	Closed
						Containment Isolation Phase B	Transfer Closed	
						Low-low CCW surge tank water level	Transfer Closed	
Auxiliary building CCW supply line second isolation valve	NCS-AOV-602	3	Yes	Yes	Yes/No	ECCS Actuation	Transfer Closed	Closed
						Containment Isolation Phase B	Transfer Closed	
						Low-low CCW surge tank water level	Transfer Closed	
Auxiliary building component cooling water return header check valve	NCS-VLV-652	3	Yes	-	-/-	-	Transfer Closed	-
Auxiliary building component cooling water return header check valve	NCS-VLV-653	3	Yes	-	-/-	-	Transfer Closed	-

Table 2.7.3.3-2 Component Cooling Water System Equipment Characteristics (Sheet 6 of 7)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Turbine building CCW supply line first isolation valves	NCS-AOV-661 A, B	3	Yes	Yes	Yes/No	ECCS Actuation and undervoltage	Transfer Closed	Closed
						Containment Isolation Phase B	Transfer Closed	
						Low-low CCW surge tank water level	Transfer Closed	
Turbine building CCW supply line second isolation valves	NCS-AOV-662 A, B	3	Yes	Yes	Yes/No	ECCS Actuation and undervoltage	Transfer Closed	Closed
						Containment Isolation Phase B	Transfer Closed	
						Low-low CCW surge tank water level	Transfer Closed	
Turbine building component cooling water return header check valve	NCS-VLV-670A, B	3	Yes	-	-/-	-	Transfer Closed	-
Turbine building component cooling water return header check valve	NCS-VLV-671A, B	3	Yes	-	-/-	-	Transfer Closed	-

Table 2.7.3.3-2 Component Cooling Water System Equipment Characteristics (Sheet 7 of 7)

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
RCP thermal barrier heat exchanger CCW return line first isolation valves	NCS-FCV-129 A 130 A 131 A 132 A	3	Yes	Yes	Yes / Yes	High RCP thermal barrier CCW flow 1	Transfer Closed	As Is
RCP thermal barrier heat exchanger CCW return line second isolation valves	NCS-FCV-129 B 130 B 131 B 132 B	3	Yes	Yes	Yes / Yes	High RCP thermal barrier CCW flow 2	Transfer Closed	As Is
Component cooling water Header Flow	NCS-FT-034, 035, 037, 038	-	Yes	-	Yes/ No	-	-	-
Component cooling water Surge Tank Water Level	NCS-LT-010, 011, 020, 021	-	Yes	-	Yes/ No	-	-	-
Component cooling water Header Pressure	NCS-PT-030, 031, 032, 033	-	Yes	-	Yes/ No	-	-	-
Component cooling water Supply Temperature	NCS-TE-025, 026, 027, 028,	-	Yes	-	Yes/ No	-	-	-
RCP thermal barrier component cooling water flow 1	NCS-FT-129 A 130 A 131 A 132 A	-	Yes	-	Yes/No	-	-	-
RCP thermal barrier component cooling water flow 2	NCS-FT-129 B 130 B 131 B 132 B	-	Yes	-	Yes/No	-	-	-

NOTE:
Dash (-) indicates not applicable

Table 2.7.3.3-3 Component Cooling Water System Piping Characteristics (Sheet 1 of 2)

Pipe Line Name	ASME Code Section III Class	Seismic Category I
Component cooling water supply, return lines piping and valves excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033A and 034A	3	Yes
Component cooling water supply, return lines piping and valves excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033B and 034B	3	Yes
Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033A and 034A, excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water system piping and valves between and including the valve NCS-AOV-661A and NCS-VLV-671A Component cooling water system piping and valves between and including the valve NCS-AOV-601 and NCS-VLV-653	-	No
Component cooling water supply, return lines piping and valves between and excluding the valves NCS-VLV-033B and 034B, excluding the following; Component cooling water system containment isolation valves and piping between the valves Component cooling water system piping and valves between and including the valve NCS-AOV-661B and NCS-VLV-671B	-	No
Component cooling water system piping and valves related to the excess letdown heat exchanger inside containment between and including the valves NCS-MOV-511,517, SRV-513	2	Yes
Component cooling water system piping and valves related to the letdown heat exchanger inside containment between and including the valves NCS-MOV-531,537, SRV-533	2	Yes
Component cooling water system piping and valves between and including the containment isolation valves NCS-MOV-402A,436A,438A,445A,447A,448A and NCS-VLV-403A,437A	2	Yes

Table 2.7.3.3-3 Component Cooling Water System Piping Characteristics (Sheet 2 of 2)

Pipe Line Name	ASME Code Section III Class	Seismic Category I
Component cooling water piping and valves between and including the containment isolation valves NCS-MOV-402B,436B,438B,445B,447B,448B and NCS-VLV-403B,437B	2	Yes
Component cooling water system piping and valves related to components installed in A/B from and excluding isolation valve NCS-AOV-602 up to and excluding stop valve NCS-VLV-651	-	No
Component cooling water system piping and valves related to components installed in T/B from and excluding isolation valves NCS-AOV-662A,B up to and excluding stop valves NCS-VLV-669A,B	-	No
Component cooling water system piping and valves related to reactor coolant pumps between the containment isolation valves NCS-MOV-436A,447A (excluding) and NCS-VLV-403A,437A (excluding) and the valves NCS-SRV-406A,B,435A (including)	3	Yes
Component cooling water system piping and valves related to reactor coolant pumps between the containment isolation valves NCS-MOV-436B,447B (excluding) and NCS-VLV-403B,437B (excluding) and the valves NCS-SRV-406C,D,435B (including)	3	Yes
Component cooling water system piping and valves between and including the valves NCS-AOV-601 and 602	3	Yes
Component cooling water system piping and valves between and including the valves NCS-VLV-651 and 653	3	Yes
Component cooling water system piping and valves between and including the valves NCS-AOV-661A,B and 662A,B	3	Yes
Component cooling water system piping and valves between and including the valves NCS-VLV-669A,B and 671A,B	3	Yes
Component cooling water surge tank surge line piping	3	Yes

NOTE:
Dash (-) indicates not applicable

Table 2.7.3.3-4 Component Cooling Water System Equipment Alarms, Displays, and Control Functions

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Component cooling water pumps	No	Yes	Yes	Yes
CCW supply header tie line isolation valves	No	Yes	Yes	Yes
CCW return header tie line isolation valves	No	Yes	Yes	Yes
CS/RHR heat exchanger CCW outlet valves	No	Yes	Yes	Yes
RCP CCW supply line outside containment isolation valves	No	Yes	Yes	Yes
RCP CCW supply line outside containment isolation valve bypass valves	No	Yes	Yes	Yes
RCP CCW return line inside containment isolation valves	No	Yes	Yes	Yes
RCP CCW return line inside containment isolation valve bypass valves	No	Yes	Yes	Yes
RCP CCW return line outside containment isolation valves	No	Yes	Yes	Yes
RCP CCW return line outside containment isolation valve bypass valves	No	Yes	Yes	Yes
RCP motor CCW supply line isolation valves	No	Yes	Yes	Yes
RCP CCW supply line tie line isolation valves	No	Yes	Yes	Yes
RCP CCW return line tie line isolation valves	No	Yes	Yes	Yes
RCP CCW return line isolation valve	No	Yes	Yes	Yes
RCP CCW supply line isolation valves	No	Yes	Yes	Yes
Letdown heat exchanger CCW supply line outside containment isolation valve	No	Yes	Yes	Yes
Letdown heat exchanger CCW return line outside containment isolation valve	No	Yes	Yes	Yes
Excess letdown heat exchanger CCW supply line outside containment isolation valve	No	Yes	Yes	Yes
Excess letdown heat exchanger CCW return line outside containment isolation valve	No	Yes	Yes	Yes
Auxiliary building CCW supply line first isolation valve	No	Yes	Yes	Yes
Auxiliary building CCW supply line second isolation valve	No	Yes	Yes	Yes
Turbine building CCW supply line first isolation valves	No	Yes	Yes	Yes
Turbine building CCW supply line second isolation valves	No	Yes	Yes	Yes
RCP thermal barrier heat exchanger CCW return line first isolation valves	No	Yes	Yes	Yes
RCP thermal barrier heat exchanger CCW return line second isolation valves	No	Yes	Yes	Yes
CCW header flow NCS-FT-034,035,037,038	No	Yes	No	Yes
CCW supply temperature NCS-TE-025,026,027,028	Yes	Yes	No	Yes
CCW header pressure NCS-PT-030,031,032,033	Yes	Yes	No	Yes
CCW surge tank water level NCS-LT-010,011,020,021	Yes	Yes	No	Yes
RCP thermal barrier component cooling water flow NCS-FT-129A,B, 130A,B, 131A,B, 132A,B	Yes	Yes	No	Yes

Table 2.7.3.3-5 Component Cooling Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a The functional arrangement of the CCWS is as described in the Design Description of Subsection 2.7.3.3 and as shown in Figure 2.7.3.3-1.	1.a An inspection of the as-built CCWS will be performed.	1.a The as-built CCWS conforms to the functional arrangement as described in the Design Description of Subsection 2.7.3.3 and as shown in Figure 2.7.3.3-1.
1.b Each mechanical division of the CCWS(Division A, B, C, D, A1 & C1) is physically separated from the other divisions with the exception of that portion of the system that is Division A2 & C2.	1.b Inspections of the as-built CCWS will be performed.	1.b Each mechanical division of the as-built CCWS (Division A, B, C, D, A1 & C1) is physically separated from the other divisions of the system by structural barriers with the exception of that portion of the system that is Division A2 & C2.
2.a.i The ASME Code Section III components of the CCWS, identified in Table 2.7.3.3-2, are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.a.i An inspection of the as-built ASME Code Section III components of the CCWS will be performed.	2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the CCWS identified in Table 2.7.3.3-2 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.a.ii The ASME Code Section III components of the CCWS identified in Table 2.7.3.3-2 are reconciled with the design requirements.	2.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the CCWS identified in Table 2.7.3.3-2 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.

Table 2.7.3.3-5 Component Cooling Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.b.i The ASME Code Section III piping of the CCWS, including supports, identified in Table 2.7.3.3-3, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.b.i An inspection of the as-built ASME Code Section III piping of the CCWS, including supports, will be performed.	2.b.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the CCWS, including supports, identified in Table 2.7.3.3-3 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.b.ii The ASME Code Section III piping of the CCWS, including supports, identified in Table 2.7.3.3-3 is reconciled with the design requirements.	2.b.ii A reconciliation analysis of the piping of the CCWS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.b.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the CCWS, including supports, identified in Table 2.7.3.3-3 is reconciled with the design requirements. The report documents the results of the reconciliation analysis.
3.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.7.3.3-2, meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.

Table 2.7.3.3-5 Component Cooling Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3.b Pressure boundary welds in ASME Code Section III piping, identified in Table 2.7.3.3-3, meet ASME Code Section III requirements for non-destructive examination of welds.	3.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
4.a The ASME Code Section III components, identified in Table 2.7.3.3-2, retain their pressure boundary integrity at their design pressure.	4.a A hydrostatic test will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	4.a The results of the hydrostatic test of the as-built components identified in Table 2.7.3.3-2 as ASME Code Section III conform with the requirements of the ASME Code Section III.
4.b The ASME Code Section III piping, identified in Table 2.7.3.3-3, retains its pressure boundary integrity at its design pressure.	4.b A hydrostatic test will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the hydrostatic test of the as-built piping identified in Table 2.7.3.3-3 as ASME Code Section III conform to the requirements of the ASME Code Section III.
5.a The seismic Category I equipment identified in Table 2.7.3.3-2 is designed to withstand seismic design basis loads without loss of safety function.	5.a.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.7.3.3-2 is located in the containment and reactor building.	5.a.i The seismic Category I as-built equipment identified in Table 2.7.3.3-2 is located in the containment and reactor building.
	5.a.ii Type tests and/or analyses of the seismic Category I equipment will be performed.	5.a.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.a.iii Inspections will be performed on the as-built equipment including anchorage.	5.a.iii The as-built equipment including anchorage are seismically bounded by the tested or analyzed conditions.
5.b Each of the seismic Category I piping, including supports, identified in Table 2.7.3.3-3 is designed to withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table 2.7.3.3-3 are supported by a seismic Category I structure(s).	5.b.i Reports(s) document that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.3.3-3 is supported by a seismic Category I structure(s).

Table 2.7.3.3-5 Component Cooling Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	5.b.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, identified in Table 2.7.3.3-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.3.3-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.
6.a The applicable Class 1E equipment identified in Table 2.7.3.3-2 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.a.i Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	6.a.i The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.7.3.3-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	6.a.ii An inspection will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.7.3.3-2, as being qualified for a harsh environment are bounded by type tests and/or analyses.
6.b The Class 1E equipment identified in Table 2.7.3.3-2 is powered from their respective Class 1E division.	6.b A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.7.3.3-2 under test.
6.c Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	6.c Inspections of the as-built Class 1E divisional cables will be performed.	6.c Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.

Table 2.7.3.3-5 Component Cooling Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. The CCWS components identified in Table 2.7.3.3-2 remove heat from various components during all plant operating conditions, including normal plant operating, abnormal and accident conditions.	7.i An inspection for the existence of a report that determines the heat removal capability of the as-built heat exchangers will be performed.	7.i A report exists and concludes that the product of the overall heat transfer coefficient and the heat exchange area of the as-built CCWS heat exchanger identified in Table 2.7.3.3-2 is greater than or equal to the design values for all plant operating conditions, including normal plant operating, abnormal and accident conditions.
	7.ii Tests will be performed to confirm that the as-built CCWS pumps can provide flow to the CCW heat exchangers.	7.ii The as-built CCWS pumps identified in Table 2.7.3.3-2 are capable of achieving their design flow rate.
8.a Controls exist in the MCR to open and close the remotely operated valves identified in Table 2.7.3.3-2.	8.a Tests will be performed on the as-built remotely operated valves listed in Table 2.7.3.3-2 using controls in the as-built MCR.	8.a Controls exist in the as-built MCR to open and close the as-built remotely operated valves listed in Table 2.7.3.3-2.
8.b The valves identified in Table 2.7.3.3-2 as having PSMS control perform an active safety function after receiving a signal from PSMS.	8.b Test will be performed on the as-built remotely operated valves listed in Table 2.7.3.3-2 using simulated signals.	8.b The as-built remotely operated valves identified in Table 2.7.3.3-2 as having PSMS control perform the active safety function identified in the table after receiving a simulated signal.
9.a The remotely operated and check valves, identified in Table 2.7.3.3-2, perform an active safety function to change position as indicated in the table.	9.a.i Tests or type tests of the remotely operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	9.a.i Each remotely operated valve changes position as indicated in Table 2.7.3.3-2 under design conditions.
	9.a.ii Tests of the as-built remotely operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	9.a.ii Each as-built remotely operated valve changes position as indicated in Table 2.7.3.3-2 under pre-operational test conditions.
	9.a.iii Tests of the as-built check valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	9.a.iii Each as-built check valve changes position as indicated in Table 2.7.3.3-2 under pre-operational test conditions.

Table 2.7.3.3-5 Component Cooling Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9.b After loss of motive power, the remotely operated valves, identified in Table 2.7.3.3-2, assume the indicated loss of motive power position.	9.b Tests of the as-built valves will be performed under the conditions of loss of motive power.	9.b Upon loss of motive power, each as-built remotely operated valve identified in Table 2.7.3.3-2 assumes the indicated loss of motive power position.
10.a Controls exist in the MCR to start and stop the pumps identified in Table 2.7.3.3-4.	10.a Tests will be performed on the as-built pumps listed in Table 2.7.3.3-4 using controls in the as-built MCR.	10.a Controls exist in the as-built MCR to start and stop the as-built pumps listed in Table 2.7.3.3-4.
10.b The pumps identified in Table 2.7.3.3-2 as having PSMS control perform an active safety function after receiving a signal from PSMS.	10.b Test will be performed on the as-built pumps listed in Table 2.7.3.3-2 using simulated signals.	10.b The as-built pumps identified in Table 2.7.3.3-2 as having PSMS control perform the active safety function identified in the table after receiving a simulated signal.
11. MCR alarms and displays of the parameters identified in Table 2.7.3.3-4 can be retrieved in the MCR.	11. Inspections will be performed for retrievability of the CCWS parameters in the as-built MCR.	11. The MCR alarms and displays identified in Table 2.7.3.3-4 can be retrieved in the as-built MCR.
12. RSC alarms, displays and controls are identified in Table 2.7.3.3-4.	12. Inspections of the as-built RSC alarms, displays and controls will be performed.	12. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.7.3.3-4.
13. The CCW pumps have sufficient net positive suction head (NPSH).	13. Tests to measure the as-built CCW pump suction pressure will be performed. Inspections and analyses to determine NPSH available to each pump will be performed.	13. The as-built system meets the design, and the analysis confirms that the NPSH available exceeds the required NPSH.

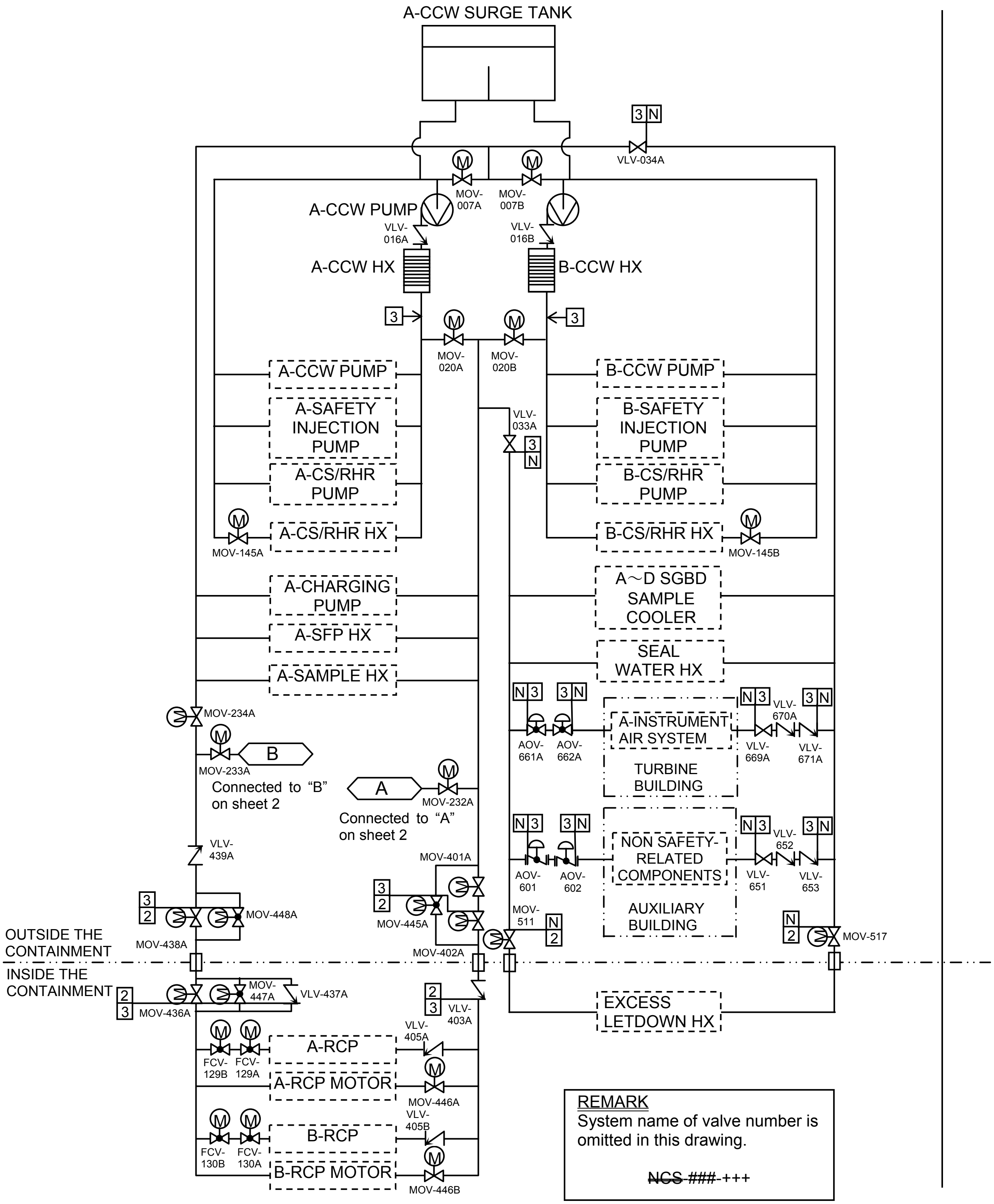


Figure 2.7.3.3-1 Component Cooling Water System (Sheet 1 of 2)

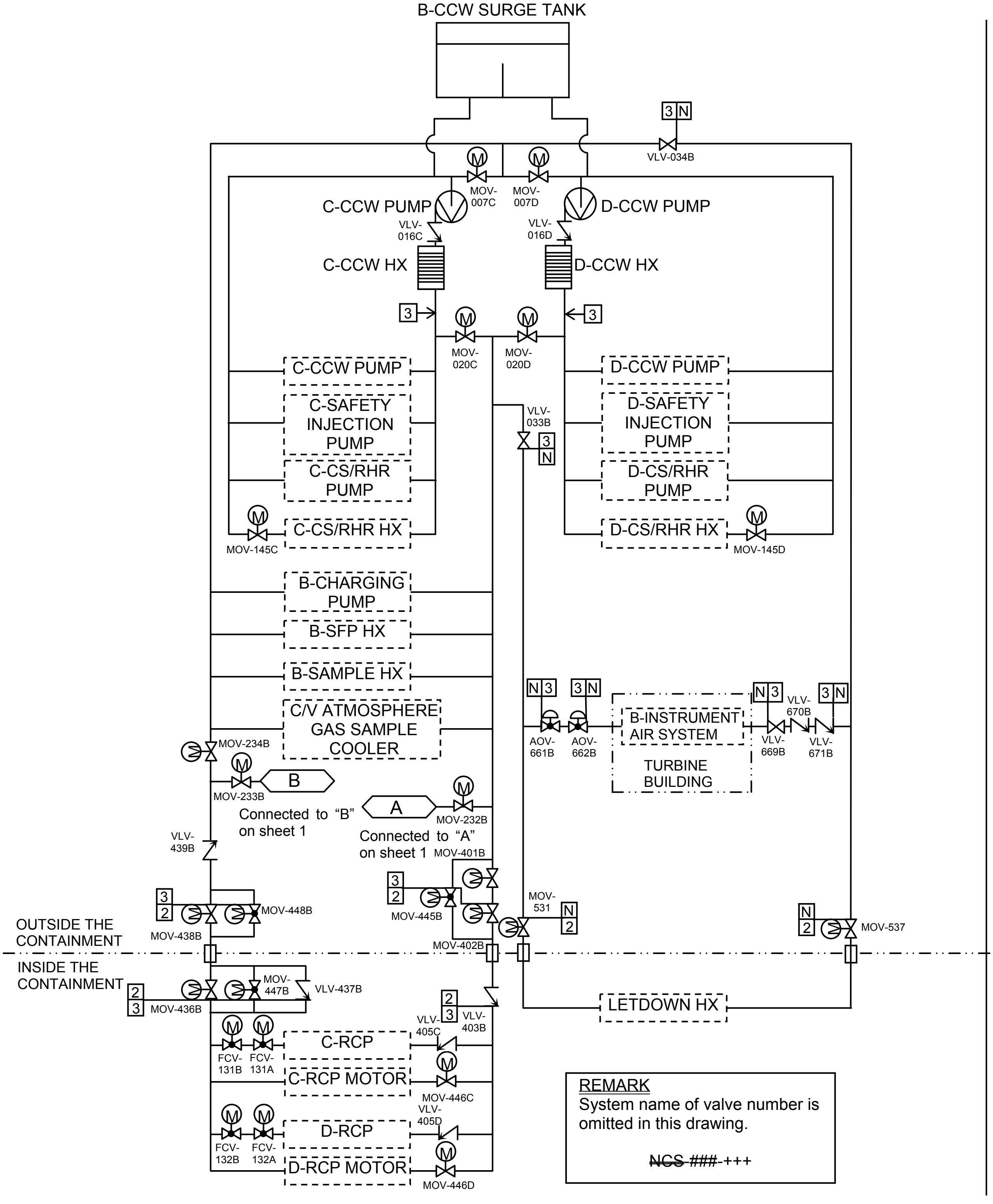


Figure 2.7.3.3-1 Component Cooling Water System (Sheet 2 of 2)

2.7.3.4 Turbine Component Cooling Water System

2.7.3.4.1 Design Description

System Purpose and Functions

The turbine component cooling water system (TCS) is a non safety-related system. The TCS provides chemically treated, demineralized cooling water for the removal of heat from non safety-related heat exchangers in the turbine building and rejects the heat to the non-ESW system.

Location and Functional Arrangement

The major components of the TCS are located in turbine building.

Key Design Features

The TCS provides corrosion-inhibited, demineralized cooling water to the turbine building equipment during normal plant operation.

The heat sink for the TCS is the non-ESW system. The heat is transferred to the non-ESW system through heat exchangers.

Seismic and ASME Code Classifications

The TCS is non-seismic category and is not designed to ASME code specifications.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the TCS.

Interlocks

There are no interlocks needed for direct safety functions related to the TCS.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.3.4.2 Inspections, Tests, Analysis, and Acceptance Criteria

Table 2.7.3.4-1 describes the ITAAC for the TCS.

Table 2.7.3.4-1 Turbine Component Cooling Water System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the TCS is as described in the Design Description of Subsection 2.7.3.4.1.	1. Inspection of the as-built TCS will be performed.	1. The as-built TCS conforms to the functional arrangement described in the Design Description of this Subsection 2.7.3.4.1.

2.7.3.5 Essential Chilled Water System (ECWS)

2.7.3.5.1 Design Description

System Purpose and Functions

The ECWS is designed to provide chilled water for the safety-related HVAC systems during all plant operation.

These HVAC systems include:

- Main Control Room HVAC system
- Class 1E electrical room HVAC system
- Safeguard component area HVAC system
- Emergency feedwater pump area HVAC system
- Safety related component area HVAC system

The ECWS consists of four independent trains, each train sized for 50% cooling capacity. Each train includes one chiller unit, one chilled water pump and one compression tank. The ECWS is a safety-related system.

Location and Functional Arrangement

The functional arrangement of ECWS equipment is shown in Figure 2.7.3.5-1. Table 2.7.3.5-1 also provides a tabulation of the location of all major components. All major components are located in the PS/B, while the piping and valves are located in the R/B and the PS/B.

Key Design Features

The ECWS system provides chilled water to the plant safety-related HVAC systems during all plant conditions, including normal plant operations, abnormal and accident conditions.

Each division of the essential chilled water system is physically separated from the other divisions.

Seismic and ASME Code Classifications

The seismic classifications for system components are identified in Table 2.7.3.5-2. The ASME Code Section III requirements for system components are also identified in Table 2.7.3.5-2. Table 2.7.3.5-3 provides this information for system piping.

System Operation

The ECWS provides chilled water required for the safety-related HVAC systems during all plant conditions, including normal plant operations, abnormal and accident conditions.

Alarms, Displays, and Controls

Table 2.7.3.5-4 identified alarms, displays, and controls associated with the ECWS that are located in the MCR.

Logic

Upon receipt of the ECCS actuation signal, the ECWS automatically starts or, if in operation, continue to operate. The ECWS automatically starts in case of loss of off-site power.

Interlocks

The starting of the essential chilled water pumps and the detection of the ESWS flows are a prerequisite for the chiller unit startup.

Class 1E Electrical Power Sources and Divisions

The ECWS equipment identified in Table 2.7.3.5-2 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

The equipment identified in Table 2.7.3.5-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITTAC acceptance criteria in Table 2.7.3.5-5.

2.7.3.5.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.3.5-5 describes the ITAAC for the ECWS.

Table 2.7.3.5-1 Essential Chilled Water System Location of Equipment and Piping

System and Components	Location
Essential Chiller Unit	Power Source Building
Essential Chilled Water Pump	Power Source Building
Essential Chilled Water Compression Tank	Power Source Building
Essential chilled water distribution loop	Reactor Building Power Source Building
Essential chilled water piping from compression tank to and including the valve (VWS-VLV-252A,B,C,D, VWS-VLV-258A,B,C,D, VWS-SRV-253A,B,C,D, and VWS-VLV-254A,B,C,D,)	Power Source Building
Essential chilled water compression tank surge line piping	Power Source Building
Essential chilled water piping from distribution loop to and including the valve (VWS-VLV-271A,B,C,D and VWS-VLV-274A,B,C,D)	Power Source Building

Table 2.7.3.5-2 Essential Chilled Water System Equipment Characteristics (Sheet 1 of 3)

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active safety Function	Loss of Motive Power Position
Essential Chiller Units	VWS-MEQ-001 A, B, C, D	3	Yes	-	Yes/No	ECCS Actuation	Start	-
Essential Chilled Water Pumps	VWS-MPP-001 A, B, C, D	3	Yes	-	Yes/No	ECCS Actuation	Start	-
Essential Chilled Water Compression Tanks	VWS-MTK-001 A, B, C, D	3	Yes	-	-/-	-	None	-
Main Control Room Air Handling Unit Chilled Water Control Valves	VWS-TMV-141, 151, 161, 171	3	Yes	Yes	Yes/No	High Temperature	Transfer Open	As Is
Class 1E Electrical Room Air Handling Unit Chilled Water Control Valves	VWS-TMV-206, 226, 246, 266	3	Yes	Yes	Yes/No	High Temperature	Transfer Open	As Is
Safeguard Component Area Air Handling Unit Chilled Water Control Valves	VWS-TMV-304, 314, 324, 334	3	Yes	Yes	Yes/No	High Temperature	Transfer Open	As Is
Emergency Feedwater Pump Area Air Handling Unit Chilled Water Control Valves	VWS-TMV-402, 412, 422, 432	3	Yes	Yes	Yes/No	High Temperature	Transfer Open	As Is
Component Cooling Water Pump Area Air Handling Unit Chilled Water Control Valves	VWS-TMV-502, 512, 522, 532	3	Yes	Yes	Yes/No	High Temperature	Transfer Open	As Is

Table 2.7.3.5-2 Essential Chilled Water System Equipment Characteristics (Sheet 2 of 3)

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active safety Function	Loss of Motive Power Position
Essential Chiller Unit Area Air Handling Unit Chilled Water Control Valves	VWS-TMV-542, 552, 562, 572	3	Yes	Yes	Yes/No	High Temperature	Transfer Open	As Is
Charging Pump Area Air Handling Unit Chilled Water Control Valves	VWS-TMV-582, 592	3	Yes	Yes	Yes/No	High Temperature	Transfer Open	As Is
Annulus Emergency Exhaust Filtration Unit Area Air Handling Unit Chilled Water Control Valves	VWS-TMV-602A, 602B, 612A, 612B	3	Yes	Yes	Yes/No	High Temperature	Transfer Open	As Is
Penetration Area Air Handling Unit Chilled Water Control Valves	VWS-TMV-622, 632, 642, 652	3	Yes	Yes	Yes/No	High Temperature	Transfer Open	As Is
Spent Fuel Pit Pump Area Air Handling Unit Chilled Water Control Valves	VWS-TMV-662A, 662B, 672A, 672B	3	Yes	Yes	Yes/No	High Temperature	Transfer Open	As is
Essential chilled water pump discharge check valves	VWS-VLV-005 A, B, C, D	3	Yes	-	-/-	-	Transfer Open	-
Compression tank relief valves	VWS-SRV-253 A, B, C, D	3	Yes	-	-/-	-	Transfer Open	-

Table 2.7.3.5-2 Essential Chilled Water System Equipment Characteristics (Sheet 3 of 3)

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active safety Function	Loss of Motive Power Position
Nitrogen supply check valves	VWS-VLV-252 A, B, C, D	3	Yes	-	-/-	-	Transfer Close	-
Makeup water supply check valves	VWS-VLV-258 A, B, C, D	3	Yes	-	-/-	-	Transfer Close	-

NOTE:

Dash (-) indicates not applicable

Table 2.7.3.5-3 Essential Chilled Water System Piping Characteristics

Pipe Line Name	ASME Code Section III Class	Seismic Category I
Chilled Water Distribution Loop A	3	Yes
Chilled Water Distribution Loop B	3	Yes
Chilled Water Distribution Loop C	3	Yes
Chilled Water Distribution Loop D	3	Yes

Table 2.7.3.5-4 Essential Chilled Water System Equipment Displays and Control Functions (Sheet 1 of 2)

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Essential Chiller Units (VWS-MEQ-001 A, B, C, D)	Yes	Yes	Yes	Yes
Essential Chilled Water Pumps (VWS-MPP-001 A, B, C, D)	Yes	Yes	Yes	Yes
Essential Chilled Water Compression Tanks (VWS-MTK 001 A, B, C, D)	No	Yes	No	Yes
Main Control Room Air Handling Unit Chilled Water Control Valves (VWS-TMV-141, 151, 161, 171)	No	Yes	No	Yes
Class 1E Electrical Room Air Handling Unit Chilled Water Control Valves (VWS-TMV-206, 226, 246, 266)	No	Yes	No	Yes
Safeguard Component Area Air Handling Unit Chilled Water Control Valves (VWS-TMV-304, 314, 324, 334)	No	Yes	No	Yes
Emergency Feedwater Pump Area Air Handling Unit Chilled Water Control Valves (VWS-TMV-402, 412, 422, 432)	No	Yes	No	Yes
Component Cooling Water Pump Area Air Handling Unit Chilled Water Control Valves (VWS-TMV-502, 512, 522, 532)	No	Yes	No	Yes
Essential Chiller Unit Area Air Handling Unit Chilled Water Control Valves (VWS-TMV-542, 552, 562, 572)	No	Yes	No	Yes
Charging Pump Area Air Handling Unit Chilled Water Control Valves (VWS-TMV-582, 592)	No	Yes	No	Yes
Annulus Emergency Exhaust Filtration Unit Area Air Handling Unit Chilled Water Control Valves (VWS-TMV-602A, 602B, 612A, 612B)	No	Yes	No	Yes

Table 2.7.3.5-4 Essential Chilled Water System Equipment Displays and Control Functions (Sheet 2 of 2)

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Penetration Area Air Handling Unit Chilled Water Control Valves (VWS-TMV-622, 632, 642, 652)	No	Yes	No	Yes
Spent Fuel Pit Pump Area Air Handling Unit Area Air Handling Unit Chilled Water Control Valves (VWS-TMV-662A, 662B, 672A, 672B)	No	Yes	No	Yes

Table 2.7.3.5-5 Essential Chilled Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a The functional arrangement of the ECWS is as described in the Design Description of this Subsection 2.7.3.5 and as shown in Figure 2.7.3.5-1.	1.a An inspection of the as-built system will be performed.	1.a The as-built ECWS conforms with the functional arrangement as described in the Design Description of this Subsection 2.7.3.5 and as shown in Figure 2.7.3.5-1.
1.b Each mechanical division of the ECWS except for piping (Divisions A, B, C & D) is physically separated from the other divisions with exception of the components in the annulus emergency filtration unit area, charging pump air handling unit area and the spent fuel pit pump air handling unit area.	1.b Inspections of the as-built ECWS will be performed.	1.b Each mechanical division of the as-built ECWS except for piping is physically separated from other mechanical divisions of the system by structural and/or fire barriers with exception of the components in the annulus emergency filtration unit area, charging pump air handling unit area and the spent fuel pit pump air handling unit area.
2.a.i The ASME Code Section III components of the ECWS, identified in Table 2.7.3.5-2, are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.a.i An inspection of the as-built ASME Code Section III components of the ECWS will be performed.	2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the ECWS identified in Table 2.7.3.5-2 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.a.ii The ASME Code Section III components of the ECWS identified in Table 2.7.3.5-2 are reconciled with the design requirements.	2.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the ECWS identified in Table 2.7.3.5-2 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.

Table 2.7.3.5-5 Essential Chilled Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.b.i The ASME Code Section III piping of the ECWS, including supports, identified in Table 2.7.3.5-3, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.b.i An inspection of the as-built ASME Code Section III piping of the ECWS, including supports, will be performed.	2.b.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the ECWS, including supports, identified in Table 2.7.3.5-3 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.b.ii The ASME Code Section III piping of the ECWS, including supports, identified in Table 2.7.3.5-3 is reconciled with the design requirements.	2.b.ii A reconciliation analysis of the piping of the ECWS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.b.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the ECWS, including supports, identified in Table 2.7.3.5-3 is reconciled with the design requirements.
3.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.7.3.5-2, meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
3.b Pressure boundary welds in ASME Code Section III piping, identified in Table 2.7.3.5-3, meet ASME Code Section III requirements for non-destructive examination of welds.	3.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.

Table 2.7.3.5-5 Essential Chilled Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4.a The ASME Code Section III components, identified in Table 2.7.3.5-2, retain their pressure boundary integrity at their design pressure.	4.a A hydrostatic test will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	4.a The results of the hydrostatic test of the as-built components identified in Table 2.7.3.5-2, as ASME Code Section III conform with the requirements of the ASME Code Section III.
4.b The ASME Code Section III piping, identified in Table 2.7.3.5-3, retains its pressure boundary integrity at its design pressure.	4.b A hydrostatic test will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the hydrostatic test of the as-built piping identified in Table 2.7.3.5-3, as ASME Code Section III conform with the requirements of the ASME Code Section III.
5.a The seismic Category I equipment, identified in Table 2.7.3.5-2, is designed to withstand seismic design basis loads without loss of safety function.	5.a.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.7.3.5-2 is located in the reactor building and power source building.	5.a.i The seismic Category I as-built equipment identified in Table 2.7.3.5-2 is located in the reactor building and power source building.
	5.a.ii Type tests and/or analyses of the seismic Category I equipment will be performed.	5.a.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.a.iii Inspection will be performed on the as-built equipment including anchorage.	5.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.
5.b Each of the seismic Category I piping, including supports, identified in Table 2.7.3.5-3 is designed to withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table 2.7.3.5-3 are supported by a seismic Category I structure(s).	5.b.i Reports(s) document that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.3.5-3 is supported by a seismic Category I structure(s).

Table 2.7.3.5-5 Essential Chilled Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	5.b.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, identified in Table 2.7.3.5-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.3.5-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.
6.a The Class 1E equipment, identified in Table 2.7.3.5-2, is powered from their respective Class 1E division.	6.a A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	6.a The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.7.3.5-2 under test.
6.b Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	6.b Inspections of the as-built Class 1E divisional cables will be performed.	6.b Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.
7. The ECWS components identified in Table 2.7.3.5-2 remove heat from various cooling coils during all plant operating conditions, including normal plant operating, abnormal and accident conditions.	7.i An inspection for the existence of a report that determines the heat removal capability of the as-built ECWS will be performed.	7.i A report exists and concludes that the heat removal capability of the as-built ECWS is greater than or equal to the design values for all plant operating conditions, including normal plant operating, abnormal and accident conditions.
	7.ii Tests will be performed to confirm that the as-built ECWS pumps identified in Table 2.7.3.5-2 provide flow to the ECWS cooling unit.	7.ii The as-built ECWS pumps identified in Table 2.7.3.5-2 are capable of achieving their design flow rate.
8. The remotely operated valves identified in Table 2.7.3.5-2 as having PSMS control perform an active safety function after receiving a signal from PSMS.	8. Test will be performed on the as-built remotely operated valves listed in Table 2.7.3.5-2 using simulated signals.	8. The as-built remotely operated valves identified in Table 2.7.3.5-2 as having PSMS control perform the active function identified in the table after receiving a simulated signal.

Table 2.7.3.5-5 Essential Chilled Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9.a The remotely operated valves and check valves, identified in Table 2.7.3.5-2, perform an active safety function to change position as indicated in the table.	9.a.i Tests or type tests of the remotely operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	9.a.i Each remotely operated valve changes position as indicated in Table 2.7.3.5-2 under design conditions.
	9.a.ii Tests of the as-built remotely operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	9.a.ii Each as-built remotely operated valve changes position as indicated in Table 2.7.3.5-2 under pre-operational test conditions.
	9.a.iii Tests of the as-built check valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	9.a.iii Each as-built check valve changes position as indicated in Table 2.7.3.5-2.
9.b After loss of motive power, the remotely operated valves, identified in Table 2.7.3.5-2, assume the indicated loss of motive power position.	9.b Tests of the as-built remotely operated valves will be performed under the conditions of loss of motive power.	9.b Upon loss of motive power, each as-built remotely operated valve identified in Table 2.7.3.5-2 assumes the indicated loss of motive power position.
10.a Controls exist in the MCR to start and stop the ECWS pumps and chiller units identified in Table 2.7.3.5-4.	10.a Tests will be performed on the as-built ECWS pumps and chiller units identified in Table 2.7.3.5-4 using controls in the as-built MCR.	10.a Controls exist in the as-built MCR to start and stop the as-built ECWS pumps and chiller units identified in Table 2.7.3.5-4.
10.b The ECWS pumps and chiller units identified in Table 2.7.3.5-2 as having PSMS control perform an active safety function after receiving a signal from PSMS.	10.b Tests will be performed on the as-built pumps and chiller units listed in Table 2.7.3.5-2 using simulated signals.	10.b The as-built pumps and chiller units identified in Table 2.7.3.5-2 as having PSMS control performs the active safety function identified in the table after receiving a simulated signal.

Table 2.7.3.5-5 Essential Chilled Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
11. MCR alarms and displays of the parameters identified in Table 2.7.3.5-4 can be retrieved in the MCR.	11. Inspections will be performed for retrievability of the ECWS parameters in the as-built MCR.	11. The MCR alarms and displays identified in Table 2.7.3.5-4 can be retrieved in the as-built MCR.
12. RSC alarms displays and controls are identified in Table 2.7.3.5-4.	12. Inspections of the as-built RSC alarms, displays and controls will be performed	12. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.7.3.5-4.
13. The ECWS pumps have sufficient net positive suction head (NPSH).	13. Tests to measure the as-built ECWS pump suction pressure will be performed. Inspections and analysis to determine NPSH available to each pump will be performed.	13. The as-built system meets the design, and the analysis confirms that the NPSH available exceeds the required NPSH.

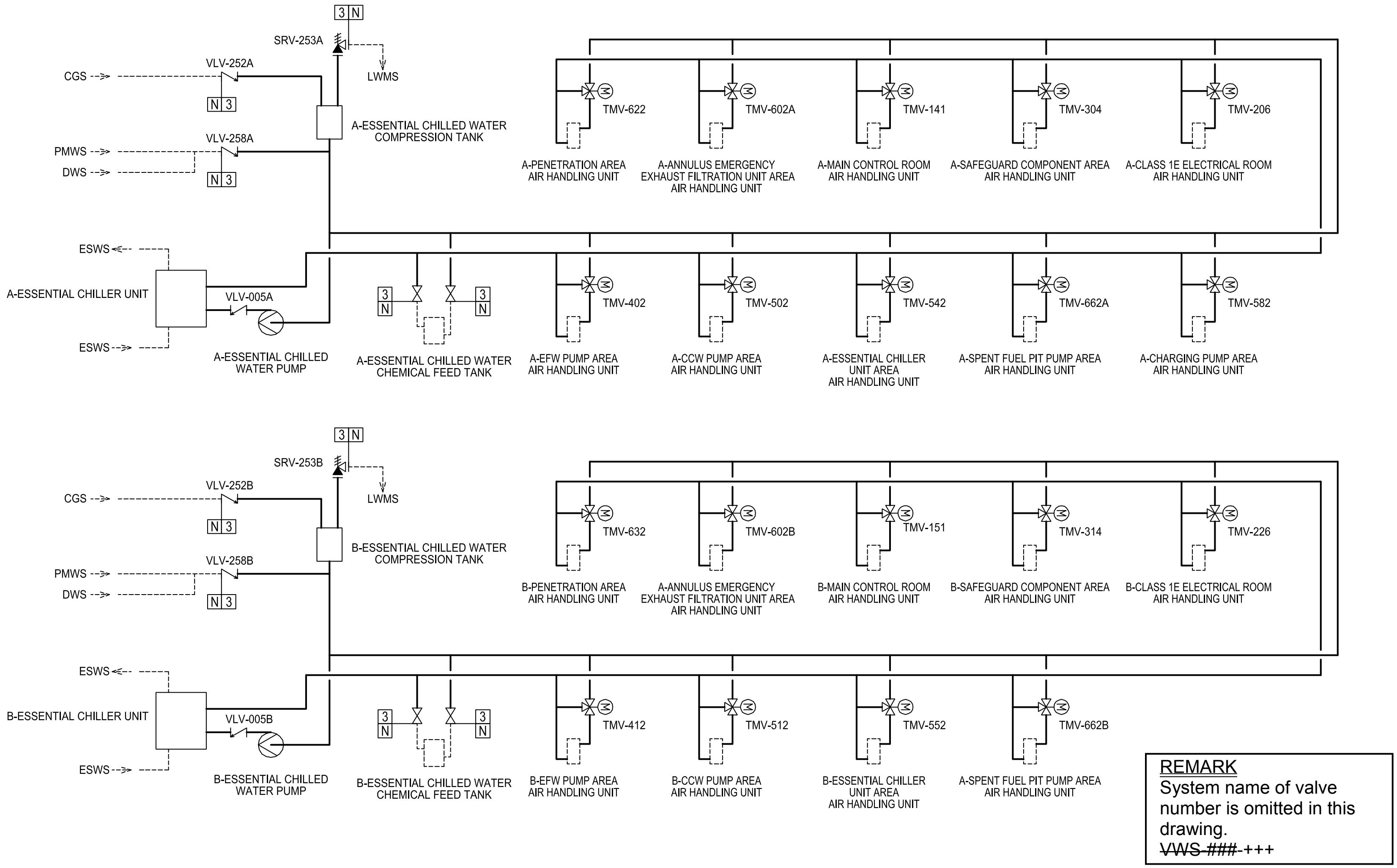
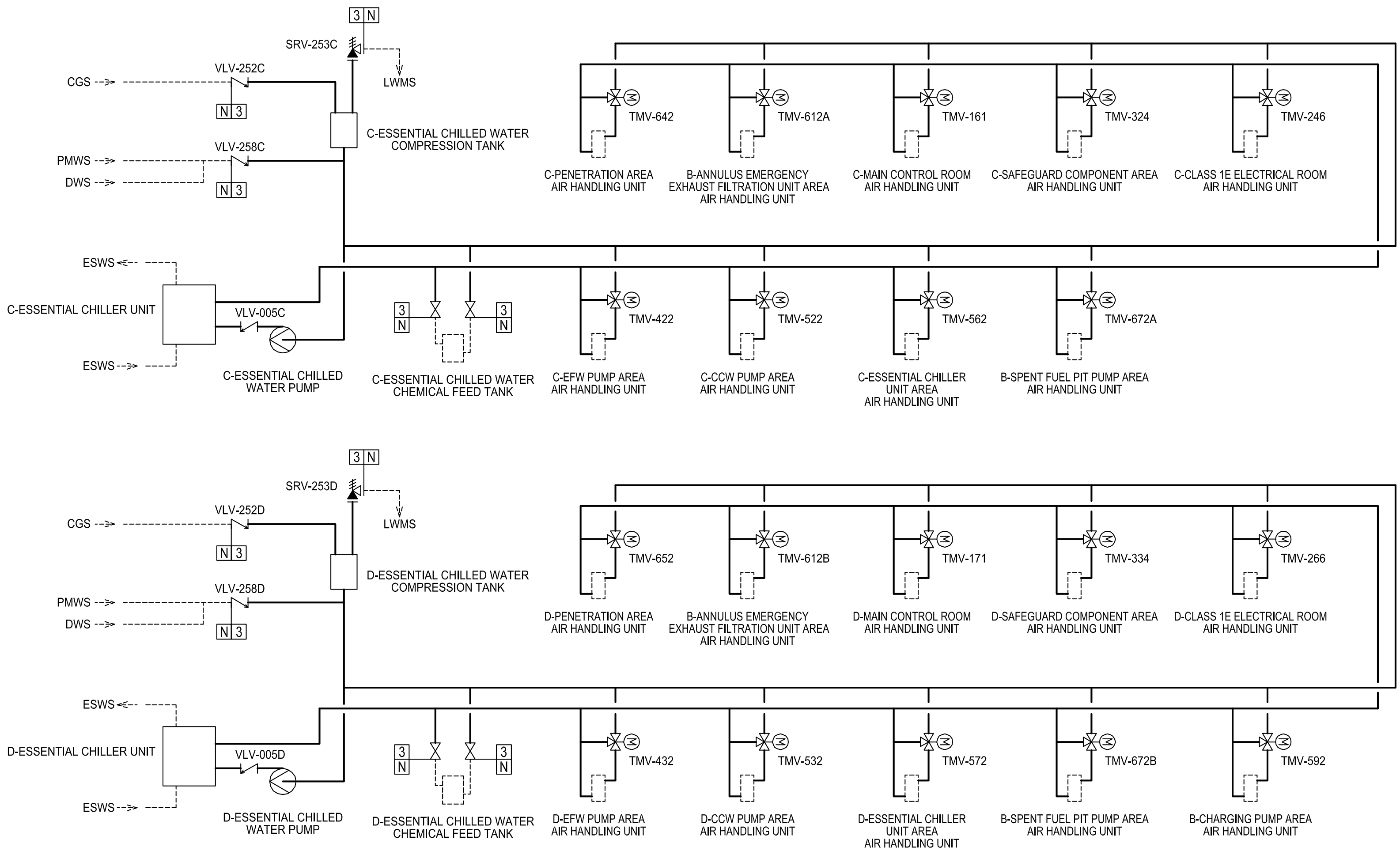


Figure 2.7.3.5-1 Essential Chilled Water System (Sheet 1 of 2)



REMARK
System name of valve number is omitted in this drawing.
~~VWS-###~~-+++

Figure 2.7.3.5-1 Essential Chilled Water System (Sheet 2 of 2)

2.7.3.6 Non-Essential Chilled Water System (non-ECWS)

2.7.3.6.1 Design Description

System Purpose and Functions

The non-ECWS provides chilled water for the non safety-related HVAC systems during plant normal operation and loss of offsite power (LOOP). With the exception of the piping and valves between and including the containment isolation valves that are safety-related ASME Class 2 seismic Category I, the non-ECWS is non safety-related system. The non-ECWS provides the containment isolation function, as described in Section 2.11.2, of the non-ECWS lines penetrating the containment.

Location and Functional Arrangement

The functional arrangement of Non-ECWS component is shown in Figure 2.7.3.6-1. Table 2.7.3.6-1 also provides a tabulation of the location of the safety components. The major components of the non-ECWS are located in the auxiliary building. The non-ECWS consists of factory packaged chiller units, chilled water pumps, condenser water pumps and a compression tank.

Key Design Features

The design requirements consist of the following:

- Provide containment isolation of the chilled water lines penetrating containment.
- Provide chilled water to the non-safety related HVAC systems during normal plant operations and loss of offsite power.
- Provides alternate component cooling water to charging pumps in order to maintain RCP seal water injection.

Seismic and ASME Code Classifications

The containment penetration piping and the related isolation valves meet seismic category I requirements. The piping and valves between and including the containment isolation valves comply with requirements of the ASME Code Section III Class 2.

System Operation

The important aspects of system operation are specified under “logic”.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

The containment isolation valves in the non-ECWS operate properly upon receipt of a containment isolation signal, as described in Subsection 2.11.2.

Interlocks

There are no interlocks needed for direct safety functions related to the non-ECWS.

Class 1E Electrical Power Sources and Divisions

There are no Class 1E power sources for the non-ECWS except the containment isolation valves.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.3.6.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.3.6-3 describes the ITAAC for the non-ECWS.

The ITAAC associated with the non-ECWS equipment, components, and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.7.3.6-1 Non-Essential Chilled Water System Location of Equipment and Piping

System and Components	Location
Non-Essential chilled water system piping and valves between and including the containment isolation valves, VWS-MOV-403,-407, -422 and VWS-VLV-421, -423.	Containment Reactor Building
CCW supply line isolation valves, VWS-MOV-424, -425	Reactor Building

Table 2.7.3.6-2 Non-Essential Chilled Water System Piping Characteristics

Pipe Line Name	ASME Code Section III Class	Seismic Category I
Non-Essential chilled water system piping and valves between and including the containment isolation valves, VWS-MOV-403,-407, -422 and VWS-VLV-421, -423.	2	Yes
Others	-	No

NOTE:
Dash (-) indicates not applicable

Table 2.7.3.6-3 Non-Essential Chilled Water System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the non-ECWS is as described in the Design Description of this Subsection 2.7.3.6.1 and as shown in Figure 2.7.3.6-1.	1. An inspection of the as-built system will be performed.	1. The as-built non-ECWS conforms with the functional arrangement described in the Design Description of this Subsection 2.7.3.6.1 and as shown in Figure 2.7.3.6-1.
2. Deleted.	2. Deleted.	2. Deleted.
3. Non-essential chilled water system provides alternate component cooling water to charging pumps in order to maintain RCP seal water injection.	3. Tests will be performed to verify the as-built non-essential chilled water system provides alternate component cooling water to charging pumps in order to maintain RCP seal water injection.	3. The as-built non-essential chilled water system provides alternate component cooling water to charging pumps in order to maintain RCP seal water injection.

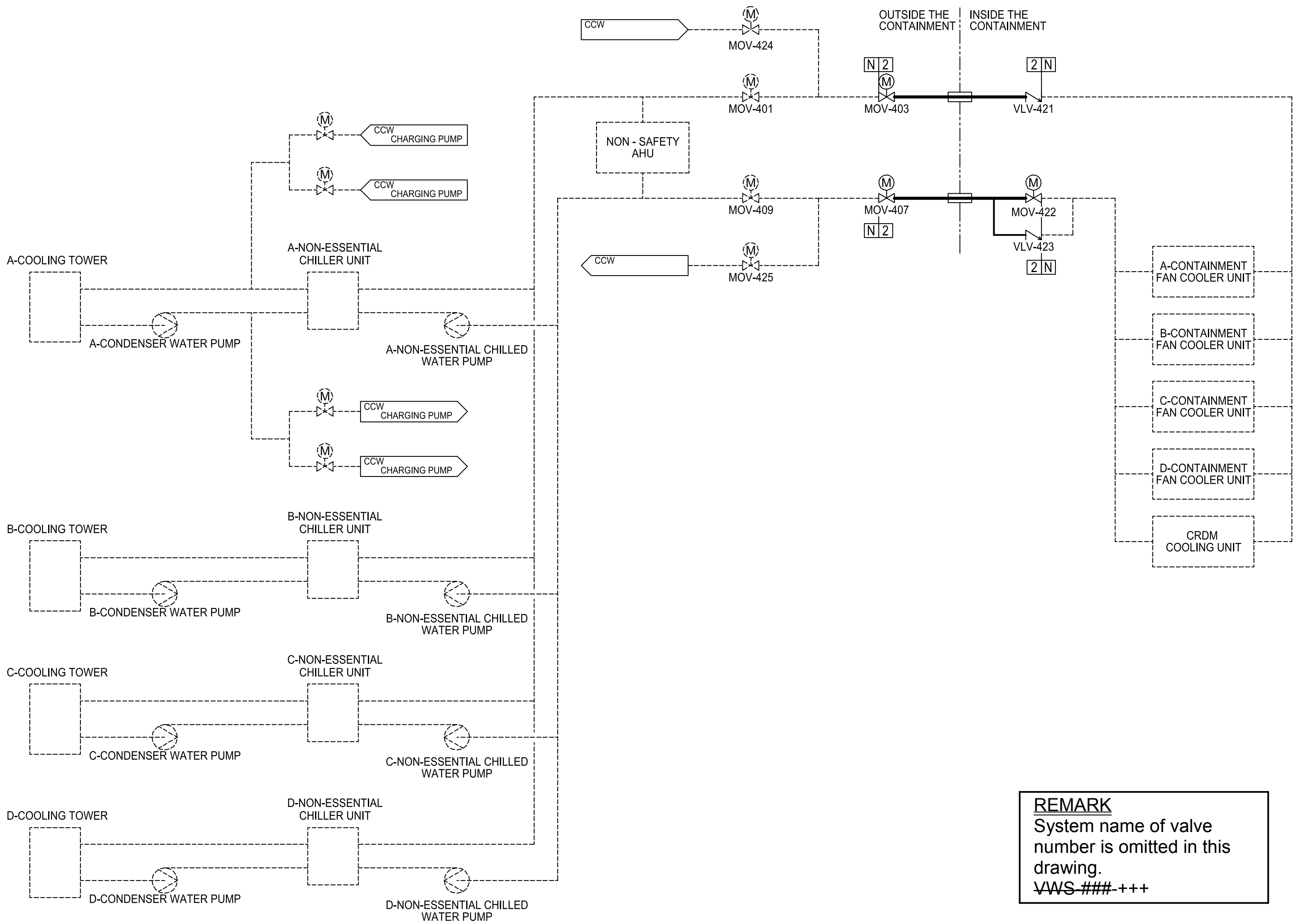


Figure 2.7.3.6-1 Non-Essential Chilled Water System

2.7.4 Radwaste Systems

2.7.4.1 Liquid Waste Management System (LWMS)

2.7.4.1.1 Design Description

System Purpose and Functions

The LWMS is non safety-related system. The reactor coolant drain tank and the containment vessel sump include a safety-related containment isolation function as described in Section 2.11.2. The LWMS is designed to safely monitor, control, collect, process, handle, store, and dispose of liquid radioactive waste generated as a result of normal operation, including anticipated operational occurrences (AOOs).

Location and Functional Arrangement

The LWMS is located in the containment, the A/B, and the R/B.

Key Design Features

The LWMS has different subsystems so that the liquid wastes from various sources can be segregated and processed separately in the most appropriate manner for the type of waste. These systems are interconnected in order to provide additional flexibility in processing the wastes and to provide redundancy.

The LWMS includes the following:

- The equipment and floor drain processing subsystem
- The detergent drain subsystem
- The chemical drain subsystem
- The reactor coolant drain subsystem

The LWMS provides the capability to segregate, collect and treat the liquid waste to acceptable release or recycle specifications for plant use. The LWMS also provides the capability to store, sample, and analyze treated liquid for safe control and disposal.

Tanks, equipment, pumps, etc., used for storing and processing radioactive material are located in controlled areas and shielded in accordance with their design basis source term inventories. After the waste has been processed, it is temporarily stored in monitor tanks where it is sampled prior to recycle or discharge. Connections are provided to forward liquid waste to contracted mobile systems or temporary equipment.

LWMS is designed in compliance with the as low as reasonable achievable (ALARA) principle.

The LWMS is designed to provide containment isolation of the LWMS lines penetrating containment.

Seismic and ASME Code Classifications

The seismic and ASME code classifications of the containment isolation components of the reactor coolant drain tank and the containment vessel sump are described in Table 2.11.2-1. The portions of the auxiliary building (A/B) that house the principal LWMS equipment are designed to seismic Category II. The LWMS is a non-safety system and the components are non-seismic.

System Operation

The LWMS is designed to process liquid waste generated from normal operation. Treated effluent is normally recycled for plant use. In the event that there is excess water, or that the treated effluent does not meet recycled water quality specifications, the water is discharged after sampling and analysis. The discharge valve is under supervisory control and requires approval to open for discharge.

Alarms, Displays, and Controls

A radiation monitor and dual isolation valves are installed on the sole discharge line to monitor and control effluents to the environment. Detection of radioactivity levels in the stream exceeding the predetermined setpoint automatically closes the discharge valves.

Logic

The containment isolation logic for the reactor coolant drain tank and the containment vessel sump is consistent with Subsection 2.11.2.

Interlocks

There are no interlocks needed for direct safety functions related to the LWMS.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

The safety related LWMS equipment to be qualified for harsh environments is identified in Table 2.11.2-1.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.4.1.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.4.1-1 describes the ITAAC for the LWMS.

The ITAAC associated with the LWMS equipment, components, and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.7.4.1-1 Liquid Waste Management System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the LWMS is as described in Design Description of this Subsection 2.7.4.1.	1. Inspections of the as-built system will be performed.	1. The as-built LWMS conforms with the functional arrangement as described in the Design Description of this Subsection 2.7.4.1.
2. Upon the receipt of LWMS effluent discharge isolation signal, the LWMS effluent discharge valves close automatically.	2. Tests of the as-built LWMS effluent discharge valves will be performed using a simulated test signal.	2. Upon the receipt of a simulated test signal, the as-built LWMS effluent discharge valves close automatically.
3. The ASME components of the LWMS retain their pressure boundary integrity at their design pressure.	3. A pressure test will be performed on the as-built ASME components of the LWMS required to be hydrostatically examined by the ASME B31.3 as described by Regulatory Guide 1.143.	3. The results of the pressure test of the as-built ASME components of the LWMS conform with the requirements in the ASME B31.3, as described by Regulatory Guide 1.143.
4. Deleted.	4. Deleted.	4. Deleted.
5. The LWMS valves and piping are designed and constructed in accordance with ASME B31.3 requirements.	5.a Inspections will be conducted of the fabrication and installation of as-built components.	5.a Design documentation exists and concludes that the as-built valves and piping of the LWMS are fabricated, installed, and inspected in accordance with ASME B31.3 requirements.
	5.b Analysis will be conducted to reconcile the as-designed and as-built component information with the ASME design documentation.	5.b The analysis concludes that the as-built LWMS valves and piping are reconciled with the design documents.

2.7.4.2 Gaseous Waste Management System (GWMS)

2.7.4.2.1 Design Description

System Purpose and Functions

The GWMS is a not safety-related system. The GWMS is designed to monitor, control, collect, process, handle, store, and dispose of gaseous radioactive waste generated as the result of normal operation, including anticipated operational occurrences (AOOs).

Location and Functional Arrangement

The GWMS is located in the A/B. The GWMS uses the gas surge tanks to provide temporary storage of radioactive gas for the decay of the short-lived isotopes that contribute the majority of radioactivity. It also includes the charcoal beds for radioactive gases decay before the gases are released into the environment.

Key Design Features

The GWMS design provides sufficient capacity and flexibility to collect and process incoming radioactive waste gases for release. Streams in the GWMS are monitored for both hydrogen and oxygen content to prevent flammable mixture. The waste gas compressor packages are used to compress the nitrogen waste gas. The charcoal beds provide adequate delay and decay time before the gases are released into the environment. The radiation level in the treated gases is verified with radiation monitors prior to release to the environment. These radiation monitors send signal to close the GWMS discharge valves upon detection of radiation levels above the set point.

Seismic and ASME Code Classifications

The portions of the A/B that house the principal GWMS equipment are designed to seismic Category II. The GWMS is a non-safety system and the components are non-seismic.

System Operation

A gas compressor operates continuously to draw gaseous waste from the holdup tanks, volume control tank and the reactor coolant drain tank and directs the gaseous waste into the gas surge tanks for radioactive decay of short-half life isotopes. Then the gaseous waste is processed through the dryer, the charcoal bed absorbers, and sent to the plant stack for release to the environment.

Alarms, Displays, and Controls

Upon detection of radiation levels above the setpoint, the GWMS radiation monitor activates an alarm and sends signals to close the GWMS discharge valves.

Logic

There is no logic needed for direct safety functions related to the GWMS.

Interlocks

There are no interlocks needed for direct safety functions related to the GWMS.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.4.2.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.4.2-1 describes the ITAAC for the GWMS.

Table 2.7.4.2-1 Gaseous Waste Management System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the GWMS is as described in Design Description of this Subsection 2.7.4.2.	1. Inspections of the as-built system will be performed.	1. The as-built GWMS conforms with the functional arrangement as described in the Design Description of this Subsection 2.7.4.2.
2. Upon the receipt of GWMS effluent discharge isolation signal, the GWMS effluent discharge valves close automatically.	2. Tests of the as-built GWMS effluent discharge valves will be performed using a simulated test signal.	2. Upon the receipt of a simulated GWMS effluent discharge isolation test signal, the as-built GWMS effluent discharge valves close automatically.
3. The ASME Code components of the GWMS retain their pressure boundary integrity at their design pressure.	3. A pressure test will be performed on the as-built ASME code components of the GWMS required to be hydrostatically examined by applicable ASME code.	3. The results of the pressure test of the as-built ASME Code components of the GWMS conform with the requirements in the applicable ASME Code.
4. The GWMS valves and piping are designed and constructed in accordance with ASME B31.3 requirements.	4.a Inspections will be conducted of the fabrication and installation of as-built components.	4.a Design documentation exists and concludes that the as-built valves and piping of the GWMS are fabricated, installed, and inspected in accordance with ASME B31.3 requirements.
	4.b Analysis will be conducted to reconcile the as-designed and as-built component information with the ASME design documentation.	4.b The analysis concludes that the as-built GWMS valves and piping are reconciled with the design documents.

2.7.4.3 Solid Waste Management System (SWMS)

2.7.4.3.1 Design Description

System Purpose and Functions

The SWMS is non safety-related system. The SWMS is designed to provide collection, processing, packaging, and storage of radioactive wastes produced during normal operation and anticipated operational occurrences (AOOs) including startup, shutdown, and refueling operations.

Location and Functional Arrangement

The SWMS is located in the A/B. The SWMS consists of several subsystems, each is designed to handle different types of wastes as follows: spent resin and spent carbon, spent filter, sludge and oily waste, and dry active wastes including contaminated clothing, contaminated and/or broken tools and maintenance materials.

The spent resin and spent carbon handling and dewatering subsystem consists of spent resin storage tanks and a modular dewatering station consisting of a control console, a fillhead, and a dewatering pump.

Spent filter elements are handled with remote handling equipment to minimize worker exposure.

Sludge and oily wastes are collected in specially designed sumps and are pumped to shipping containers for offsite treatment and/or disposal.

The dry active wastes are separately collected at the point of generation and are packaged for separate disposal. The onsite wastes storage area is equipped with an overhead crane and an indoor truck bay to load packaged waste for off-site transportation and disposal.

Key Design Features

The SWMS has the capability of processing, packaging, and storing radioactive wet solid wastes that mainly consist of spent resin, spent activated carbon, oily waste, and sludge.

The SWMS provides storage of the packaged wastes in the A/B.

The spent resin storage tanks are cross-connected so that the failure or maintenance of one component does not impair system or plant operation.

The SWMS is designed with permanently installed equipment and modular equipment.

Seismic and ASME Code Classifications

The portions of the A/B that house the principal SWMS equipment are designed to seismic Category II. The SWMS is a non-safety system and the components are non seismic.

System Operation

The spent resin storage tanks receive spent resin from various plant sources and provide staging for decay and transfer capability into disposal containers for off-site disposal. The spent charcoal handling subsystem shares the use of the spent resin storage tanks and the resin dewatering equipment. Spent resin, spent charcoal, and spent filter packaging operations are controlled remotely and/or from a local control console for filter replacement and spent resin dewatering. Lubricants and waste solvents drainage is collected in the area sump tanks which are specially designed to provide staging and gravitational oil separation. The separated oils are transferred directly into disposable drums.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the SWMS.

Interlocks

There are no interlocks needed for direct safety functions related to the SWMS.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.4.3.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.4.3-1 describes the ITAAC for the SWMS.

Table 2.7.4.3-1 Solid Waste Management System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the SWMS is as described in Design Description of this Subsection 2.7.4.3.	1. Inspections of the as-built system will be performed.	1. The as-built SWMS conforms with the functional arrangement as described in the Design Description of this Subsection 2.7.4.3.
2. The ASME Code components of the liquid containing portions of the SWMS retain their pressure boundary integrity at their design pressure.	2. A pressure test will be performed on the as-built ASME code components of the liquid containing portions of the SWMS required to be hydrostatically examined by the applicable ASME code.	2. The results of the pressure test of the as-built ASME Code components of the liquid containing portions of the SWMS conform with the requirements in the applicable ASME code.
3. The valves and piping of the liquid containing portions of the SWMS are designed and constructed in accordance with ASME B31.3 requirements.	3.a Inspections will be conducted of the fabrication and installation of as-built components.	3.a Design documentation exists and concludes that the as-built valves and piping of the liquid containing portions of the SWMS are fabricated, installed, and inspected in accordance with ASME B31.3 requirements.
	3.b Analysis will be conducted to reconcile the as-designed and as-built component information with the ASME design documentation.	3.b The analysis concludes that the as-built valves and piping of the liquid containing portions of the SWMS are reconciled with the design documents.

2.7.5 Heating, Ventilation, and Air Conditioning (HVAC) Systems

2.7.5.1 Main Control Room HVAC System

2.7.5.1.1 Design Description

System Purpose and Functions

The main control room (MCR) HVAC system is designed to protect operators against a release of radioactive material. The MCR HVAC system is also designed to provide conditioning air to maintain the proper environmental condition of the MCR and other areas within the control room envelope (CRE). The MCR HVAC system is a safety-related system, except for the toilet/kitchen exhaust and smoke purge fans.

Location and Functional Arrangement

The MCR HVAC system is located within the reactor building. As shown in Figure 2.7.5.1-1, the MCR HVAC system consists of two 100% capacity MCR emergency filtration units and four 50% capacity MCR air handling units. The MCR air handling units are connected to a common overhead air distribution ductwork.

Key Design Features

The key design features of MCR HVAC system are reflected in the system design bases, which include:

- The MCR HVAC system is designed to exclude entry of airborne radioactivity into the CRE and remove radioactive material from the CRE environment.
- The MCR HVAC system is designed to provide conditioning air to maintain the proper environmental condition of the CRE during all plant conditions.
- The MCR emergency filtration unit consists, in direction of airflow, of a high efficiency filter, an electric heating coil, a high-efficiency particulate air filter, a charcoal absorber and a high efficiency filter.
- The adverse effects associated with tornado depressurization of the outside air intakes and exhaust outlets are prevented by the specially designed tornado dampers located at the outside air intakes and exhaust outlets.
- The MCR air handling units and the MCR emergency filtration units are physically separated from the other divisions by a structural barrier, which also serves as a fire barrier.

Seismic and ASME Code Classifications

The seismic classifications for system components are identified in Table 2.7.5.1-1. The system components are not designed or constructed to ASME Code Section III requirements.

System Operation

The MCR HVAC system provides the proper environmental conditions within the CRE during all plant operating conditions, including normal plant operating, abnormal and accident conditions.

There are four different MCR HVAC system modes of operation:

1. Normal mode - the MCR HVAC system is aligned to take in fresh outside air. The CRE is maintained at the proper ambient conditions during this mode of operation.

2. Emergency pressurization mode is automatically started upon a MCR isolation signal. Outside air is directed to both 100% capacity MCR emergency filtration units and the CRE is maintained at a positive pressure 0.125 inches w.g. as a minimum relative to external areas adjacent to the CRE boundary.

3. Emergency isolation mode provides the capability to protect the control room operators from smoke in the outside air intakes. The MCR HVAC system goes into full recirculation and there is no positive pressurization of the CRE during this mode.

4. Smoke purge mode is manually initiated to route outside air into the MCR. In this mode, the air temperature controls are defeated. The outside air is removed from the MCR through the MCR smoke purge fan.

Alarms, Displays, and Controls

Table 2.7.5.1-2 identifies alarms, displays and controls associated with the system that are located in the MCR.

Logic

Emergency Pressurization Mode:

Upon the receipt of an MCR isolation signal:

- MCR toilet/kitchen exhaust line isolation dampers and smoke purge line isolation dampers automatically close or remain in the closed position.

- The two MCR emergency filtration units start, MCR air intake isolation dampers open automatically and the MCR air handling units start, or continue to operate if running.

- The Class 1E electric heating coils that are contained in MCR emergency filtration units automatically start to maintain a relative humidity level of 70% for charcoal filter efficiency.

Emergency Isolation Mode:

Upon the receipt of a signal to initiate emergency isolation mode (smoke):

- The outside air intake isolation dampers automatically close.
- The standby MCR air handling units automatically start.
- If running, the smoke purge fan automatically trips and the associated dampers close.
- The MCR toilet/kitchen exhaust fan automatically trips and the associated dampers close.

Interlocks

The dampers in the MCR HVAC system reposition to establish the flow path for the required mode.

Class 1E Electrical Power Sources and Divisions

The equipment identified in Table 2.7.5.1-1 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

The MCR HVAC system is located in controlled environmental conditions that exist before, during, and following a design basis event. Therefore the MCR HVAC system equipment is not qualified for harsh environments.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Selected numerical performance values of the MCR HVAC system used in the safety analysis are shown on the table below:

Unfiltered CRE inleakage	120 cfm
Filtered air intake flow	1,200 cfm
Filtered air recirculation flow	2,400 cfm
Filter efficiencies	
Elemental iodine	95%
Organic iodine	95%
Particulates	99%

2.7.5.1.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.5.1-3 specifies the inspections, tests analyses, and associated acceptance criteria for the MCR HVAC system. Table 2.7.3.5-5 specifies the ITAAC for the ECWS piping that supplies cooling water to the main control room air handling unit cooling coils.

Table 2.7.5.1-1 Main Control Room HVAC System Equipment Characteristics (Sheet 1 of 3)

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Main Control Room Air Handling Units	VRS-MAH-101 A, B, C, D	–	Yes	–	–/No	–	None	–
Main Control Room Air Handling Unit Fans	VRS-MFN-101 A, B, C, D	–	Yes	–	Yes/No	MCR isolation	Start	–
Main control Room Emergency Filtration Units	VRS-MFU-111 A, B	–	Yes	–	–/No	–	None	–
Main control Room Emergency Filtration Unit Fans	VRS-MFN-111 A, B	–	Yes	–	Yes/No	MCR isolation	Start	–
Main Control Room Air Intake Isolation Dampers	VRS-EHD-101 A, B, 102A, B	–	Yes	Yes	Yes/No	MCR isolation	Transfer Open (pressurization mode)	Closed
						Smoke detection	Transfer Closed (isolation mode)	
Main Control Room Toilet/Kitchen Exhaust Line Isolation Dampers	VRS-AOD-121, 122	–	Yes	Yes	Yes/No	MCR isolation	Transfer Closed	Closed
Main Control Room Smoke Purge Line Isolation Dampers	VRS-AOD-131, 132	–	Yes	Yes	Yes/No	MCR isolation	Transfer Closed	Closed
Main Control Room Emergency Filtration Unit Air Intake Dampers	VRS-MOD-111 A, B	–	Yes	Yes	Yes/No	MCR isolation	Transfer Open	As is

Table 2.7.5.1-1 Main Control Room HVAC System Equipment Characteristics (Sheet 2 of 3)

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Main Control Room Emergency Filtration Unit Air Return Dampers	VRS-MOD-112 A, B	–	Yes	Yes	Yes/No	MCR isolation	Transfer Open	As is
Main Control Room Normal Air Intake Line Isolation Dampers	VRS-AOD-103 A, B	–	Yes	Yes	Yes/No	MCR isolation	Transfer Closed	Closed
Main Control Room Circulation Line Changeover Dampers	VRS-EHD-104 A, B, 107A, B	–	Yes	Yes	Yes/No	MCR isolation	Transfer Open	Closed
Main Control Room Air Handling Unit Inlet Dampers	VRS-EHD-105 A, B, C, D	–	Yes	Yes	Yes/No	MCR isolation	Transfer Open	Closed
Main Control Room Air Handling Unit Outlet Dampers	VRS-EHD-106 A, B, C, D	–	Yes	Yes	Yes/No	MCR isolation	Transfer Open	Closed
Main Control Room Emergency Filtration Unit Fan Outlet Dampers	VRS-MOD-113 A, B	–	Yes	Yes	Yes/No	MCR isolation	Transfer Open	As is
Tornado Dampers	VRS-OTD-108A,B, -124, -133	–	Yes	–	–/No	–	Transfer Closed (Tornado condition)	–
Ductwork	–	–	Yes	–	–/No	–	None	–

Table 2.7.5.1-1 Main Control Room HVAC System Equipment Characteristics (Sheet 3 of 3)

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Main Control Room Temperature	VRS-TS-146, 156, 166, 176	–	Yes	–	Yes/No	–	–	–

NOTE: Dash (-) indicates not applicable

Table 2.7.5.1-2 Main Control Room HVAC System Equipment Alarms, Displays and Control Functions (Sheet 1 of 2)

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Main Control Room Air Handling Unit Fans (VRS-MFN-101 A, B, C, D)	No	Yes	Yes	Yes
Main Control Room Emergency Filtration Unit Fans (VRS-MFN-111 A, B)	No	Yes	Yes	Yes
Main Control Room Air Intake Isolation Dampers (VRS-EHD-101 A, B, 102 A, B)	No	Yes	Yes	Yes
Main Control Room Toilet/Kitchen Exhaust Line Isolation Dampers (VRS-AOD-121,122)	No	Yes	Yes	Yes
Main Control Room Smoke Purge Line Isolation Dampers (VRS-AOD-131,132)	No	Yes	Yes	Yes
Main Control Room Emergency Filtration Unit Air Intake Dampers (VRS-MOD-111 A, B)	No	Yes	Yes	Yes
Main Control Room Emergency Filtration Unit Air Return Dampers (VRS-MOD-112 A, B)	No	Yes	Yes	Yes
Main Control Room Normal Air Intake Line Isolation Dampers (VRS-AOD-103 A, B)	No	Yes	Yes	Yes
Main Control Room Circulation Line Changeover Dampers (VRS-EHD-104 A, B, 107 A, B)	No	Yes	Yes	Yes
Main Control Room Air Handling Unit Inlet Dampers (VRS-EHD-105 A, B, C, D)	No	Yes	No	Yes
Main Control Room Air Handling Unit Outlet Dampers (VRS-EHD-106 A, B, C, D)	No	Yes	No	Yes

Table 2.7.5.1-2 Main Control Room HVAC System Equipment Alarms, Displays and Control Functions (Sheet 2 of 2)

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Main Control Room Emergency Filtration Unit Fan Outlet Dampers (VRS-MOD-113 A, B)	No	Yes	No	Yes
Main Control Room Temperature (VRS-TCA-146, 156, 166, 176)	Yes	No	No	No

Table 2.7.5.1-3 Main Control Room HVAC System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a The functional arrangement of the MCR HVAC system is as described in the Design Description of this Subsection 2.7.5.1.1 and as shown in Figure 2.7.5.1-1.	1.a An inspection of the as-built system will be performed.	1.a The as-built MCR HVAC system conforms with the functional arrangement as described in the Design Description of this Subsection 2.7.5.1.1 and as shown in Figure 2.7.5.1-1.
1.b The MCR air handling units (Divisions A, B, C & D) and MCR emergency filtration units (Divisions A&D) that are identified in Table 2.7.5.1-1 are physically separated from the other divisions.	1.b Inspections of the as-built MCR HVAC system will be performed.	1.b Each mechanical division of the as-built MCR air handling unit and the MCR emergency filtration units that are identified in Table 2.7.5.1-1 are physically separated from other mechanical divisions by structural barriers.
2. The seismic Category I equipment, identified in Table 2.7.5.1-1, is designed to withstand seismic design basis loads without loss of safety function.	2.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.7.5.1-1 is located in the reactor building.	2.i The seismic Category I as-built equipment identified in Table 2.7.5.1-1 is located in the reactor building.
	2.ii Type tests and/or analyses of the seismic Category I equipment will be performed.	2.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	2.iii Inspections will be performed on the as-built equipment including anchorage.	2.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.
3.a The Class 1E equipment, identified in Table 2.7.5.1-1, is powered from their respective Class 1E division.	3.a A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	3.a The simulated test signal exists at the as-built Class 1E equipment, identified in Table 2.7.5.1-1, under test.
3.b Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	3.b Inspections of the as-built Class 1E divisional cables will be performed.	3.b Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.

Table 2.7.5.1-3 Main Control Room HVAC System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4.a The MCR HVAC system provides conditioning air to maintain the proper design temperature and relative humidity limits for the CRE during all plant operating conditions, including normal plant operations, abnormal and accident conditions.	4.a Tests and analyses of the as-built MCR HVAC system will be performed.	4.a The as-built MCR HVAC system is capable of providing conditioned air to maintain the proper design temperature and relative humidity limits for the CRE during all plant operating conditions including normal plant operations, abnormal and accident conditions.
4.b The MCR HVAC system is capable of meeting the selected numerical performance values used in the safety analysis listed in Subsection 2.7.5.1.1.	4.b.i Type tests, tests and analyses of filter efficiencies for the MCR HVAC system will be performed.	4.b.i The MCR HVAC system is capable of meeting the filter efficiencies identified in Subsection 2.7.5.1.1.
	4.b.ii Tests of airflow for the as-built MCR HVAC system will be performed.	4.b.ii The as-built MCR HVAC system is capable of meeting the airflow identified in Subsection 2.7.5.1.1.
	4.b.iii Tests and analyses of as-built unfiltered CRE inleakage will be performed.	4.biii The as-built CRE is capable of meeting the unfiltered inleakage identified in Subsection 2.7.5.1.1.
5.a The MCR HVAC system isolation dampers and tornado dampers, identified in Table 2.7.5.1-1, perform an active safety function to change position as indicated in the table.	5.a.i Tests of the as-built MCR HVAC system isolation dampers identified in Table 2.7.5.1-1 will be performed using a simulated signal.	5.a.i Each as-built MCR HVAC system isolation damper performs the active safety function identified in Table 2.7.5.1-1 after receiving an outside air smoke detection signal or a MCR isolation signal.
	5.a.ii Tests of the as-built tornado dampers identified in Table 2.7.5.1-1 will be performed under preoperational test pressure, and fluid flow conditions.	5.a.ii Each as-built tornado damper changes position as identified in Table 2.7.5.1-1.
5.b After loss of motive power, the MCR HVAC system dampers, identified in Table 2.7.5.1-1, assume the indicated loss of motive power position.	5.b Tests of the as-built MCR HVAC system dampers will be performed under the conditions of loss of motive power.	5.b Upon loss of motive power, each as-built MCR HVAC system damper identified in Table 2.7.5.1-1 assumes the indicated loss of motive power position.

Table 2.7.5.1-3 Main Control Room HVAC System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5.c The MCR HVAC system isolation dampers identified in Table 2.7.5.1-1 close within their design basis closure time after receiving a MCR isolation signal.	5.c Tests of the as-built MCR HVAC system isolation dampers identified in Table 2.7.5.1-1 will be performed using a simulated signal.	5.c The as-built MCR HVAC system isolation dampers identified in Table 2.7.5.1-1 close in less than or equal to 10 seconds after receiving a MCR isolation signal.
5.d The fire dampers in ductwork that penetrates fire barriers that are required to protect safe-shutdown capability close fully when called upon to do so.	5.d Tests of the as-built fire dampers will be performed.	5.d Each as-built fire damper in ductwork that penetrates fire barrier that are required to protect safe-shutdown capability close under design air flow conditions.
5.e Controls exist in the MCR to open and close the remotely operated dampers identified in Table 2.7.5.1-2.	5.e Tests will be performed on the as-built remotely operated dampers listed in Table 2.7.5.1-2 using controls in the MCR.	5.e Controls exist in the as-built MCR to open and close the as-built remotely operated dampers listed in Table 2.7.5.1-2.
6.a Controls exist in the MCR to start and stop the MCR HVAC system air handling units and filtration units identified in Table 2.7.5.1-2.	6.a Tests will be performed on the as-built air handling units and filtration units identified in Table 2.7.5.1-2 using controls in the as-built MCR.	6.a Controls exist in the as-built MCR to start and stop the as-built MCR HVAC system air handling units and filtration units identified in Table 2.7.5.1-2.
6.b The MCR HVAC system air handling unit fans and emergency filtration unit fans, identified in Table 2.7.5.1-2, start after receiving a MCR isolation signal (emergency pressurization mode).	6.b. Tests of the as-built MCR HVAC system will be performed using a simulated signal.	6.b The as-built MCR HVAC system air handling unit fans and emergency filtration unit fans, identified in Table 2.7.5.1-2, start after receiving a MCR isolation signal (emergency pressurization mode).
6.c. The MCR HVAC system air handling unit fans identified in Table 2.7.5.1-2 start after receiving an outside air smoke detection signal to initiate CRE emergency isolation mode.	6.c. Tests of the as-built MCR HVAC system will be performed using a simulated signal.	6.c. The as-built MCR HVAC system air handling unit fans identified in Table 2.7.5.1-2 start after receiving an outside air smoke detection signal to initiate CRE emergency isolation mode.

Table 2.7.5.1-3 Main Control Room HVAC System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. MCR alarms and displays of the MCR HVAC system parameters identified in Table 2.7.5.1-2 can be retrieved in the MCR.	7. Inspections will be performed for retrievability of the MCR HVAC system parameters in the as-built MCR.	7. MCR alarms and displays, identified in Table 2.7.5.1-2, can be retrieved in the as-built MCR.
8. RSC alarms, displays and controls are identified in Table 2.7.5.1-2.	8. Inspections of the as-built RSC alarms, displays and controls will be performed.	8. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.7.5.1-2.

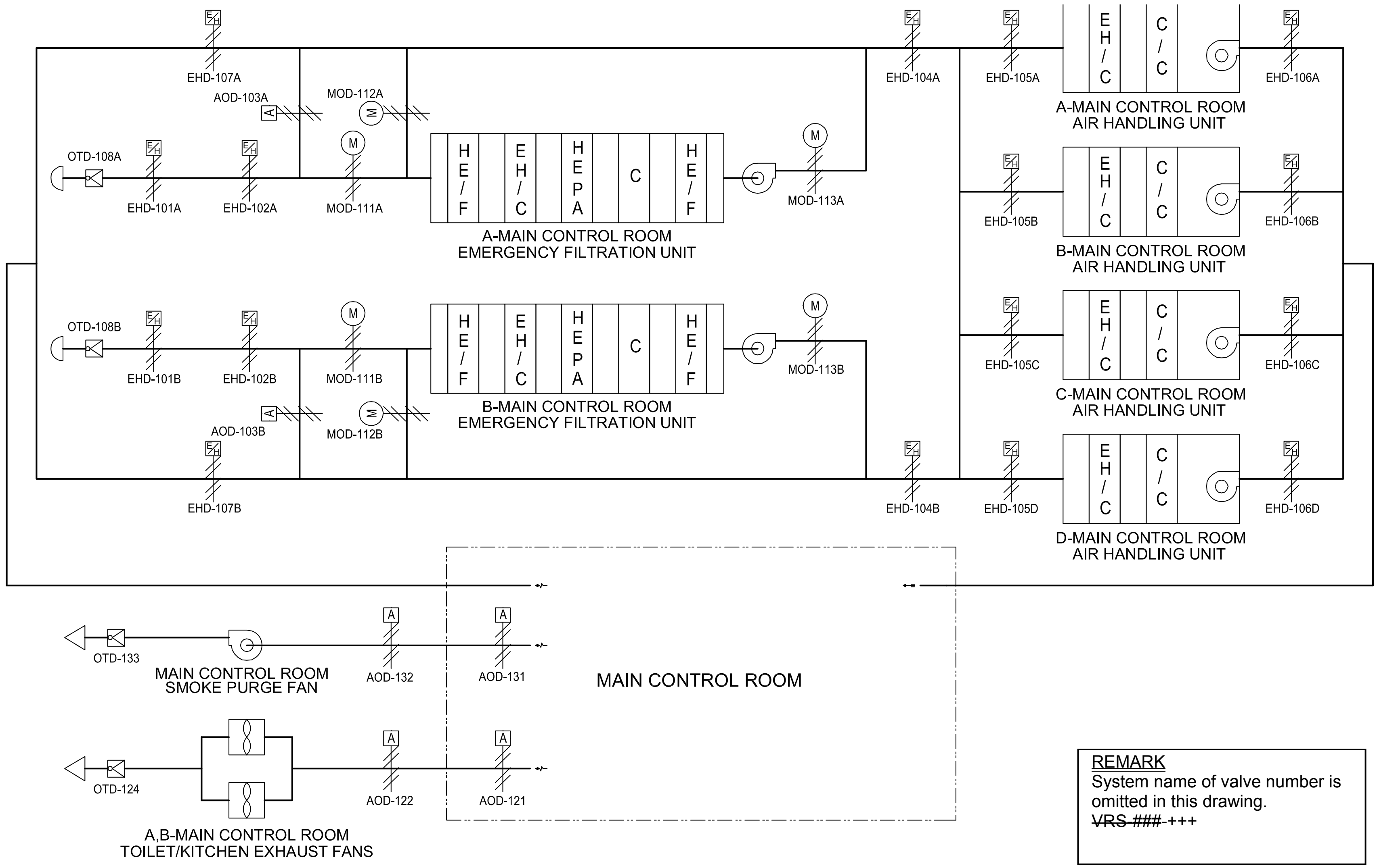


Figure 2.7.5.1-1 Main Control Room HVAC System

2.7.5.2 Engineered Safety Features Ventilation System (ESFVS)

The ESFVS of the US-APWR is designed to provide conditioning air to maintain the proper environmental conditions within plant areas that house ESF equipment. The system's function is to support and assure the safe and continuous operation of the ESF equipment during abnormal and accident conditions.

The ESFVS includes:

- Annulus emergency exhaust system
- Class 1E electrical room HVAC system
- Safeguard component area HVAC system
- Emergency feedwater pump area HVAC system
- Safety related component area HVAC system

2.7.5.2.1 Design Description

2.7.5.2.1.1 Annulus Emergency Exhaust System

System Purpose and Functions

The annulus emergency exhaust system is an ESF system designed for fission product removal and retention by filtering the air it exhausts from penetration and safeguard component areas following accidents. The annulus emergency exhaust system is a safety-related system.

Location and Functional Arrangement

The annulus emergency exhaust system is located within the reactor building. As shown in Figure 2.7.5.2-1, the annulus emergency exhaust system consists of two redundant divisions, each sized to have 100% capacity. Each division includes an exhaust filtration unit and fan.

Key Design Features

The key design features of the annulus emergency exhaust system are reflected in the system design bases, which include:

- The annulus emergency exhaust system is designed to remove the airborne radioactive material that may leak from containment or ECCS and CSS components.
- The annulus emergency exhaust system exhausts air and maintains a negative pressure at least 0.25 inches w.g. in the penetration and safeguard component areas relative to the adjacent areas.

- The annulus emergency exhaust filtration unit consists, in direction of airflow, of a high efficiency filter and a HEPA filter.
- The adverse effects associated with the tornado depressurization of the air exhaust line are prevented by the specially designed tornado damper in the exhaust line.
- The annulus emergency filtration units are physically separated from the other divisions by a structural barrier, which also serves as a fire barrier.

Seismic and ASME Code Classifications

The seismic classifications for system components are identified in Table 2.7.5.2-1. The system components are not designed or constructed to ASME Code Section III requirements.

System Operation

The annulus emergency exhaust system operates under accident conditions to exhaust air from the penetration and safeguard component areas and maintain a negative pressure.

Alarms, Displays, and Controls

Table 2.7.5.2-2 identifies alarms, displays, and controls associated with the system that are located in the MCR.

Logic

Upon receipt of the ECCS actuation signal, the annulus emergency exhaust system automatically starts.

Interlocks

The dampers in the annulus emergency exhaust system reposition upon receipt of their respective fan run signals to establish the required flow path.

Class 1E Electrical Power Sources and Divisions

The equipment identified in Table 2.7.5.2-1 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

The annulus emergency exhaust system is located in controlled environmental conditions that would exist before, during, and following a design basis event. Therefore, the annulus emergency exhaust system equipment is not qualified for harsh environments.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Selected numerical performance values of the annulus emergency exhaust system used in the safety analysis are shown on the table below:

Penetration and Safeguard Component Areas negative pressure arrival time	240 sec
Filter efficiencies for Particulates	99%

2.7.5.2.1.2 Class 1E Electrical Room HVAC System

System Purpose and Functions

The Class 1E electrical room HVAC system provides conditioning air to maintain the proper environmental conditions within Class 1E I&C rooms, Class 1E electrical rooms, Class 1E battery rooms, Class 1E UPS Rooms and Class 1E battery charger rooms. The Class 1E electrical room HVAC system is a safety-related system.

Location and Functional Arrangement

The Class 1E electrical room HVAC system is located in the reactor building. As shown in Figure 2.7.5.2-2, the Class 1E electrical room HVAC system consists of four redundant divisions, each sized to satisfy 100% of the cooling demand of two divisions of the equipment they serve. Each system includes an air handling unit, a return air fan and a battery room exhaust fan.

Key Design Features

The Class 1E electrical room HVAC system provides conditioning air to maintain the proper environmental conditions within the Class 1E electrical rooms during all plant operating conditions.

The adverse effects associated with the tornado depressurization of the outside air intakes and exhaust openings are prevented by the specially designed tornado dampers located at the outside air intakes and exhaust opening.

The battery rooms are ventilated with sufficient supply and exhaust airflow during all modes of operation in order to limit the hydrogen concentration.

All duct penetrations in fire walls are protected by fire dampers to prevent the spread of fire from the affected area to the adjacent redundant component areas.

Air supply, return and exhaust fan housings are designed to resist penetration of internally generated missiles in the event of fan rotor failure.

The Class 1E electrical room air handling units, Class 1E electrical room return air fans and Class 1E battery room exhaust fans are physically separated by a structural barrier, which also serves as a fire barrier.

Seismic and ASME Code Classifications

The seismic classifications for system components are identified in Table 2.7.5.2-1. The system components are not designed or constructed to ASME Code Section III requirements.

System Operation

The Class 1E electrical room HVAC system provides conditioning air to maintain the proper environmental conditions within the Class 1E electrical rooms during all plant operating conditions, including normal plant operations, abnormal and accident conditions.

Alarms, Displays, and Controls

Table 2.7.5.2-2 identifies alarms, displays, and controls associated with the system that are located in the MCR.

Logic

Upon receipt of the ECCS actuation signal, the Class 1E electrical room HVAC system automatically starts, or continues to operate if running.

Interlocks

The dampers in the Class 1E electrical room HVAC system reposition upon receipt of their respective fan run signals to establish the required flow path.

Class 1E Electrical Power Sources and Divisions

The equipment identified in Table 2.7.5.2-1 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

The Class 1E electrical room HVAC system is located in controlled environmental conditions that would exist before, during, and following a design basis event. Therefore, the Class 1E electrical room HVAC system equipment is not qualified for harsh environments.

Interface requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITAAC acceptance criteria in Table 2.7.5.2-3.

2.7.5.2.1.3 Safeguard Component Area HVAC System

System Purpose and Functions

The safeguard component area HVAC system provides conditioning air to maintain the proper environmental conditions to each controlled area of the safeguard components area. The safeguard component area HVAC system is a safety-related system.

Location and Functional Arrangement

The safeguard components area HVAC system is located in the reactor building. As shown in Figure 2.7.5.2-3, the safeguard component area HVAC system provides four 100% capacity air handling units.

Key Design Features

The safeguard components area HVAC system provides conditioning air to maintain the proper environmental conditions within safeguard component areas, when the respective equipment is operating.

Air handling unit fan housings are designed to resist penetration of internally generated missiles in the event of fan rotor failure.

The safeguards component area air handling units are physically separated from the other divisions by a structural barrier, which also serves as a fire barrier.

Seismic and ASME Code Classifications

The seismic classifications for system components are identified in Table 2.7.5.2-1. The system components are not designed or constructed to ASME Code Section III requirements.

System Operation

The safeguard component area HVAC system provides conditioning air to maintain the proper environmental conditions within the safeguard component area during abnormal and accident conditions.

Alarms, Displays, and Controls

Table 2.7.5.2-2 identifies alarms, displays, and controls associated with the system that are located in the MCR.

Logic

Upon receipt of high area temperature signal, each respective air handling unit is actuated.

Interlocks

The dampers in the safeguard component area HVAC system reposition upon receipt of their respective fan run signals to establish the required flow path.

Class 1E Electrical Power Sources and Divisions

The equipment identified in Table 2.7.5.2-1 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

The safeguard component area HVAC system is located in controlled environmental conditions that would exist before, during, and following a design basis event. Therefore, the safeguard component area HVAC system equipment is not qualified for harsh environments.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITAAC acceptance criteria in Table 2.7.5.2-3.

2.7.5.2.1.4 Emergency Feedwater Pump Area HVAC System

System Purpose and Functions

The emergency feedwater pump area HVAC system provides conditioning air to maintain the proper environmental conditions to each emergency feedwater pump area. The emergency feedwater pump area HVAC system is a safety-related system.

Location and Functional Arrangement

The emergency feedwater pump area HVAC system is located in the reactor building. As shown in Figure 2.7.5.2-4, the emergency feedwater pump area HVAC system provides air handling units. Each pump room is provided with one 100% capacity air handling unit on a separate division.

Key Design Features

The emergency feedwater pump area HVAC system provides conditioning air to maintain the proper environmental conditions within emergency feedwater pump areas, when the respective equipment is operating.

The adverse effects associated with the tornado depressurization of the outside air intakes and exhaust openings are prevented by the specially designed tornado dampers located at the outside air intakes and exhaust opening.

Air handling unit fan housings are designed to resist penetration of internally generated missiles in the event of fan rotor failure.

The emergency feedwater pump area air handling units are physically separated from the other divisions by a structural barrier, which also serves as a fire barrier.

Seismic and ASME Code Classifications

The seismic classifications for system components are identified in Table 2.7.5.2-1. The system components are not designed or constructed to ASME Code Section III requirements.

System Operation

The emergency feedwater pump area HVAC system provides conditioning air to maintain the proper environmental conditions within the emergency feedwater pump areas during abnormal and accident conditions.

Alarms, Displays, and Controls

Table 2.7.5.2-2 identifies alarms, displays, and controls associated with the system that are located in the main control room.

Logic

Upon receipt of high area temperature signal, each respective air handling unit is actuated.

Interlocks

There are no interlocks needed for direct safety functions related to the emergency feedwater pump area HVAC system.

Class 1E Electrical Power Sources and Divisions

The equipment identified in Table 2.7.5.2-1 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

The emergency feedwater pump area HVAC system is located in controlled environmental conditions that would exist before, during, and following a design basis event. Therefore, the emergency feedwater pump area HVAC system equipment is not qualified for harsh environments.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITAAC acceptance criteria in Table 2.7.5.2-3.

2.7.5.2.1.5 Safety Related Component Area HVAC System

System Purpose and Functions

The safety related component area HVAC system, a safety-related system, provides conditioning air to maintain the proper environmental conditions to each area of the safety-related component areas listed below.

- Component cooling water pump area
- Essential chiller unit area
- Charging pump area
- Annulus emergency exhaust filtration unit area

- Penetration area
- Spent fuel pit pump area

Location and Functional Arrangement

The safety related component area HVAC system is located within the reactor building and power source building. As shown in Figure 2.7.5.2-5, the safety related component area HVAC system provides air handling units. Each area it serves is provided with one 100% capacity air handling unit.

Key Design Features

The safety related component area HVAC system provides conditioning air to maintain the proper environmental condition in each individual safety-related component area, when the respective equipment is operating.

Air handling unit fan housings are designed to resist penetration of internally generated missiles in the event of fan rotor failure.

The safety-related component area air handling units are physically separated from the other divisions by a structural barrier, which also serves as a fire barrier.

Seismic and ASME Code Classifications

The seismic classifications for system components are identified in Table 2.7.5.2-1. The system components are not designed or constructed to ASME Code Section III requirements.

System Operation

The safety related component area HVAC system provides conditioning air to maintain the proper environmental conditions within the individual safety-related equipment rooms during abnormal and accident conditions.

Alarms, Displays, and Controls

Table 2.7.5.2-2 identifies alarms, displays, and controls associated with the system that are located in the main control room.

Logic

Upon receipt of high area temperature signal, each respective air handling unit is actuated.

Interlocks

There are no interlocks needed for direct safety functions related to the safety related component area HVAC system.

Class 1E Electrical Power Sources and Divisions

The equipment identified in Table 2.7.5.2-1 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

The safety related component area HVAC system is located in controlled environmental conditions that would exist before, during, and following a design basis event. Therefore, the safety related component area HVAC system equipment is not qualified for harsh environments.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITAAC acceptance criteria in Table 2.7.5.2-3.

2.7.5.2.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.5.2-3 specifies the inspections, tests analyses, and associated acceptance criteria for the ESFVS. Table 2.7.3.5-5 specifies the ITAAC for the ECWS piping that supplies cooling water to the ESFVS air handling unit cooling coils.

Table 2.7.5.2-1 Engineered Safety Features Ventilation System Equipment Characteristics (Sheet 1 of 8)

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Annulus Emergency Exhaust System								
Annulus Emergency Exhaust Filtration Units	VRS-MFU-001 A, B	—	Yes	—	—/No	—	None	—
Annulus Emergency Exhaust Filtration Unit Fans	VRS-MFN-001 A, B	—	Yes	—	Yes/No	ECCS Actuation	Start	—
Annulus Area Exhaust Dampers	VRS-EHD-001 A, B	—	Yes	Yes	Yes/No	ECCS Actuation	Transfer Open	Closed
Safeguard Component Area Exhaust Dampers	VRS-EHD-002 A, B	—	Yes	Yes	Yes/No	ECCS Actuation	Transfer Open	Closed
Annulus Emergency Exhaust Filtration Unit Outlet Dampers	VRS-EHD-003 A, B	—	Yes	Yes	Yes/No	ECCS Actuation	Transfer Open	Closed
Tornado Damper	VRS-OTD-004	—	Yes	—	—/No	—	Transfer Closed (Tornado condition)	–
Ductwork	—	—	Yes	—	—/No	—	None	–

Table 2.7.5.2-1 Engineered Safety Features Ventilation System Equipment Characteristics (Sheet 2 of 8)

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Class 1E Electrical Room HVAC System								
Class 1E Electrical Room Air Handling Units	VRS-MAH-201 A, B, C, D	—	Yes	—	—/No	—	None	—
Class 1E Electrical Room Air Handling Unit Fans	VRS-MFN-201 A, B, C, D	—	Yes	—	Yes/No	ECCS Actuation	Start	—
Class 1E Electrical Room Return Air Fans	VRS-MFN-202 A, B, C, D	—	Yes	—	Yes/No	ECCS Actuation	Start	—
Class 1E Battery Room Exhaust Fans	VRS-MFN-251 A,B,C,D	—	Yes	—	Yes/No	ECCS Actuation	Start	—
Class 1E Electrical Room Outside Air Intake Isolation Dampers	VRS-EHD-201 A,B,C,D	—	Yes	Yes	Yes/No	—	Transfer Open	Closed
Class 1E Electrical Room Air Handling Unit Outlet Dampers	VRS-EHD-202 A,B,C,D	—	Yes	Yes	Yes/No	ECCS Actuation	Transfer Open	Closed
Class 1E Electrical Room Return Air Fan Inlet Dampers	VRS-EHD-203 A,B,C,D	—	Yes	Yes	Yes/No	ECCS Actuation	Transfer Open	Closed

Table 2.7.5.2-1 Engineered Safety Features Ventilation System Equipment Characteristics (Sheet 3 of 8)

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Class 1E Electrical Room Air Handling Unit Inlet Dampers	VRS-EHD-204 A,B,C,D	—	Yes	Yes	Yes/No	ECCS Actuation	Transfer Open	Closed
Class 1E Electrical Room Exhaust Line Isolation Dampers	VRS-AOD-205 A,B,C,D	—	Yes	Yes	Yes/No	ECCS Actuation	Transfer Closed	Closed
Class 1E Battery Room Exhaust Fan Inlet Dampers	VRS-EHD-251 A,B,C,D	—	Yes	Yes	Yes/No	ECCS Actuation	Transfer Open	Closed
Class 1E Battery Room Exhaust Fan Outlet Dampers	VRS-EHD-252 A,B,C,D	—	Yes	Yes	Yes/No	ECCS Actuation	Transfer Open	Closed
Tornado Dampers	VRS-OTD-206 A,B,C,D VRS-OTD-207A,B,C,D VRS-OTD-253 A,B,C,D	—	Yes	—	—/No	—	Transfer Closed (Tornado condition)	—
Ductwork	—	—	Yes	—	—/No	—	None	—
Class 1E Electrical Room Temperature	VRS-TS-210, 230, 250, 270	—	Yes	—	Yes/No	—	—	—

Table 2.7.5.2-1 Engineered Safety Features Ventilation System Equipment Characteristics (Sheet 4 of 8)

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Safeguard Component Area HVAC System								
Safeguard Component Area Air Handling Units	VRS-MAH-301 A, B, C, D	—	Yes	—	—/No	—	None	—
Safeguard Component Area Air Handling Unit Fans	VRS-MFN-301 A, B, C, D	—	Yes	—	Yes/No	High Temperature	Start	—
Safeguard Component Area Air Handling Unit Inlet Dampers	VRS-MOD-301 A, B, C, D	—	Yes	Yes	Yes/No	High Temperature	Transfer Open	As is
Safeguard Component Area Air Handling Unit Outlet Dampers	VRS-MOD-302 A, B, C, D	—	Yes	Yes	Yes/No	High Temperature	Transfer Open	As is
Ductwork	—	—	Yes	—	—/No	—	None	—
Safeguard Component Area Temperature	VRS-TS-305, 306, 307, 315, 316, 317, 325,326, 327, 335, 336, 337	—	Yes	—	Yes/No	—	—	—

Table 2.7.5.2-1 Engineered Safety Features Ventilation System Equipment Characteristics (Sheet 5 of 8)

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Emergency Feedwater Pump Area HVAC System								
Emergency Feedwater Pump Area Air Handling Units	VRS-MAH-401 A, B, C, D	—	Yes	—	—/No	—	None	—
Emergency Feedwater Pump Area Air Handling Unit Fans	VRS-MFN-401 A, B, C, D	—	Yes	—	Yes/No	High Temperature	Start	—
Tornado Damper	VRS-OTD-403A,D, -404A,D	—	Yes	—	–/No	—	Transfer Closed	—
Ductwork	—	—	Yes	—	—/No	—	None	—
Emergency Feedwater Pump Area Temperature	VRS-TS-401, 405, 406, 411, 415, 416, 421, 425, 426, 431, 435, 436	—	Yes	—	Yes/No	—	—	—
Safety Related Component Area HVAC System								
Component Cooling Water Pump Area Air Handling Units	VRS-MAH-501 A, B, C, D	—	Yes	—	—/No	—	None	—

Table 2.7.5.2-1 Engineered Safety Features Ventilation System Equipment Characteristics (Sheet 6 of 8)

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Component Cooling Water Pump Area Air Handling Unit Fans	VRS-MFN-501 A, B, C, D	—	Yes	—	Yes/No	High Temperature	Start	—
Essential Chiller Unit Area Air Handling Units	VRS-MAH-511 A, B, C, D	—	Yes	—	—/No	—	None	—
Essential Chiller Unit Area Air Handling Unit Fans	VRS-MFN-511 A, B, C, D	—	Yes	—	Yes/No	High Temperature	Start	—
Charging Pump Area Air Handling Units	VRS-MAH-531 A, B	—	Yes	—	—/No	—	None	—
Charging Pump Area Air Handling Unit Fans	VRS-MFN-531 A, B	—	Yes	—	Yes/No	High Temperature	Start	—
Annulus Emergency Exhaust Filtration Unit Area Air Handling Units	VRS-MAH-541 A, B	—	Yes	—	—/No	—	None	—

Table 2.7.5.2-1 Engineered Safety Features Ventilation System Equipment Characteristics (Sheet 7 of 8)

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Annulus Emergency Exhaust Filtration Unit Area Air Handling Unit Fans	VRS-MFN-541 A, B	—	Yes	—	Yes/No	High Temperature	Start	—
Penetration Area Air Handling Units	VRS-MAH-551 A, B, C, D	—	Yes	—	—/No	—	None	—
Penetration Area Air Handling Unit Fans	VRS-MFN-551 A, B, C, D	—	Yes	—	Yes/No	High Temperature	Start	—
Spent Fuel Pit Pump Area Air Handling Units	VRS-MAH-561 A, B	—	Yes	—	—/No	—	None	—
Spent Fuel Pit Pump Area Air Handling Unit Fans	VRS-MFN-561 A, B	—	Yes	—	Yes/No	High Temperature	Start	—
Ductwork	—	—	Yes	—	—/No	—	None	—
Component Cooling Water Pump Area Temperature	VRS-TS-501, 504, 505, 511, 514, 515, 521, 524, 525, 531, 534, 535	—	Yes	—	Yes/No	—	—	—

Table 2.7.5.2-1 Engineered Safety Features Ventilation System Equipment Characteristics (Sheet 8 of 8)

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Essential Chiller Unit Area Temperature	VRS-TS-541, 544, 545, 551, 554, 555, 561, 564, 565, 571, 574, 575	—	Yes	—	Yes/No	—	—	—
Charging Pump Area Temperature	VRS-TS-581, 584, 585, 591, 594, 595	—	Yes	—	Yes/No	—	—	—
Annulus Emergency Exhaust Filtration Unit Area Temperature	VRS-TS-601, 604, 605, 611, 614, 615	—	Yes	—	Yes/No	—	—	—
Penetration Area Temperature	VRS-TS-621, 624, 625, 631, 634, 635, 641, 644, 645, 651, 654, 655	—	Yes	—	Yes/No	—	—	—
Spent Fuel Pit Pump Area Temperature	VRS-TS-661, 664, 665, 671, 674, 675	—	Yes	—	Yes/No	—	—	—

NOTE:
Dash (-) indicates not applicable

Table 2.7.5.2-2 Engineered Safety Features Ventilation System Equipment Alarms, Displays and Control Functions (Sheet 1 of 4)

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Annulus Emergency Exhaust System				
Annulus Emergency Exhaust Filtration Unit Fans (VRS-MFN-001 A, B)	No	Yes	Yes	Yes
Annulus Area Exhaust Dampers (VRS-EHD-001 A, B)	No	Yes	No	Yes
Safeguard Component Area Exhaust Dampers (VRS-EHD-002 A, B)	No	Yes	No	Yes
Annulus Emergency Exhaust Filtration Unit Outlet Dampers (VRS-EHD-003 A, B)	No	Yes	No	Yes
Class 1E Electrical Room HVAC System				
Class 1E Electrical Room Air Handling Unit Fans (VRS-MFN-201 A, B, C, D)	No	Yes	Yes	Yes
Class 1E Electrical Room Return Air Fans (VRS-MFN-202 A, B, C, D)	No	Yes	Yes	Yes
Class 1E Battery Room Exhaust Fans (VRS-MFN-251 A, B, C, D)	No	Yes	Yes	Yes
Class 1E Electrical Room Outside Air Intake Isolation Dampers (VRS-EHD-201 A, B, C, D)	No	Yes	No	Yes
Class 1E Electrical Room Air Handling Unit Outlet Dampers (VRS-EHD-202 A, B, C, D)	No	Yes	No	Yes
Class 1E Electrical Room Return Air Fan Inlet Dampers (VRS-EHD-203 A, B, C, D)	No	Yes	No	Yes

Table 2.7.5.2-2 Engineered Safety Features Ventilation System Equipment Alarms, Displays and Control Functions (Sheet 2 of 4)

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Class 1E Electrical Room Air Handling Unit Inlet Dampers (VRS-EHD-204 A, B, C, D)	No	Yes	Yes	Yes
Class 1E Electrical Room Exhaust Line Isolation Dampers (VRS-AOD-205 A, B, C, D)	No	Yes	Yes	Yes
Class 1E Battery Room Exhaust Fan Inlet Dampers (VRS-EHD-251 A, B, C, D)	No	Yes	No	Yes
Class 1E Battery Room Exhaust Fan Outlet Dampers (VRS-EHD-252 A, B, C, D)	No	Yes	No	Yes
Class 1E Electrical Room Temperature (VRS-TCA-210, 230, 250, 270)	Yes	No	No	No
Safeguard Component Area HVAC System				
Safeguard Component Area Air Handling Unit Fans (VRS-MFN-301 A, B, C, D)	No	Yes	Yes	Yes
Safeguard Component Area Air Handling Unit Inlet Dampers (VRS-MOD-301 A, B, C, D)	No	Yes	No	Yes
Safeguard Component Area Air Handling Unit Outlet Dampers (VRS-MOD-302 A, B, C, D)	No	Yes	No	Yes

Table 2.7.5.2-2 Engineered Safety Features Ventilation System Equipment Alarms, Displays and Control Functions (Sheet 3 of 4)

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Safeguard Component Area Temperature (VRS-TCA-305, 315, 325, 335)	Yes	No	No	No
Emergency Feedwater Pump Area HVAC System				
Emergency Feedwater Pump Area Air Handling Unit Fans (VRS-MFN-401 A, B, C, D)	No	Yes	Yes	Yes
Emergency Feedwater Pump Area Temperature (VRS-TCA-401, 411, 421, 431)	Yes	No	No	No
Safety Related Component Area HVAC System				
Component Cooling Water Pump Area Air Handling Unit Fans (VRS-MFN-501 A, B, C, D)	No	Yes	Yes	Yes
Essential Chiller Unit Area Air Handling Unit Fans (VRS-MFN-511 A, B, C, D)	No	Yes	Yes	Yes
Charging Pump Area Air Handling Unit Fans (VRS-MFN-531 A, B, C, D)	No	Yes	Yes	Yes
Annulus Emergency Exhaust Filtration Unit Area Air Handling Unit Fans (VRS-MFN-541 A, B)	No	Yes	Yes	Yes
Penetration Area Air Handling Unit Fans (VRS-MFN-551 A, B, C, D)	No	Yes	Yes	Yes

Table 2.7.5.2-2 Engineered Safety Features Ventilation System Equipment Alarms, Displays and Control Functions (Sheet 4 of 4)

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Component Cooling Water Pump Area Temperature (VRS-TCA-501, 511, 521, 531)	Yes	No	No	No
Essential Chiller Unit Area Temperature (VRS-TCA-541, 551, 561, 571)	Yes	No	No	No
Charging Pump Area Temperature (VRS-TCA-581, 591)	Yes	No	No	No
Annulus Emergency Exhaust Filtration Unit Area Temperature (VRS-TCA-601, 611)	Yes	No	No	No
Penetration Area Temperature (VRS-TCA-621, 631, 641, 651)	Yes	No	No	No
Spent Fuel Pit Pump Area Temperature (VRS-TCA-661,671)	Yes	No	No	No

Table 2.7.5.2-3 Engineered Safety Features Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a The functional arrangement of the ESFVS is as described in the Design Description of this Subsection 2.7.5.2.1, and as shown in Figures 2.7.5.2-1 through 2.7.5.2-5.	1.a An inspection of the as-built ESFVS will be performed.	1.a The as-built ESFVS conforms with the functional arrangement as described in the Design Description of this Subsection 2.7.5.2.1 and as shown in Figures 2.7.5.2-1 through 2.7.5.2-5.
1.b The annulus emergency filtration units that are identified in Table 2.7.5.2-1 are physically separated from the other divisions of the annulus emergency exhaust system.	1.b Inspections of the as-built annulus emergency exhaust system will be performed.	1.b Each mechanical division of the as-built annulus emergency filtration units that are identified in Table 2.7.5.2-1 are physically separated from other mechanical divisions by structural barriers.
1.c The Class 1E electrical room air handling units, Class 1E electrical room return air fans and Class 1E battery room exhaust fans that are identified in Table 2.7.5.2-1 are physically separated from the other divisions of the Class 1 E electrical room.	1.c Inspections of the as-built Class 1 E electrical room HVAC system will be performed.	1.c Each mechanical division of the as-built Class 1E electrical room air handling units, Class 1E electrical room return air fans and Class 1E battery room exhaust fans that are identified in Table 2.7.5.2-1 are physically separated from other mechanical divisions by structural barriers.
1.d The safeguard component area air handling units that are identified in Table 2.7.5.2-1 are physically separated from the other divisions of the safeguard component area HVAC system.	1.d Inspections of the as-built safeguard component area HVAC system will be performed.	1.d Each mechanical division of the as-built safeguard component area air handling units that are identified in Table 2.7.5.2-1 are physically separated from other mechanical divisions by structural barriers.
1.e The emergency feedwater pump area air handling units that are identified in Table 2.7.5.2-1 are physically separated from the other divisions of the emergency feedwater pump area HVAC system.	1.e Inspections of the as-built emergency feedwater pump area HVAC system will be performed.	1.e Each mechanical division of the as-built emergency feedwater pump area air handling units that are identified in Table 2.7.5.2-1 are physically separated from other mechanical divisions by structural barriers.

Table 2.7.5.2-3 Engineered Safety Features Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.f The safety-related component area air handling units that are identified in Table 2.7.5.2-1 are physically separated from the other divisions of the safety-related component area HVAC system.	1.f Inspections of the as-built safety-related component area HVAC system will be performed.	1.f Each mechanical division of the as-built safety-related component area air handling units that are identified in Table 2.7.5.2-1 are physically separated from other mechanical divisions by structural barriers.
2. The seismic Category I equipment, identified in Table 2.7.5.2-1, is designed to withstand seismic design basis loads without loss of safety function.	2.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.7.5.2-1 is located in the reactor building and power source building.	2.i The seismic Category I as-built equipment identified in Table 2.7.5.2-1 is located in the reactor building and power source building.
	2.ii Type tests and/or analyses of the seismic Category I equipment will be performed.	2.ii The result of the type tests and/or analyses concludes that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	2.iii Inspections will be performed on the as-built equipment including anchorage.	2.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.
3.a The Class 1E equipment, identified in Table 2.7.5.2-1, is powered from their respective Class 1E division.	3.a A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	3.a The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.7.5.2-1, under test.
3.b. Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	3.b Inspections of the as-built Class 1E divisional cables will be performed.	3.b Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.

Table 2.7.5.2-3 Engineered Safety Features Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4.a The annulus emergency exhaust system is capable of meeting the selected numerical performance values used in the safety analysis listed in Subsection 2.7.5.2.1.1.	4.a.i Type tests, tests and analyses of filter efficiencies for the annulus emergency exhaust system will be performed on both divisions.	4.a.i The annulus emergency exhaust system is capable of meeting the filter efficiencies identified in Subsection 2.7.5.2.1.1 on both divisions.
	4.a.ii A Test of negative pressure arrival time for the as-built annulus emergency exhaust system will be performed on both divisions.	4.a.ii The as-built annulus emergency exhaust system is capable of drawing down all four penetration areas and all four safeguard component areas to less than or equal to -0.25 inches w.g. relative to adjacent areas within the arrival time identified in Subsection 2.7.5.2.1.1 on both divisions.
4.b The Class 1E electrical room HVAC system provides conditioning air to maintain area design temperature limits in the Class 1E electrical rooms during all plant operating conditions, including normal plant operations, abnormal and accident conditions.	4.b Tests and analyses of the as-built Class 1E electrical room HVAC system will be performed for all four divisions.	4.b The as-built Class 1E electrical room HVAC system is capable of providing conditioning air to maintain area design temperature limits within the Class 1E electrical rooms during all plant operating conditions, including normal plant operations, abnormal and accident conditions.
4.c The Class 1E electrical room HVAC system provides battery room ventilation to maintain hydrogen concentration within the design limit.	4.c Tests and analyses of the as-built Class 1E electrical room HVAC system will be performed for all four divisions.	4.c The as-built Class 1E electrical room HVAC system is capable of providing battery room ventilation to maintain hydrogen concentration below 2% by battery room volume.
4.d The safeguard component area HVAC system provides conditioning air to maintain area design temperature limits within the safeguard component areas when the respective equipment is operating.	4.d Tests and analyses of the as-built safeguard component area HVAC system will be performed for all four divisions.	4.d The as-built safeguard component area HVAC system is capable of providing conditioning air to maintain area design temperature limits within the safeguard component areas when the respective equipment is operating.

Table 2.7.5.2-3 Engineered Safety Features Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 6)

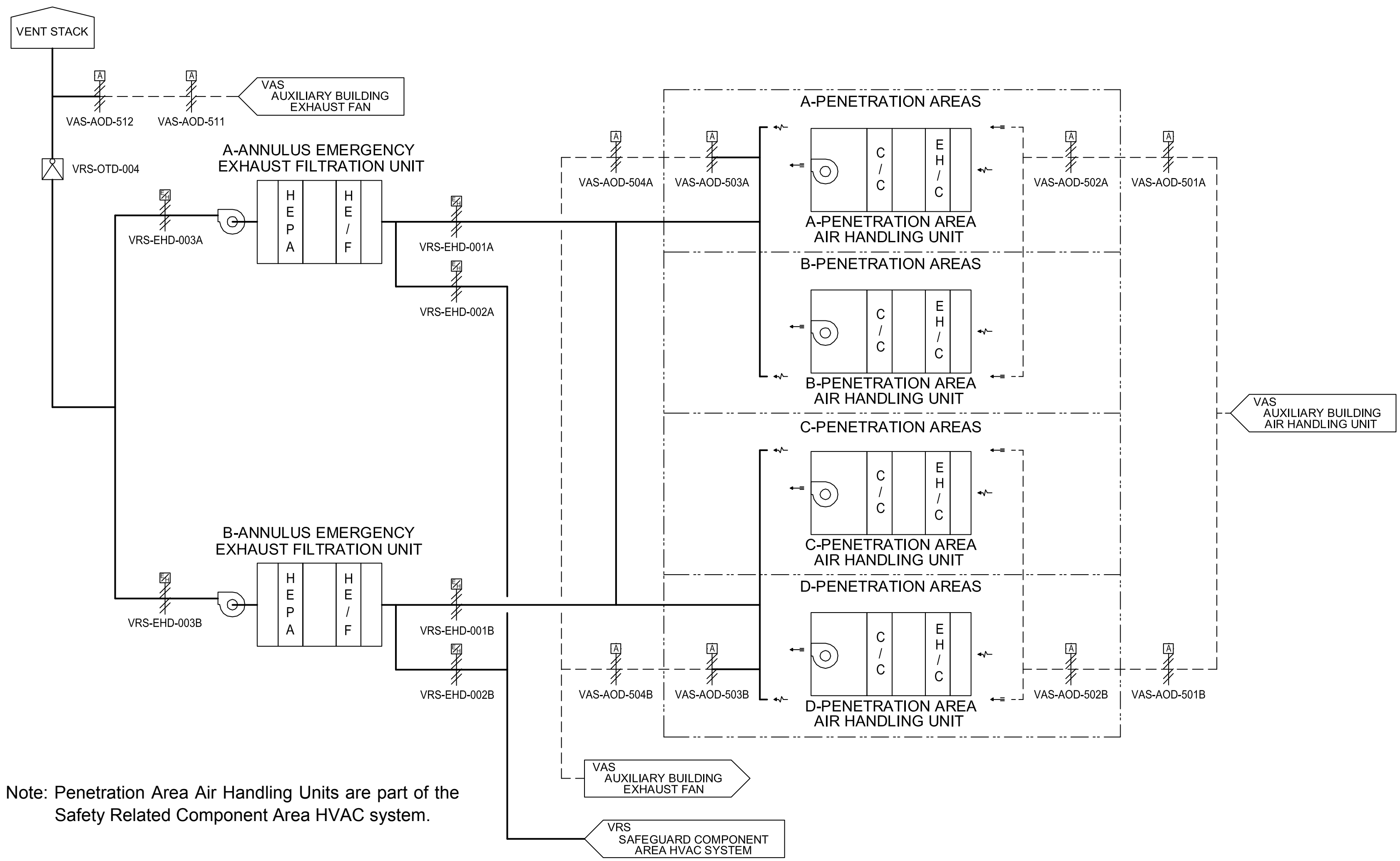
Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4.e The emergency feedwater pump area HVAC system provides conditioning air to maintain area design temperature limits within the emergency feedwater pump areas when the respective equipment is operating.	4.e Tests and analyses of the as-built emergency feedwater pump area HVAC system will be performed for all four divisions.	4.e The as-built emergency feedwater pump area HVAC system is capable of providing conditioning air to maintain area design temperature limits within the emergency feedwater pump areas when the respective equipment is operating.
4.f The safety-related component area HVAC system provides conditioning air to maintain area design temperature limits in each individual safety-related component area, when the respective equipment is operating.	4.f Tests and analyses of the as-built safety-related component area HVAC system will be performed for each safety-related component area.	4.f The as-built safety-related component area HVAC system is capable of providing conditioning air to maintain area design temperature limits in each individual safety-related component area, when the respective equipment is operating.
5.a The dampers identified in Table 2.7.5.2-1 perform an active safety function to change position as indicated in the table.	5.a.i Tests of the as-built dampers identified in Table 2.7.5.2-1 will be performed using a simulated signal.	5.a.i Each as-built damper identified in Table 2.7.5.2-1 perform the active safety function identified in the table after receiving an ECCS actuation signal or a high temperature signal.
	5.a.ii Tests of the as-built tornado dampers identified in Table 2.7.5.2-1 will be performed under preoperational test pressure, and fluid flow conditions.	5.a.ii Each as-built tornado damper changes position as identified in Table 2.7.5.2-1.
5.b After loss of motive power, the remotely operated dampers, identified in Table 2.7.5.2-1, assume the indicated loss of motive power position.	5.b Tests of the as-built remotely operated dampers will be performed under the conditions of loss of motive power.	5.b Upon loss of motive power, each as-built remotely operated damper identified in Table 2.7.5.2-1 assumes the indicated loss of motive power position.
5.c The fire dampers in ductwork that penetrates fire barrier that are required to protect safe-shutdown capability close fully when called upon to do so.	5.c Tests of the as-built fire dampers will be performed.	5.c Each as-built fire damper in ductwork that penetrates fire barrier that are required to protect safe-shutdown capability close under design air flow conditions.

Table 2.7.5.2-3 Engineered Safety Features Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5.d Controls exist in the MCR to open and close the remotely operated dampers identified in Table 2.7.5.2-2.	5.d Tests will be performed on the as-built remotely operated dampers listed in Table 2.7.5.2-2 using controls in the MCR.	5.d Controls exist in the as-built MCR to open and close the as-built remotely operated dampers listed in Table 2.7.5.2-2.
6.a. Controls exist in the MCR to start and stop the ESFVS air handling units and filtration units identified in Table 2.7.5.2-2.	6.a. Tests will be performed on the as-built air handling units and filtration units identified in Table 2.7.5.2-2 using controls in the as-built MCR.	6.a Controls exist in the as-built MCR to start and stop the as-built air handling units and filtration units identified in Table 2.7.5.2-2.
6.b. The annulus emergency exhaust system filtration unit fans system air handling unit fans identified in Table 2.7.5.2-1 start and the isolation dampers identified in Table 2.7.5.4-1 perform an active safety function to change close position simultaneously after receiving an ECCS actuation signal.	6.b. Tests of the as-built annulus emergency exhaust system filtration unit fans and isolation damper will be performed using a simulated signal.	6.b. The as-built annulus emergency exhaust system filtration unit fans identified in Table 2.7.5.2-1 start and the as-built isolation damper identified in Table 2.7.5.4-1 performs the active safety function simultaneously after receiving an ECCS actuation signal.
6.c. The Class 1E electrical room HVAC system air handling unit fans identified in Table 2.7.5.2-1 start after receiving an ECCS actuation signal.	6.c. Tests of the as-built Class 1E electrical room HVAC system air handling unit fans will be performed using a simulated signal.	6.c. The as-built Class 1E electrical room HVAC system air handling unit fans identified in Table 2.7.5.2-1 start after receiving an ECCS actuation signal.
6.d The safeguard component area HVAC system, emergency feedwater pump area HVAC system, and the safety related component area HVAC system air handling unit fans identified in Table 2.7.5.2-1 start after receiving a high temperature signal.	6.d Tests of the as-built safeguard component area HVAC system, emergency feedwater pump area HVAC system, and the safety related component area HVAC system air handling unit fans will be performed using a simulated signal.	6.d The as-built safeguard component area HVAC system, emergency feedwater pump area HVAC system, and the safety related component area HVAC system air handling unit fans identified in Table 2.7.5.2-1 start after receiving a high temperature signal.

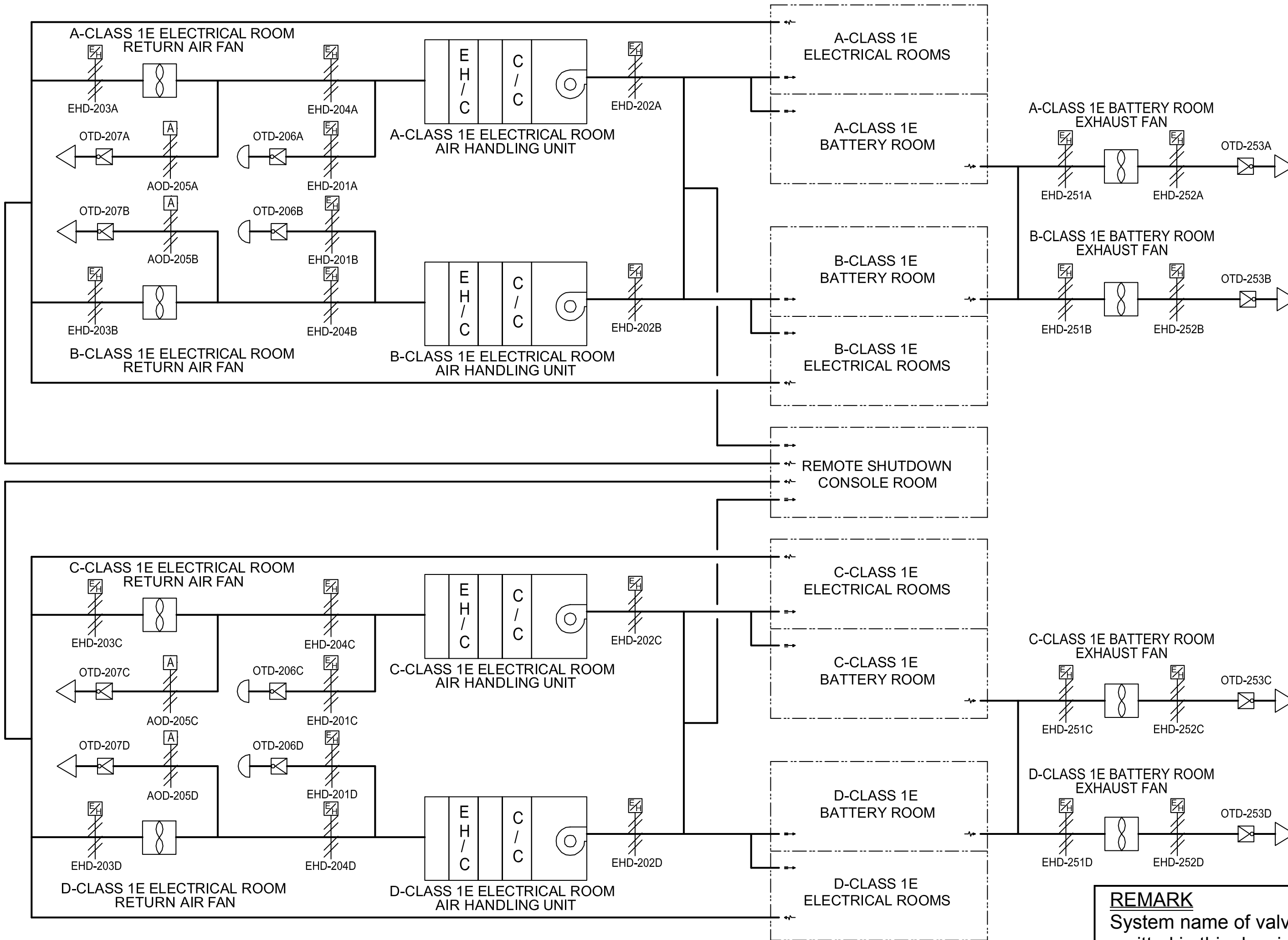
Table 2.7.5.2-3 Engineered Safety Features Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. MCR alarms and displays of the ESFVS parameters identified in Table 2.7.5.2-2 can be retrieved in the MCR.	7. Inspections will be performed for retrievability of the ESFVS parameters in the as-built MCR.	7. MCR alarms and displays identified in Table 2.7.5.2-2 can be retrieved in the as-built MCR.
8. RSC alarms, displays and controls are identified in Table 2.7.5.2-2.	8. Inspections of the as-built RSC alarms, displays and controls will be performed.	8. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.7.5.2-2.



Note: Penetration Area Air Handling Units are part of the Safety Related Component Area HVAC system.

Figure 2.7.5.2-1 Annulus Emergency Exhaust System



REMARK
System name of valve number is omitted in this drawing.
~~VRS-###~~-+++

Figure 2.7.5.2-2 Class 1E Electrical Room HVAC System

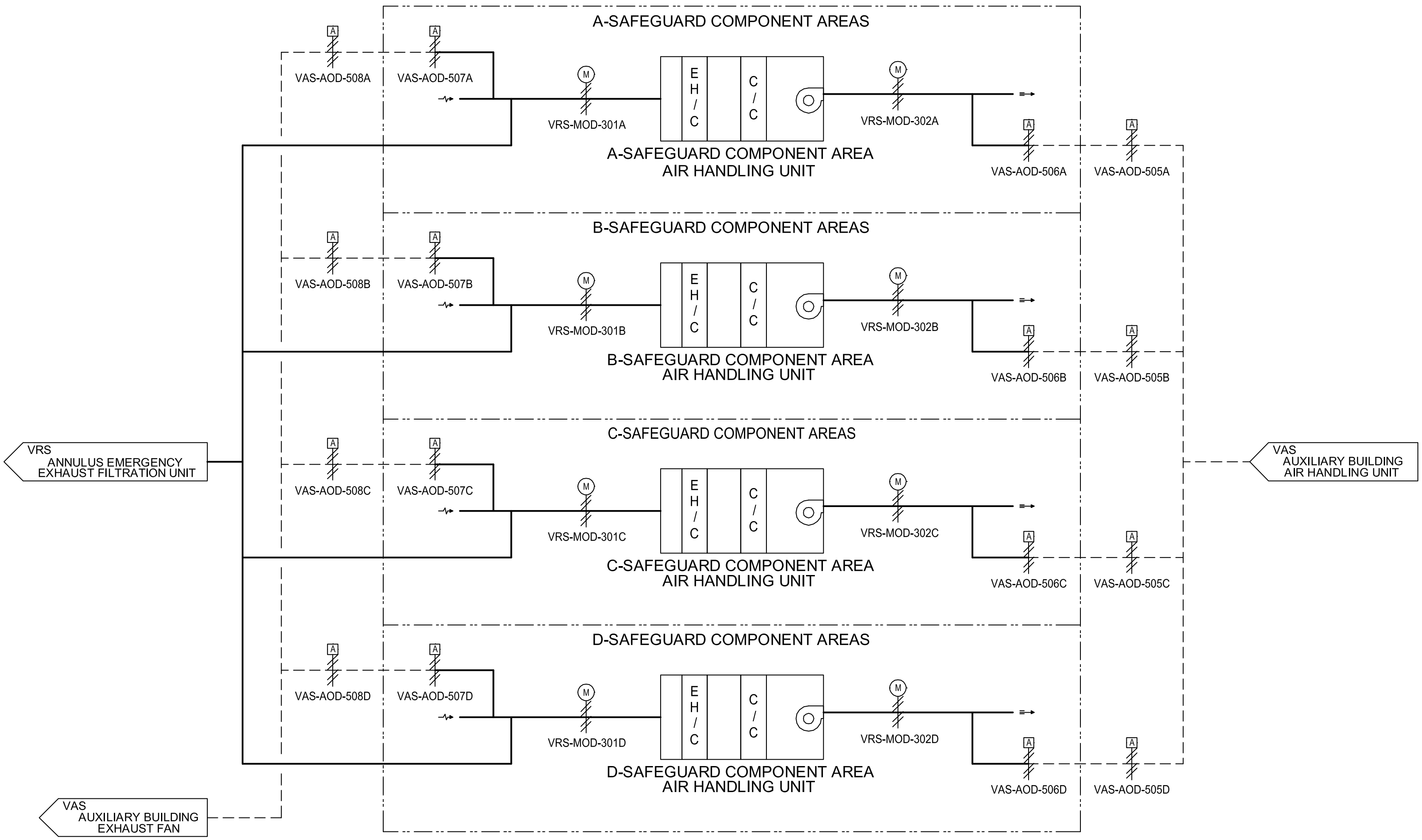
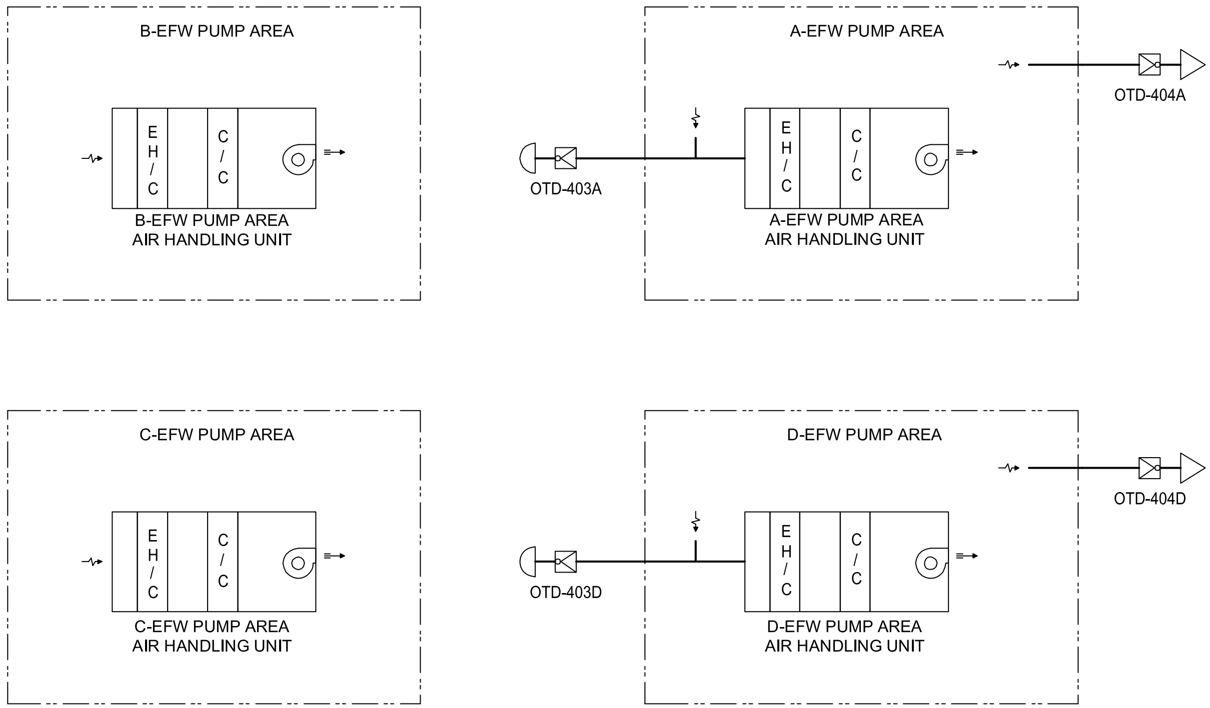
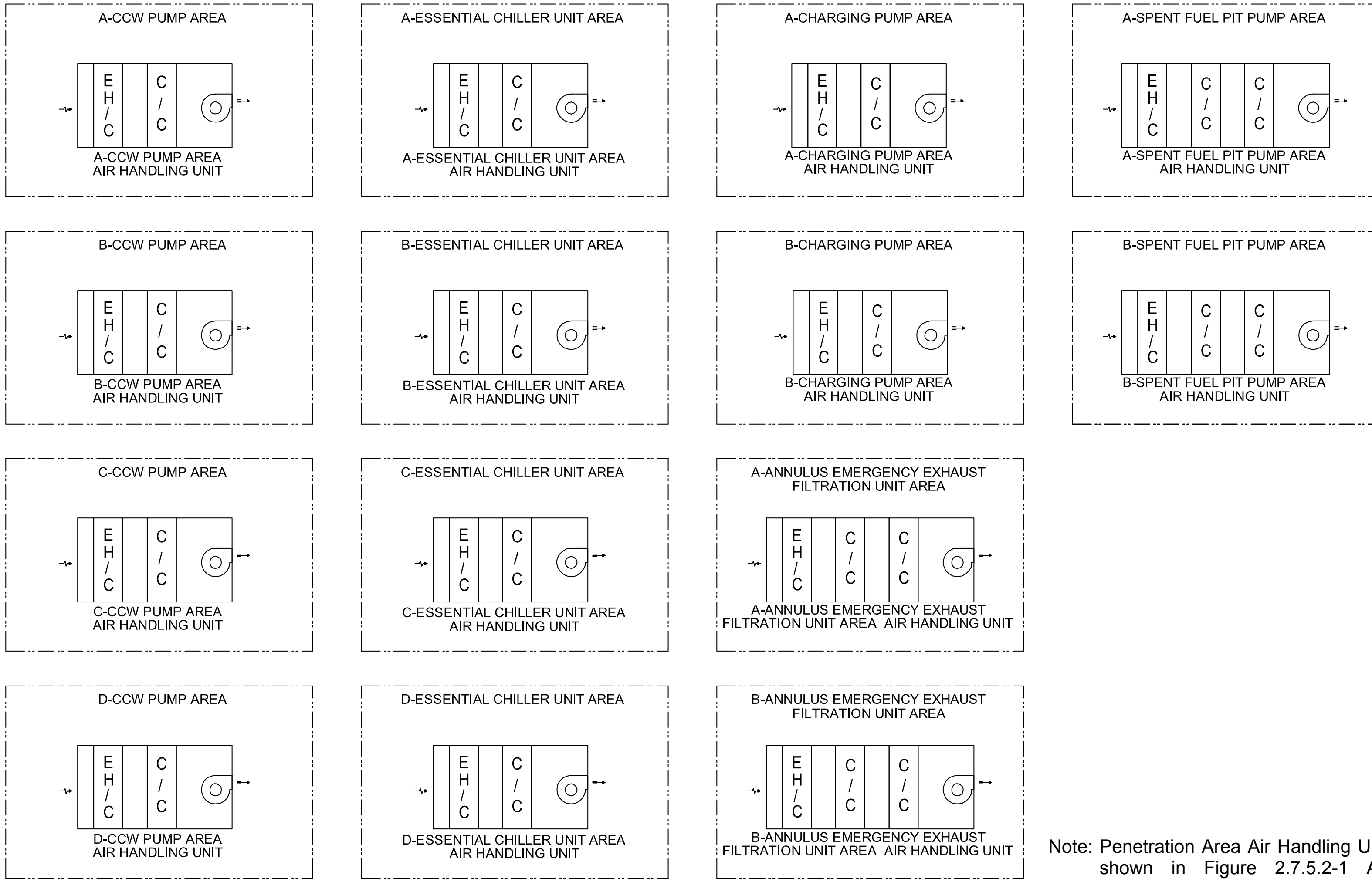


Figure 2.7.5.2-3 Safeguard Component Area HVAC System



REMARK
System name of valve number is omitted in this drawing.
~~VRS-###~~-+++

Figure 2.7.5.2-4 Emergency Feedwater Pump Area HVAC System



Note: Penetration Area Air Handling Units are shown in Figure 2.7.5.2-1 Annulus Emergency Filtration System.

Figure 2.7.5.2-5 Safety Related Component Area HVAC System

2.7.5.3 Containment Ventilation System (CVVS)

The CVVS is designed to control and maintain the environment temperature and radioactivity concentration within the containment at a level suitable for plant equipment operations and to allow the safe access to the containment for the operating personnel during inspection and maintenance periods.

The CVVS includes:

- Containment purge system
- Containment fan cooler system
- Control rod drive mechanism (CRDM) cooling system
- Reactor cavity cooling system

2.7.5.3.1 Design Description

2.7.5.3.1.1 Containment Purge System

System Purpose and Functions

The containment purge system maintains sufficiently low concentrations of radioactivity in the containment atmosphere to allow access during maintenance and inspection activities. The containment purge system also provides means of relieving pressure build-up resulting from instrument air leakage and containment temperature fluctuations. The containment purge system has a safety function to support the containment isolation function as described in Subsection 2.11.2. With the exception of the containment isolation valves, the containment purge system is a non safety-related system.

Location and Functional Arrangement

The major components of the containment purge system are located in the reactor building and auxiliary building. The containment purge system consists of the containment low volume purge system and the containment high volume purge system. The containment low volume purge system consists of two containment low volume purge air handling units and two exhaust filtration units. The containment high volume purge system consists of a containment high volume purge air handling unit and an exhaust filtration unit.

Key Design Features

The key design features of the containment purge system are reflected in the system design bases, which include:

- The containment purge system has the capability to close the safety-related, seismic Category I, containment isolation valves during a design basis accident.

- The low volume purge exhaust airflow is made to pass through a HEPA filter and a charcoal absorber by an exhaust fan, prior to being discharged to the atmosphere through the vent stack.

- The high volume purge exhaust airflow is made to pass through a HEPA filter by an exhaust fan, prior to being discharged to the atmosphere through the vent stack.

Seismic and ASME Code Classifications

The containment penetration piping and related isolation valves meet seismic Category I requirements. The containment penetration piping and the related isolation valves comply with requirements of the ASME Code Section III Class 2.

Almost all of the containment purge system components located inside of the containment meet seismic Category II, except for the containment isolation valves and penetration piping.

System Operation

The important aspects of system operation are specified under “Logic“.

Alarms, Displays, and Controls

With the exception of the containment isolation valves, there are no important alarms, displays, and controls.

Logic

The containment isolation valves in the containment purge system operate upon receipt of a containment isolation signal, as described in Subsection 2.11.2.

Interlocks

There are no interlocks needed for direct safety functions related to the containment purge system.

Class 1E Electrical Power Sources and Divisions

There are no Class 1E power sources for the containment purge system except the containment isolation valves.

Equipment to be Qualified for Harsh Environments

The safety-related portions of the containment purge system to be qualified for harsh environments are identified in Subsection 2.11.2.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.5.3.1.2 Containment Fan Cooler System

System Purpose and Functions

The containment fan cooler system is designed to maintain containment air temperature below 120°F during the normal operation of the plant. The containment fan cooler system is a non safety-related system.

Location and Functional Arrangement

The containment fan cooler system is located in the containment. The containment fan cooler system consists of four fan cooler units.

Key Design Features

The containment fan cooler system maintains containment air temperature below 120°F during the normal operation of the plant.

Seismic and ASME Code Classifications

The containment fan cooler system is not designed to ASME Code Section III requirements. However, almost all of the containment fan cooler system components meet seismic Category II.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the containment fan cooler system.

Interlocks

There are no interlocks needed for direct safety functions related to the containment fan cooler system.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.5.3.1.3 Control Rod Drive Mechanism (CRDM) Cooling System

System Purpose and Functions

The CRDM cooling system is designed to remove heat dissipated by the CRDM. The CRDM cooling system is a non safety-related system.

Location and Functional Arrangement

The CRDM cooling system is located in the containment. The CRDM cooling system consists of one CRDM cooling unit and two CRDM cooling fans.

Key Design Features

The CRDM cooling system removes heat dissipated by the CRDM during normal plant operation.

Seismic and ASME Code Classifications

The CRDM cooling system is not designed to ASME Code Section III requirements. However, almost all of the CRDM cooling system components meet seismic Category II.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the CRDM cooling system.

Interlocks

There are no interlocks needed for direct safety functions related to the CRDM cooling system.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.5.3.1.4 Reactor Cavity Cooling System

System Purpose and Functions

The reactor cavity cooling system is designed to remove the heat dissipated by the reactor vessel and the reactor vessel support structure, and the heat generated by gamma radiation and fast neutron bombardment on the primary shield wall. The reactor cavity cooling system is a non safety-related system.

Location and Functional Arrangement

The reactor cavity cooling system is located in the containment. The reactor cavity cooling system consists of two 100% capacity fans.

Key Design Features

The reactor cavity cooling system removes the heat dissipated by the reactor vessel and the reactor vessel support structure, and the heat generated by gamma radiation and fast neutron bombardment on the primary shield wall.

Seismic and ASME Code Classifications

The reactor cavity cooling system is not designed to ASME Code Section III requirements. However, almost all of the reactor cavity cooling system components meet seismic Category II.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the reactor cavity cooling system.

Interlocks

There are no interlocks needed for direct safety functions related to the reactor cavity cooling system.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.5.3.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.5.3-1 specifies the inspections, tests, analyses, and associated acceptance criteria for the CVVS. Table 2.11.2-2 specifies the ITAAC for the non-ECWS piping system and components that are part of the CIS that supplies cooling water to the containment fan cooler unit and CRDM cooling unit cooling coils. The ITAAC associated with the CVVS equipment, components and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.7.5.3-1 Containment Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the CVVS is as described in the Design Description of this Subsection 2.7.5.3.1.	1. Inspections of the as-built CVVS will be performed.	1. The as-built CVVS conforms with the functional arrangement as described in Design Description of this Subsection 2.7.5.3.1.

2.7.5.4 Auxiliary Building Ventilation System (ABVS)

The ABVS is designed to provide proper environmental conditions throughout all areas of the reactor building, the power source building, the auxiliary building and the access building during normal plant operation.

The ABVS includes:

- Auxiliary building HVAC system
- Non-Class 1E electrical room HVAC system
- Main steam / feedwater piping area HVAC system
- Technical support center HVAC system

2.7.5.4.1 Design Description

2.7.5.4.1.1 Auxiliary Building HVAC System

System Purpose and Functions

The auxiliary building HVAC system is designed to provide conditioning air to maintain the proper environmental conditions for areas housing mechanical and electrical equipment (including area housing ESF equipment) in the reactor building, power source building, auxiliary building and access building during normal plant operation. With the exception of the isolation dampers, the auxiliary building HVAC system is a non safety-related system.

Location and Functional Arrangement

The major components of auxiliary building HVAC system are located in the auxiliary building. The auxiliary building HVAC system consists of supply and exhaust systems. The supply system has two 50% capacity air handling units, both air handling units are connected to a common air distribution ductwork supplying air to served areas. The exhaust system has three 50% capacity exhaust fans.

The ABVS exhaust flow is aligned to plant vent stack and is capable of providing dilution flow to gaseous effluent stream prior to release.

Key Design Features

The key design features of the auxiliary building HVAC system are reflected in the system design bases, which include:

- The auxiliary building HVAC system has the capability to close the safety-related, seismic Category I isolation dampers of the penetration and safeguard component areas during a design basis accident, as shown in Figure 2.7.5.2-1 and Figure 2.7.5.2-3.

- The auxiliary building HVAC system has the capability to close safety-related, seismic Category I isolation dampers to prevent the back flow from the annulus emergency exhaust system during a design basis accident, as shown in Figure 2.7.5.2-1.
- The auxiliary building HVAC system ductwork is supported as required to prevent adverse interaction with other safety-related systems during a seismic event.
- The auxiliary building HVAC system provides conditioning air to maintain the proper environmental conditions for the areas it serves during normal plant condition.
- The ABVS has the non-safety related capability of providing dilution flow to the gaseous stream prior to its release from the plant vent stack.

The ventilation system has fire dampers to limit the spread of fire and combustion products. The fire dampers are capable of closing against full airflow.

Seismic and ASME Code Classifications

Only the auxiliary building HVAC system isolation dampers identified in Table 2.7.5.4-1 are qualified as seismic Category I. The system components are not designed or constructed to ASME Code Section III requirements.

System Operation

The important aspects of system operation are specified under “Logic”.

Alarms, Displays, and Controls

Table 2.7.5.4-2 identifies alarms, displays, and controls associated with the system that are located in the MCR.

Logic

The isolation dampers identified in Table 2.7.5.4-1 operate upon receipt of the ECCS actuation signal.

Interlocks

There are no interlocks needed for direct safety functions related to the auxiliary building HVAC system.

Class 1E Electrical Power Sources and Divisions

There are no Class 1E power sources for the auxiliary building HVAC system except for the isolation dampers identified in Table 2.7.5.4-1.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.5.4.1.2 Non-Class 1E Electrical Room HVAC System

System Purpose and Functions

The non-Class 1E electrical room HVAC system is designed to provide conditioning air to maintain the proper environmental conditions for equipment in the electrical rooms. The non-Class 1E electrical room HVAC system is a non safety-related system.

Location and Functional Arrangement

The major components of non-Class 1E electrical room HVAC system are located in the auxiliary building. The non-Class 1E electrical room HVAC system consists of two 50% capacity air handling units, return air fans, and two 100% capacity battery room exhaust fans.

Key Design Features

The non-Class 1E electrical room HVAC system provides conditioning air to maintain the proper environmental conditions within non-Class 1E electrical rooms during normal plant operation and LOOP. The non-Class 1E electrical room HVAC system is powered by the alternate ac power source during a LOOP.

The ventilation system has fire dampers to limit the spread of fire and combustion products. The fire dampers are capable of closing against full airflow.

Seismic and ASME Code Classifications

The non-Class 1E electrical room HVAC system is non-seismic category and is not designed to ASME Code Section III requirements.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the non-Class 1E electrical room HVAC system.

Interlocks

There are no interlocks needed for direct safety functions related to the non-Class 1E electrical room HVAC system.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.5.4.1.3 Main Steam / Feedwater Piping Area HVAC System

System Purpose and Functions

The main steam / feedwater piping area HVAC system designed to provide conditioning air to maintain the proper environmental conditions in each of the main steam / feedwater piping areas. The main steam / feedwater piping area HVAC system is a non safety-related system.

Location and Functional Arrangement

The major components of main steam / feedwater piping area HVAC system are located in the reactor building. The system consists of four 50% capacity air handling units. Each pair of air handling units services one of two main steam / feedwater piping areas.

Key Design Features

The main steam / feedwater piping area HVAC system provides conditioning air to maintain the proper environmental conditions within main steam / feedwater piping areas during normal plan operation.

Seismic and ASME Code Classifications

The main steam / feedwater piping area HVAC system is non-seismic category and is not designed to ASME Code Section III requirements.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the main steam / feedwater piping area HVAC system.

Interlocks

There are no interlocks needed for direct safety functions related to the main steam / feedwater piping area HVAC system.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.5.4.1.4 Technical Support Center HVAC System

System Purpose and Functions

The technical support center (TSC) HVAC system is designed to provide conditioning air to maintain the proper environmental conditions in the TSC. The TSC HVAC system also maintains TSC habitability and permits personnel occupancy during plant accident conditions. The TSC HVAC system is a non safety-related system.

Location and Functional Arrangement

The major components of TSC HVAC system are located in the auxiliary building. The TSC HVAC system consists of one 100% capacity TSC air handling unit, one 100% capacity emergency filtration unit classified as non-safety and one 100% toilet/kitchen exhaust fan.

Key Design Features

The key design features of the TSC HVAC system are reflected in the system design bases, which include:

- The TSC HVAC system is designed to exclude entry of airborne radioactivity and remove radioactive material from the TSC environment.
- The TSC HVAC system is designed to provide conditioning air to maintain the proper environmental condition of the TSC during normal plant and accident conditions.
- The TSC HVAC system is powered by the alternate ac power source during a LOOP.
- The TSC emergency filtration unit consists in direction of airflow, a high efficiency filter, an electric heating coil, a HEPA filter, a charcoal absorber, and a high efficiency filter.

The ventilation system has fire dampers to limit the spread of fire and combustion products. The fire dampers are capable of closing against full airflow. The heat detectors located in the charcoal filter housing when detecting the presence of smoke or heat respectively will alarm in the MCR.

Seismic and ASME Code Classifications

The TSC HVAC system is non-seismic category and is not designed to ASME Code Section III requirements.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the TSC HVAC system.

Interlocks

There are no interlocks needed for direct safety functions related to the TSC HVAC system.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable

2.7.5.4.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.5.4-3 specifies the inspections, tests analyses, and associated acceptance criteria for the ABVS.

Table 2.7.5.4-1 Auxiliary Building Ventilation System Equipment Characteristics

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Auxiliary Building HVAC System								
Penetration Area Supply Line Isolation Dampers	VAS-AOD-501 A, B, 502 A, B	—	Yes	Yes	Yes/No	ECCS Actuation	Transfer Closed	Closed
Penetration Area Exhaust Line Isolation Dampers	VAS-AOD-503 A, B, 504 A, B	—	Yes	Yes	Yes/No	ECCS Actuation	Transfer Closed	Closed
Safeguard Component Area Supply Line Isolation Dampers	VAS-AOD-505 A, B, C, D, 506 A, B, C, D	—	Yes	Yes	Yes/No	ECCS Actuation	Transfer Closed	Closed
Safeguard Component Area Exhaust Line Isolation Dampers	VAS-AOD-507 A, B, C, D, 508 A, B, C, D	—	Yes	Yes	Yes/No	ECCS Actuation	Transfer Closed	Closed
Auxiliary Building HVAC System Exhaust Line Isolation Dampers	VAS-AOD-511, 512	—	Yes	Yes	Yes/No	ECCS Actuation	Transfer Closed	Closed

Table 2.7.5.4-2 Auxiliary Building Ventilation System Equipment Alarms, Displays and Control Functions

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Penetration Area Supply Line Isolation Dampers (VAS-AOD-501 A, B, 502 A, B)	No	Yes	Yes	Yes
Penetration Area Exhaust Line Isolation Dampers (VAS-AOD-503 A, B, 504 A, B)	No	Yes	Yes	Yes
Safeguard Component Area Supply Line Isolation Dampers (VAS-AOD-505 A, B, C, D, 506 A, B, C, D)	No	Yes	Yes	Yes
Safeguard Component Area Exhaust Line Isolation Dampers (VAS-AOD-507 A, B, C, D, 508 A, B, C, D)	No	Yes	Yes	Yes
Auxiliary Building HVAC system Exhaust Line Isolation Dampers (VAS-AOD-511, 512)	No	Yes	Yes	Yes

Table 2.7.5.4-3 Auxiliary Building Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the ABVS is as described in the Design Description of this Subsection 2.7.5.4.1.	1. Inspections of the as-built ABVS will be performed.	1. The as-built ABVS conforms with the functional arrangement as described in Design Description of this Subsection 2.7.5.4.1.
2. The seismic Category I auxiliary building HVAC system isolation dampers identified in Table 2.7.5.4-1 are designed to withstand seismic design basis loads without loss of safety function.	2.i Inspections will be performed to verify that the as-built seismic Category I isolation dampers identified in Table 2.7.5.4-1 are located in the reactor building.	2.i The as-built seismic Category I isolation dampers identified in Table 2.7.5.4-1 are located in the reactor building.
	2.ii Type tests and/or analyses of the seismic Category I isolation dampers will be performed.	2.ii The result of the type tests and/or analyses concludes that the seismic Category I isolation dampers can withstand seismic design basis loads without loss of safety function.
	2.iii Inspections will be performed on the as-built isolation dampers including anchorage.	2.iii The as-built isolation dampers including anchorage are seismically bounded by the tested or analyzed conditions.
3.a The Class 1E isolation dampers identified in Table 2.7.5.4-1 are powered from their respective Class 1E division.	3.a A test will be performed on each division of the as-built isolation dampers by providing a simulated test signal only in the Class 1E division under test.	3.a The simulated test signal exists at the as-built Class 1E isolation dampers, identified in Table 2.7.5.4-1, under test.
3.b. Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	3.b Inspections of the as-built Class 1E divisional cables will be performed.	3.b Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.

Table 2.7.5.4-3 Auxiliary Building Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4.a The isolation dampers identified in Table 2.7.5.4-1 as having PSMS control, perform an active safety function after receiving a signal from PSMS.	4.a Tests will be performed on the as-built isolation dampers in Table 2.7.5.4-1 using a simulated signal.	4.a Each as-built isolation dampers identified in Table 2.7.5.4-1 as having PSMS control, perform the active function identified in the table after receiving a simulated signal.
4.b After loss of motive power, the isolation dampers identified in Table 2.7.5.4-1, assume the closed position.	4.b Tests of the as-built isolation dampers will be performed under the conditions of loss of motive power.	4.b Upon loss of motive power, each as-built isolation damper identified in Table 2.7.5.4-1 assumes the closed position.
4.c The fire dampers in ductwork that penetrates fire barrier that are required to protect safe-shutdown capability close fully when called upon to do so.	4.c Tests of the as-built fire dampers will be performed.	4.c Each as-built fire damper in ductwork that penetrates fire barrier that are required to protect safe-shutdown capability close under design air flow conditions.
5. Controls exist in the MCR to close the remotely operated isolation dampers identified in Table 2.7.5.4-2.	5. Tests will be performed on the as-built remotely operated isolation dampers listed in Table 2.7.5.4-2 using controls in the MCR.	5. Controls exist in the as-built MCR to open and close the as-built remotely operated valves listed in Table 2.7.5.4-2.
6. MCR alarms and displays of the parameters identified in Table 2.7.5.4-2 can be retrieved in the MCR.	6. Inspections will be performed for retrievability of the as-built ABVS parameters in the as-built MCR.	6. MCR alarms and displays identified in Table 2.7.5.4-2 can be retrieved in the as-built MCR.
7. RSC alarms, displays and controls are identified in Table 2.7.5.4-2.	7. Inspections of the as-built RSC alarms, displays and controls will be performed.	7. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.7.5.4-2.

Table 2.7.5.4-3 Auxiliary Building Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8. The TSC HVAC system provides a habitable workspace environment for the TSC under all plant operating conditions, including normal plant operations, abnormal and accident conditions.	8.a Tests of the as-built TSC HVAC system will be performed.	8.a The as-built TSC HVAC system is capable of providing conditioned air to maintain the proper design temperature for the TSC during all plant operating conditions, including normal plant operations, abnormal and accident conditions.
	8.b Tests and inspections of the as-built TSC HVAC system will be performed.	8.b Controls and displays are provided in the as-built MCR to operate and monitor the status of the TSC HVAC system.

2.7.5.5 Turbine Building Area Ventilation System

2.7.5.5.1 Design Description

System Purpose and Functions

The turbine building area ventilation system is not a safety-related system. This system maintains a suitable environment for the operation of equipment in the turbine building. The turbine building areas are not expected to include airborne radioactive contamination.

Location and Functional Arrangement

The turbine building area ventilation system is located inside and on the perimeter of the turbine building. The turbine building area ventilation system includes the following:

- General mechanical areas ventilation system
- Electrical equipment areas HVAC system

Key Design Features

The turbine building area ventilation system has the following design features:

- Provide a suitable environment for equipment operation in the building
- Provide effective smoke evacuation in the building
- Maintain the hydrogen concentration below the explosive limit in the battery room

Seismic and ASME Code Classifications

The turbine building area ventilation system is non-seismic category and is not designed to ASME code specifications.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the turbine building area ventilation system.

Interlocks

There are no interlocks needed for direct safety functions related to the turbine building area ventilation system.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.5.5.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.5.5-1 describes the ITAAC for the turbine building area ventilation system.

Table 2.7.5.5-1: Turbine Building Area Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the turbine building area ventilation system is as described in Section 2.7.5.5.1 Design Description.	1. Inspections of the as-built turbine building area ventilation system will be performed.	1. The as-built turbine building area ventilation system conforms to the functional arrangement described in Design Description of this Subsection 2.7.5.5.1.

2.7.6 Auxiliary Systems

2.7.6.1 New Fuel Storage

2.7.6.1.1 Design Description

System Purpose and Functions

The purpose and function of the new fuel storage facilities are to store nuclear fuel assemblies prior to their being irradiated in the reactor core. The new fuel storage facilities are safety related.

Location and Functional Arrangement

The new fuel storage facilities are located in the fuel handling area of the reactor building. The functional arrangement and design characteristics of the new fuel storage facilities are discussed below.

Key Design Features

The new fuel storage facilities consist of:

- An approximately 18 feet deep dry, unlined reinforced concrete new fuel storage pit.
- The center-to-center spacing between adjacent fuel assemblies is designed to maintain subcriticality by providing geometrically safe spacing between assemblies to reduce neutron interaction.
- The new fuel pit is provided with a drain system, which is connected to the reactor building sump and designed to prevent backflow into the new fuel pit to prevent the new fuel pit from being flooded by an unanticipated release of water.
- The new fuel storage racks maintain subcriticality for all normal and credible abnormal conditions.

Seismic and ASME Code classifications

New fuel storage racks are evaluated as seismic Category I structures. The new fuel storage pit is designed to maintain its structural integrity following a safe shutdown earthquake (SSE). Equipment, including the new fuel pit cover, with a potential to damage the stored fuel is designed to be prevented from collapsing and falling down on the structures in the event of a SSE.

The requirements of ASME Code Section III, Division I, Article NF3000 are used as the criteria for evaluation of stress analysis. The materials are procured in accordance with ASME Code Section III, Division I, Article NF2000.

System Operation

There is no important system operation of the new fuel storage facilities. Fuel is moved into and out of the new fuel storage facilities by the light load handling system (LLHS), see Subsection 2.7.6.4.

Alarms, Displays, and Controls

There are no important alarms, displays, or controls associated with the new fuel storage facilities.

Logic

There is no logic needed for direct safety functions.

Interlocks

There are no new fuel storage interlocks for direct safety functions.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no interfaces with systems outside the certified design.

Numeric Performance Values

Not applicable.

2.7.6.1.2 Inspections, Tests, Analyses, and Acceptance Criteria

The ITAAC for the new fuel storage are located in Table 2.7.6.1-1.

Table 2.7.6.1-1 New Fuel Storage Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. Deleted.	1.a Deleted.	1.a Deleted.
	1.b Deleted.	1.b Deleted.
	1.c Deleted.	1.c Deleted.
2. The functional arrangement of the new fuel storage facilities is as described in the Design Description of Subsection 2.7.6.1.1.	2. An inspection of the as-built new fuel storage facilities will be performed.	2. The as-built new fuel storage facilities conform to the functional arrangement as described in the Design Description of this Subsection 2.7.6.1.1.
3. The new fuel storage facilities meet the ASME requirements as described in the Design Description of Subsection 2.7.6.1.1.	3. An inspection of the as-built new fuel storage facilities will be performed.	3. The as-built new fuel storage facilities meet the ASME requirements described in the Design Description of this Subsection 2.7.6.1.1.
4. The new fuel storage racks are located in the reactor building.	4. An inspection will be performed to verify that the as-built new fuel storage racks are located in the reactor building.	4. The as-built new fuel storage racks are located in the reactor building.

2.7.6.2 Spent Fuel Storage

2.7.6.2.1 Design Description

System Purpose and Functions

The purpose and function of the spent fuel storage facilities are to store nuclear fuel assemblies after they have been irradiated in the reactor core. The spent fuel storage facilities are safety related.

Location and Functional Arrangement

The spent fuel storage facilities are located in the fuel handling area of the reactor building. The functional arrangement and design characteristics of the spent fuel storage facilities are discussed below.

Key Design Features

The spent fuel storage facilities consist of:

- A spent fuel pit (SFP) that is approximately 47 feet deep with reinforced concrete walls and floor, lined with stainless steel plate.
- Spent fuel storage racks that are capable of receiving up to 900 fuel assemblies.
- The center-to-center spacing between adjacent fuel assemblies is designed to preclude criticality by providing geometrically safe spacing to reduce neutron interaction.
- A liner leakage collection system is provided to collect possible leakage from liner plate welds on the pit walls and floor. This system is provided with a leak detection capability.
- The SFP is filled with water that has an initial boron concentration of approximately 4,000 ppm.
- To preclude unanticipated drainage, the spent fuel pit is not connected to the equipment drain system and the nozzles or piping connected to the SFP are installed to preclude draining below the allowed water level necessary for spent fuel cooling and radiation shielding.
- The refueling canal is connected on one side to the SFP, and on its opposite side, the refueling canal connects to the spent fuel cask loading pit and to the fuel inspection pit. A weir and gate provide physical isolation of the refueling canal from each of the pits. All the gates are located above the top elevation of the fuel seated in the SFP racks: they are normally closed and only opened as required.

- The spent fuel storage racks maintain subcriticality for all normal and credible abnormal conditions.

Seismic and ASME Code Classifications

Spent fuel storage racks are evaluated as seismic Category I structures. The spent fuel storage pit, including its integrally attached liner, is designed as seismic Category I. The walls of the spent fuel storage pit are an integral part of the seismic Category I reactor building structure. Equipment with the potential to damage the stored fuel is designed to be prevented from collapsing and falling down on the structures in the event of a safe shutdown earthquake (SSE).
The requirements of ASME Code Section III, Division I, Article NF3000 are used as the criteria for evaluation of stress analysis. The materials are procured in accordance with ASME Code Section III, Division I, Article NF2000.

System Operation

There is no "operation" of the spent fuel storage facilities. Fuel is moved into and out of the spent fuel storage facilities by the light load handling system (LLHS) as described in Subsection 2.7.6.4, and the SFP water is purified and cooled by the Spent Fuel Pit Purification and Cooling System as described in Subsection 2.7.6.3.

Alarms, Displays, and Controls

The SFP liner leakage collection system is provided with a leak detection capability. Instrumentation for SFP level and SFP temperature are addressed in Subsection 2.7.6.3. Radiation monitoring associated with the spent fuel storage facilities is addressed in Subsection 2.7.6.13.

Logic

There is no logic needed for direct safety functions.

Interlocks

There are no interlocks for direct safety functions.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no interfaces with systems outside the certified design.

Numeric Performance Values

The postulated fuel handling accident consists of an event in which the cladding of all fuel rods in one assembly is ruptured under a minimum of 23 feet of water. This allows for a decontamination factor (DF) for elemental iodine of 500 and a DF for organic iodine of 1.

2.7.6.2.2 Inspections, Tests, Analyses, and Acceptance Criteria

The ITAAC for the spent fuel storage are located in Table 2.7.6.2-1.

Table 2.7.6.2-1 Spent Fuel Storage Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. Deleted.	1.a Deleted.	1.a Deleted.
	1.b Deleted.	1.b Deleted.
	1.c Deleted.	1.c Deleted.
2. The functional arrangement of the spent fuel storage facilities is as described in the Design Description of Subsection 2.7.6.2.1.	2. An inspection of the as-built spent fuel facilities will be performed.	2. The as-built spent fuel storage facilities conform to the functional arrangement as described in the Design Description of this Subsection 2.7.6.2.1.
3. The spent fuel storage facilities meet the ASME requirements as described in the Design Description of Subsection 2.7.6.2.1.	3. An inspection of the as-built spent fuel facilities will be performed.	3. The as-built spent fuel storage facilities meet the ASME requirements described in the Design Description of this Subsection 2.7.6.2.1.
4. The spent fuel storage racks are located in the reactor building.	4. An inspection will be performed to verify that the as-built spent fuel storage racks are located in the reactor building.	4. The as-built spent fuel storage racks are located in the reactor building.

2.7.6.3 Spent Fuel Pit Cooling and Purification System

2.7.6.3.1 Design Description

System Purpose and Functions

The purpose and functions of the spent fuel pit cooling and purification system (SFPCS) include:

- Circulate the spent fuel pit (SFP) water through the SFP heat exchangers to remove the decay heat generated by spent fuel assemblies in the SFP during all plant operating conditions, including normal plant operating, abnormal and accident conditions.
- Purification and clarification of the SFP water.
- Purification of the boric acid water for the refueling water storage pit (RWSP), the refueling cavity, and the refueling water stage auxiliary tank (RWSAT) in conjunction with the refueling water system.
- Transfer boric acid water to the fuel transfer canal, fuel inspection pit and cask pit in conjunction with the refueling water system.
- Transfer boric acid water to the chemical and volume control system (CVCS) charging pump as an alternate water source.
- Supply water for RCS makeup by gravity injection from spent fuel pit as a countermeasure for loss of RHR.

The SFPCS cooling portion is safety-related, as shown in Tables 2.7.6.3-1 and 2.7.6.3-2. The purification portion of the SFPCS is non safety-related.

Location and Functional Arrangement

The location of SFPCS components is given in Table 2.7.6.3-4. Figure 2.7.6.3-1 shows the functional arrangement of the SFPCS. The functional arrangement and design characteristics of the system are further discussed below.

Key Design Features

The SFPCS, which consists of two cooling loops and two purification loops, is shown in Figure 2.7.6.3-1.

A safety-related makeup source of borated water is provided from the RWSP supply line. Borated RWSP water is pumped into the discharge line of the spent fuel cooling portion.

Seismic and ASME Code Classifications

SFPCS components and piping identified in Tables 2.7.6.3-1 and 2.7.6.3-2 meet seismic Category I standards.

SFPCS components and piping identified in Tables 2.7.6.3-1 and 2.7.6.3-2 are designed and constructed to ASME Code Section III requirements. Likewise, pressure boundary welds in ASME Code Section III components and piping meet ASME Code Section III requirements.

System Operation

During plant startup, normal plant operation, and shutdown, one SFPCS train is normally operating to provide SFP cooling and purification. The other train is available to perform other system functions, such as RWSP or RWSAT purification and water transfers. During half core off-load, two trains of SFPCS are used for SFP cooling. During full core off-loads, two trains of SFPCS in conjunction with two trains of RHRS are used for SFP cooling.

Alarms, Displays, and Controls

Alarms and displays of the SFP water level and temperature are installed both locally and in the main control room. SFPCS equipment displays and control functions are shown in Table 2.7.6.3-3.

Logic

There is no logic needed for direct safety functions related to the spent fuel pit purification and cooling system.

Interlocks

There are no interlocks needed for direct safety functions related to the spent fuel pit purification and cooling system.

Class 1E Electrical Power Sources and Divisions

The SFPCS equipment identified in Table 2.7.6.3-1 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

Not applicable

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.6.3.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.6.3-5 describes the ITAAC for the spent fuel pit cooling and purification system.

Table 2.7.6.3-1 Spent Fuel Pit Cooling and Purification System Equipment Characteristics

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Spent fuel pit pumps	SFS-MPP-001A,B	3	Yes	–	Yes/No	Remote Manual	Start	–
						ECCS Actuation	Start	
Spent fuel pit heat exchangers	SFS-MHX-001A,B	3	Yes	–	—/—	—/—	—	–
Spent fuel pit	SFS-MPT-001	—	Yes	—	—/—	—	—	–
Spent fuel pump discharge check valves	SFS-VLV-006A,B	3	Yes	—	—/—	—	Transfer Open/ Transfer Close	–

Note: Dash (-) indicates not applicable

Table 2.7.6.3-2 Spent Fuel Pit Cooling and Purification System Piping Characteristics

Pipe Line Name	ASME Code Section III	Seismic Category I
SFP cooling piping up to and including the following valves: Purification line isolation valves: SFS-VLV-101A,B and SFS-VLV-133A,B	3	Yes
Safety-related SFP make up line from RWSP	3	Yes
Connection piping to and from RHRS	3	Yes
Water transfer line to transfer canal, cask pit, fuel inspection pit.	3	Yes

Table 2.7.6.3-3 Spent Fuel Pit Cooling and Purification System Equipment Alarms, Displays and Control Functions

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
SFP pump SFS-MPP-001A, B	No	Yes	Yes	No

Table 2.7.6.3-4 Spent Fuel Pit Cooling and Purification System Location of Equipment and Piping

System and Components	Location
Spent fuel pit	Reactor Building
Spent fuel pit pumps	Reactor Building
Spent fuel pit heat exchangers	Reactor Building
SFP cooling piping up to and including the following valves : Purification line isolation valves: SFS-VLV-101A,B and SFS-VLV-133A,B	Reactor Building
Safety related SFP make up line from RWSP	Reactor Building
Connection piping to and from RHRS	Reactor Building
Water transfer line to transfer canal, cask pit, fuel inspection pit.	Reactor Building

Table 2.7.6.3-5 Spent Fuel Pit Cooling and Purification System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the SFPCS is as described in the Design Description of Subsection 2.7.6.3 and as shown on Figure 2.7.6.3-1.	1. An inspection of the as-built SFPCS will be performed.	1. The as-built SFPCS conforms to the functional arrangement described in the Design Description of this Subsection 2.7.6.3.
2.a.i The ASME Code Section III components of the SFPCS, identified in Table 2.7.6.3-1, are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.a.i An inspection of the as-built ASME Code Section III components of the SFPCS will be performed.	2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the SFPCS identified in Table 2.7.6.3-1 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.a.ii The ASME Code Section III components of the SFPCS identified in Table 2.7.6.3-1 are reconciled with the design requirements.	2.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the SFPCS identified in Table 2.7.6.3-1 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.
2.b.i The ASME Code Section III piping of the SFPCS, including supports, identified in Table 2.7.6.3-2, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.b.i An inspection of the as-built ASME Code Section III piping of the SFPCS, including supports, will be performed.	2.b.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the SFPCS, including supports, identified in Table 2.7.6.3-2 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

Table 2.7.6.3-5 Spent Fuel Pit Cooling and Purification System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.b.ii The ASME Code Section III piping of the SFPCS, including supports, identified in Table 2.7.6.3-2 is reconciled with the design requirements.	2.b.ii A reconciliation analysis of the piping of the SFPCS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.b.ii The ASME Code Section III design report(s) (certified when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the SFPCS, including supports, identified in Table 2.7.6.3-2 is reconciled with the design requirements. The report documents the results of the reconciliation analysis.
3.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.7.6.3-1, meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
3.b Pressure boundary welds in ASME Code Section III piping, identified in Table 2.7.6.3-2, meet ASME Code Section III requirements for non-destructive examination of welds.	3.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
4.a The ASME Code Section III components, identified in Table 2.7.6.3-1, retains their pressure boundary integrity at their design pressure.	4.a A hydrostatic test will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	4.a The results of the hydrostatic test of the as-built components identified in Table 2.7.6.3-1 as ASME Code Section III conform with the requirements of the ASME Code Section III.
4.b The ASME Code Section III piping, identified in Table 2.7.6.3-2, retains its pressure boundary integrity at its design pressure.	4.b A hydrostatic test will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the hydrostatic test of the as-built piping identified in Table 2.7.6.3-2 as ASME Code Section III conform with the requirements of the ASME Code Section III.

Table 2.7.6.3-5 Spent Fuel Pit Cooling and Purification System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5. The seismic Category I equipment, identified in Table 2.7.6.3-1 is designed to withstand seismic design basis loads without loss of safety function.	5.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.7.6.3-1 is located in the containment and reactor building.	5.i The seismic Category I as-built equipment identified in Table 2.7.6.3-1 is located in the containment and reactor building.
	5.ii Type tests and/or analyses of seismic Category I equipment will be performed.	5.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.iii Inspections will be performed on the as-built equipment including anchorage.	5.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.
6. Each of the seismic Category I piping, including supports, identified in Table 2.7.6.3-2 is designed to withstand combined normal and seismic design basis loads without a loss of its safety function.	6.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table 2.7.6.3-2 are supported by a seismic Category I structure(s).	6.i Reports(s) document that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.6.3-2 is supported by a seismic Category I structure(s).
	6.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, identified in Table 2.7.6.3-2 can withstand combined normal and seismic design basis loads without a loss of its safety function.	6.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.6.3-2 can withstand combined normal and seismic design basis loads without a loss of its safety function.
7.a The Class 1E equipment identified in Table 2.7.6.3-1 is powered from their respective Class 1E division.	7.a A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	7.a The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.7.6.3-1, under test.
7.b Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	7.b Inspections of the as-built Class 1E divisional cables will be performed.	7.b Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.

Table 2.7.6.3-5 Spent Fuel Pit Cooling and Purification System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8. The SFPCS components identified in Table 2.7.6.3-1 remove the decay heat generated by the spent fuel assemblies in the SFP during all plant operating conditions, including normal plant operating, abnormal and accident conditions.	8.a An inspection for the existence of a report that determines heat removal capacity of the as-built heat exchangers will be performed.	8.a A report exists and concludes that the product of the overall heat transfer coefficient and heat exchanger area of the SFP heat exchangers identified in Table 2.7.6.3-1 is greater than or equal to the design values for all plant operating conditions, including normal plant operating, abnormal and accident conditions.
	8.b Tests will be performed to confirm that the as-built SFP pumps can provide flow to the SFP heat exchangers.	8.b The as-built SFP pumps identified in Table 2.7.6.3-1 are capable of achieving their design flow rate.
9. MCR displays of the parameters identified in Table 2.7.6.3-3 can be retrieved in the MCR.	9. Inspections will be performed for the retrievability of the SFPCS parameters in the as-built MCR.	9. MCR displays identified in Table 2.7.6.3-3 can be retrieved in the as-built MCR.
10. RSC displays and controls are identified in Table 2.7.6.3-3.	10. Inspections of the as-built RSC displays and controls will be performed.	10. Displays and controls exist on the as-built RSC as identified in Table 2.7.6.3-3.
11. Controls exist in the MCR to start and stop the pumps identified in Table 2.7.6.3-3.	11. Tests will be performed on the as-built pumps in Table 2.7.6.3-3 using controls in the as-built MCR.	11. Controls exist in the as-built MCR to start and stop the as-built pumps listed in Table 2.7.6.3-3.
12. The check valves, identified in Table 2.7.6.3-1, perform an active safety function to change position as indicated in the table.	12. Tests of the as-built check valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	12. Each as-built check valve changes position as indicated in Table 2.7.6.3-1 under pre-operational test conditions.

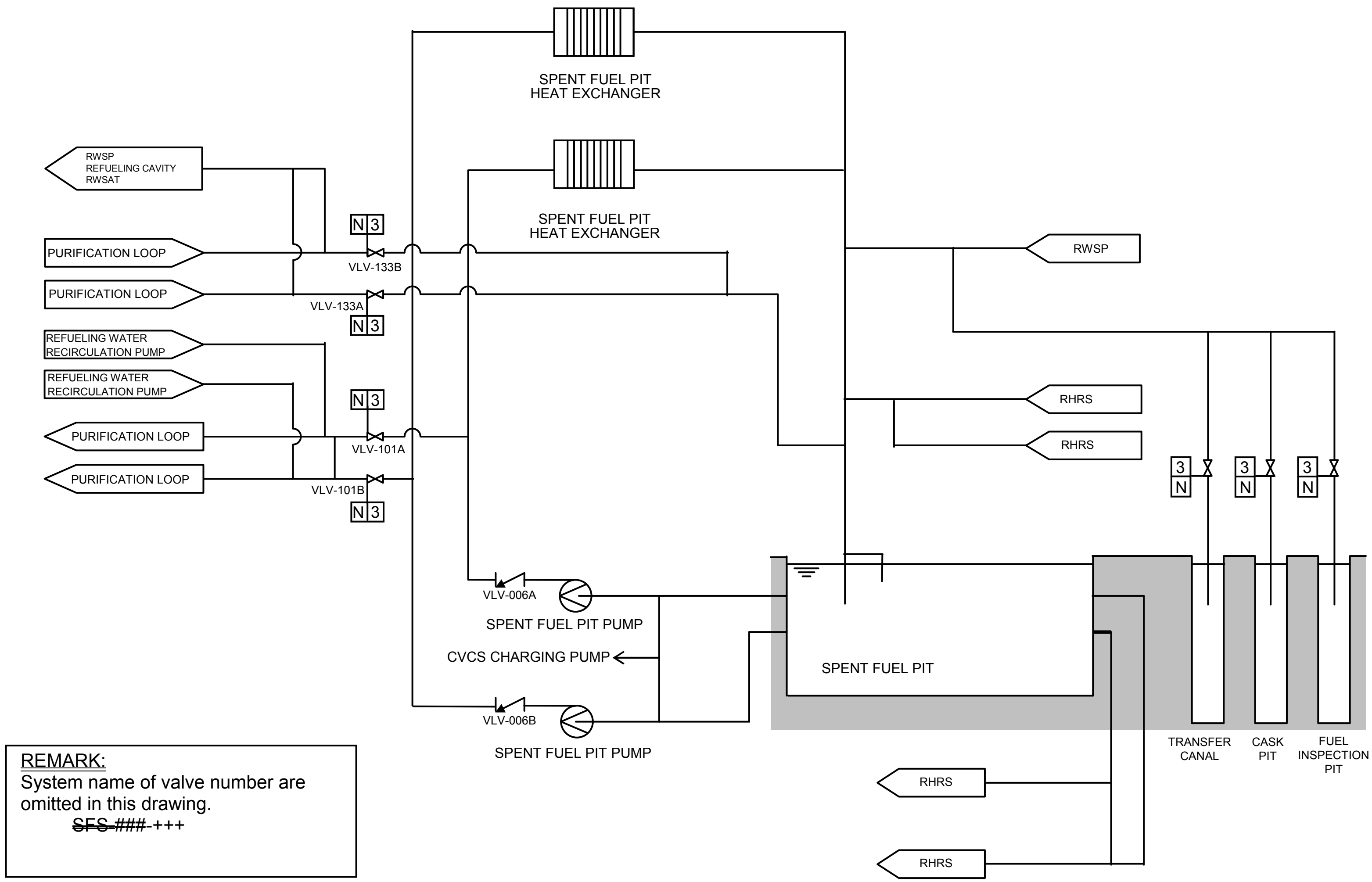


Figure 2.7.6.3-1 Spent Fuel Pit Cooling and Purification System

2.7.6.4 Light Load Handling System

2.7.6.4.1 Design Description

System Purpose and Functions

The light load handling system (LLHS) consists of mechanical and electrical equipment and building structural features related to refueling operations. This encompasses the fuel handling cycle from receipt of new fuel through loading of spent fuel into the spent fuel cask. All of the LLHS, except the fuel transfer tube and blind flange, is non-safety related.

Location and Functional Arrangement

The LLHS is located in the fuel storage and handling area of the reactor building. The functional arrangement and design characteristics of the LLHS are discussed below.

Key Design Features

The LLHS equipment includes the refueling machine, the fuel handling machine, the new fuel elevator, the suspension hoist of the spent fuel cask handling crane, the fuel transfer tube, and the fuel transfer tube blind flange.

The fuel transfer tube blind flange assures the containment pressure boundary integrity outside of refueling operations

Seismic and ASME Code Classifications

Table 2.7.6.4-1 shows the seismic Category classification of the LLHS.

System Operation

The LLHS operation includes:

- New Fuel Receipt – The new fuel shipping container is raised from the truck to the operating floor using the suspension hoist on the spent fuel cask handling crane. Using the suspension hoist, new fuel is removed from the shipping container and stored in the new fuel storage pit.

- Reactor Refueling – The LLHS is used to remove irradiated fuel assemblies from the core and relocate them to the spent fuel pit. Partially used fuel and new fuel assemblies are then transferred and installed into their designated positions in the reactor core by the LLHS.

- Spent Fuel Shipment – The fuel handling machine is used to lift the spent fuel assembly out of the spent fuel rack, transfer it across the SFP, and insert the assembly into the spent fuel cask.

Alarms, Displays, and Controls

There are no main control room alarms, displays, or controls associated with the LLHS. The LLHS has interlock actuation annunciation lamps to visually prompt the operator of interlock status. Additionally, movement of the fuel handling machine and the refueling machine bridge is audibly signaled.

Logic

The LLHS is designed such that following loss of control or power function, the load remains in a safe condition.

Interlocks

The refueling machine utilizes electrical interlocks, limit switches, and mechanical stops to: 1) prevent damage to a fuel assembly, 2) assure appropriate radiation shielding depth below the water level in the reactor cavity, and 3) monitor the fuel assembly load for imparted loads greater than the nominal weight of the fuel assembly.

The suspension hoist on the spent fuel cask handling crane (Subsection 2.7.6.5) has a load limit interlock. This interlock precludes the suspension hoist from lifting a load greater than its rated capacity.

The new fuel elevator winch has a load sensing device which prevents a fuel assembly from being raised.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.6.4.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.6.4-2 describes the ITAAC for light load handling system.

Table 2.7.6.4-1 Light Load Handling System Characteristics

Name	Seismic Category
New Fuel Elevator	II
Suspension Hoist and Auxiliary Hoist on the Spent Fuel Cask Handling Crane	II
Refueling Machine	II
Fuel Handling Machine	II
Fuel Transfer Tube	I
Fuel Transfer Tube Blind Flange	I

Table 2.7.6.4-2 Light Load Handling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the LLHS is as described in the Design Description of Subsection 2.7.6.4.1.	1. Inspections of the as-built LLHS will be performed.	1. The as-built LLHS conforms to the functional arrangement described in the Design Description of this Subsection 2.7.6.4.1.
2.a The seismic Category I LLHS equipment identified in Table 2.7.6.4-1 is designed to withstand seismic design basis loads without the loss of safety function.	2.a.i Inspections will be performed to verify that the as-built seismic Category I LLHS equipment identified in Table 2.7.6.4-1 is located in the reactor building.	2.a.i The as-built seismic Category I LLHS equipment identified in Table 2.7.6.4-1 is located in the reactor building.
	2.a.ii Type test and/or analyses of the seismic Category I equipment will be performed.	2.a.ii The results of the type test and/or analyses conclude that the seismic Category I LLHS equipment can withstand seismic design basis loads without loss of safety function.
	2.a.iii Inspection will be performed on the as-built equipment including anchorage.	2.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.
2.b The seismic Category II LLHS equipment identified in Table 2.7.6.4-1 are designed so that the SSE could not cause unacceptable structural interaction or failure with seismic Category I SSCs.	2.b A combination of inspections, tests and/or analyses will be performed on the as-built seismic Category II LLHS equipment identified in Table 2.7.6.4-1.	2.b A report exists and concludes that the as-built seismic Category II LLHS equipment identified in Table 2.7.6.4-1 are designed so that the SSE could not cause unacceptable structural interaction or failure with seismic Category I SSCs.

Table 2.7.6.4-2 Light Load Handling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3. The refueling machine utilizes electrical interlocks, limit switches, and mechanical stops to: a) prevent damage to a fuel assembly due to inadvertent operation of the gripper controls b) assure appropriate radiation shielding depth below the water level in the reactor cavity, and c) monitor the fuel assembly load for imparted loads greater than the nominal weight of the fuel assembly.	3. Tests of the as-built electrical interlocks, limit switches, and mechanical stops of the as-built refueling machine will be performed, including: a) Operating the open controls of the gripper while suspending a dummy fuel assembly. b) Attempting to raise a dummy fuel assembly above a preset height that is established to maintain adequate shielding depth below the water level in the refueling cavity. c) Attempting to lift a dummy fuel assembly that is heavier than the nominal fuel assembly.	3. The as-built refueling machine utilizes electrical interlocks, limit switches, and mechanical stops to: a) prevent damage to a fuel assembly due to inadvertent operation of the gripper controls. b) assure appropriate radiation shielding depth below the water level in the reactor cavity, and c) monitor the fuel assembly load for imparted loads greater than the nominal weight of the fuel assembly.
4. The suspension hoist is precluded from lifting a load greater than its rated capacity by a load limit interlock.	4. Test of the as-built suspension hoist's load limit interlock will be performed.	4. The as-built suspension hoist is precluded from lifting a load greater than its rated capacity of 2 metric tons.
5. The new fuel elevator winch has a load sensing device which prevents a fuel assembly from being raised.	5. Test of the as-built load sensing device on the new fuel elevator will be performed.	5. The as-built new fuel elevator which has a load sensing device which prevents a fuel assembly from being raised.

Table 2.7.6.4-2 Light Load Handling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6. The fuel handling machine utilizes electrical interlocks, limit switches, and mechanical stops to: a) prevent damage to a fuel assembly, b) assure appropriate radiation shielding depth below the water level in the reactor cavity. c) monitor the fuel assembly load for imparted loads greater than the nominal weight of the fuel assembly.	6. Test of the as-built electrical interlocks, limit switches, and mechanical stops of the as-built fuel handling machine will be performed, including: a) Operating the open controls of the gripper while suspending a dummy fuel assembly. b) Attempting to raise a dummy fuel assembly above a preset height. c) Attempting to lift a dummy assembly that is heavier than the nominal fuel assembly.	6. The as-built fuel handling machine utilizes electrical interlocks, limit switches, and mechanical stops to: a) prevent damage to a fuel assembly, b) assure appropriate radiation shielding depth below the water level in the reactor cavity. c) monitor the fuel assembly load for imparted loads greater than the nominal weight of the fuel assembly.
7. ITAAC for fuel transfer tube: Refer to DCD Tier 1 Table 2.11.2-2, ITAAC Items 1, 2b, 3b, and 4b.		

2.7.6.5 Overhead Heavy Load Handling System

2.7.6.5.1 Design Description

System Purpose and Functions

The purpose and function of the overhead heavy handling system (OHLHS) is to move heavy loads. For the US-APWR, a heavy load is defined as any load greater than approximately 2450 lbs. The OHLHS is non-safety related.

Location and Functional Arrangement

The OHLHS exists in the reactor building, specifically the fuel storage and handling area, and in the pre-stressed concrete containment vessel (PCCV) of the reactor building. The functional arrangement and design characteristics of the OHLHS are discussed below.

Key Design Features

Key design features of the OHLHS include:

- The primary equipment used in the OHLHS are the spent fuel cask handling crane in the fuel handling area and the polar crane in the PCCV.
- The spent fuel cask handling crane has three load handling hooks: the main, the auxiliary, and the suspension hoist.
- The suspension hoist is only used for new fuel assembly handling between a new fuel container to the new fuel storage area or between the new fuel storage rack and the basket on the new fuel elevator. Because of this limitation, the suspension hoist is considered part of the Light Load Handing System (LLHS) (Subsection 2.7.6.4).
- The polar crane has a seismic restraint system which precludes derailment of either the hoist trolley or the main bridge box girders during a seismic event.
- The main hooks of the PCCV polar crane and the spent fuel cask handling crane are designed as single-failure-proof cranes. Special lifting devices and slings used for critical load handling operations in conjunction with these cranes have dual load paths or double safety factors.

Seismic and ASME Code Classifications

The OHLHS is seismic Category II.

System Operation

The OHLHS operation includes:

- A spent fuel cask filled with spent fuel assemblies is lifted and transferred using the main hoist of the spent fuel cask handling crane and the spent fuel cask lift rig.
- During refueling, the reactor vessel head assembly and the upper and lower reactor internals are transferred using the polar crane's main hook and a lifting rig.
- Reactor coolant pump motors and other similar sized equipment are transferred using the polar crane's auxiliary hook.

Alarms, Displays, and Controls

There are no main control room alarms, displays, or controls associated with the OHLHS.

Logic

Not applicable.

Interlocks

The OHLHS is equipped with mechanical and electrical limit devices to disengage power to the motors as the load hook approaches its travel limits or to prevent damage to other components when continued operation would potentially damage the OHLHS.

The control system includes safety devices which assure that the OHLHS returns to and/or maintains a secure holding position of critical loads in the event of a system fault.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

The PCCV polar crane and the spent fuel cask handling crane are designed as single-failure-proof to prevent uncontrolled lowering of heavy loads. Therefore, no load drop accident analysis is required. Crane axle failure may result in limited slip of the lifted load, causing impact on the floor, which has been accounted for in the structural design.

2.7.6.5.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.6.5-1 describes the ITAAC for the OHLHS.

Table 2.7.6.5-1 Overhead Heavy Load Handling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the OHLHS is as described in the Design Description of Subsection 2.7.6.5.1.	1. An inspection of the as-built OHLHS will be performed.	1. The as-built OHLHS conforms to the functional arrangement described in the Design Description of this Subsection 2.7.6.5.1.
2.a The seismic Category II OHLHS is designed so that the SSE could not cause unacceptable structural interaction or failure with seismic Category I SSCs.	2.a A combination of inspection, tests and/or analyses will be performed on the as-built seismic Category II OHLHS.	2.a A report exists and concludes that the as-built seismic Category II OHLHS equipment is designed so that the SSE could not cause unacceptable structural interaction or failure with seismic Category I SSCs.
2.b The polar crane has a seismic restraint system which precludes derailment of either the hoist trolley or the main bridge box girders during a seismic event.	2.b A combination of inspections, test and/or analyses will be performed on the as-built polar crane seismic restraint system.	2.b A report exists and concludes that the as-built polar crane seismic restraint system precludes derailment of either the hoist trolley or the main bridge box girders during a seismic event.
2.c The PCCV polar crane and the spent fuel cask handling crane main hook are designed as single-failure proof cranes.	2.c A combination of inspection, tests and/or analyses will be performed on the as-built OHLHS.	2.c A report exists and concludes that the as-built PCCV polar crane and the spent fuel cask handling crane main hook are single failure proof.
2.d Special lifting devices and slings used in conjunction with the PCCV polar crane and the spent fuel cask handling crane main hook during critical load handling operations have dual load paths or double safety factors.	2.d A combination of inspection, tests and/or analyses will be performed on the as-built OHLHS.	2.d A report exists and concludes that the as-built special lifting devices and slings used in conjunction with the PCCV polar crane and the spent fuel cask handling crane main hook during critical load handling operations have dual load paths or double safety factors.

Table 2.7.6.5-1 Overhead Heavy Load Handling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3. The OHLHS is equipped with mechanical and electrical limit devices to disengage power to the motors as the load hook approaches its travel limits, to prevent damage to other components when continued operation would potentially damage the OHLHS or safety-related SSCs.	3. Tests of the as-built OHLHS mechanical and electrical limit devices to disengage power to the motors as the load hook approaches its travel limits will be performed.	3. The as-built OHLHS is equipped with mechanical and electrical limit devices to disengage power to the motors as the load hook approaches its travel limits or safety-related SSCs.
4. The control system includes safety devices which assure that the OHLHS returns to and/or maintains a secure holding position of critical loads in the event of a system fault.	4. Tests of the as-built OHLHS control system to assure that the as-built OHLHS returns to and/or maintains a secure holding position of critical loads in the event of a system fault will be performed.	4. The as-built control system includes safety devices which assure that the as-built OHLHS returns to and/or maintains a secure holding position of critical loads in the event of a system fault.

2.7.6.6 Process Effluent Radiation Monitoring and Sampling System

2.7.6.6.1 Design Description

System Purpose and Functions

The purpose and functions of the process effluent radiation monitoring and sampling system (PERMS) are:

- Sample, measure, control, and record the radioactivity levels of selected process streams within the plant and effluent streams released into the environment
- Actuate alarms and control releases of radioactivity
- Provide data to keep exposure to workers ALARA
- Provide process data to support plant operation

The performance of the PERMS in controlling and monitoring process and effluent streams is in accordance with the applicable NRC regulations.

The MCR monitors are safety-related, while the remainder of the PERMS is non-safety related.

The safety function of the MCR monitors is that the detection of radioactivity levels in the stream exceeding the predetermined setpoints automatically activates signals to start the main control room isolation, and activates an alarm in the MCR for operator actions.

Location and Functional Arrangement

The PERMS monitors are located in the R/B, the A/B, and the T/B. Table 2.7.6.6-1 provides information on the design characteristics of PERMS components. Information in the table is discussed below.

Key Design Features

The key design features of the PERMS are reflected in the system design bases, which include:

- Monitor the radioactivity in plant radiological effluents released to unrestricted areas during normal plant operations and anticipated operational occurrences (AOO).
- Provide state-of-the-art monitoring equipment, and controls to assure that doses in unrestricted areas from liquid and gaseous effluents are ALARA.

- Provide state-of–the-art monitoring equipment for the liquid and gaseous effluents from the plant systems to facilitate the preparation of annual release reports of nuclides to unrestricted areas.

- Provide operational data to minimize and/or prevent the contamination of the facility and of the environment.

- Control the release of liquid and gaseous effluents from the plant.

- Provide monitoring of radioactive waste systems to detect conditions that may result in excessive radiation levels.

- Provide monitoring of the containment atmosphere, the spaces containing components for recirculation of loss-of coolant accident fluids, effluent discharge paths, and the plant environs for radioactivity that may be released from normal operations, AOOs, and during post-accident conditions.

- Provide monitoring instruments to measure radiation levels and quantities of noble gases at key potential release points. Monitoring of radioactive iodine and particulates in gaseous effluents from all potential accident release points is provided.

- Provide monitoring capability for in-plant radiation and airborne radioactivity for a broad range of routine and accident conditions.

- Provide radiation monitoring capabilities to assure plant systems operate as they are designed and installed.

- Each division of the Class 1E radiation monitors identified in Table 2.7.6.6-1 is physically separated from the other divisions by a structural barrier, which also serves as a fire barrier.

Seismic Classifications

The PERMS monitors with seismic classification are the MCR monitors and the containment radiation particulate monitor.

System Operation

PERMS radiological monitoring instruments are provided for all effluent streams during normal operations, AOOs, and post-accident conditions. Likewise, PERMS monitoring is provided for the reactor containment atmosphere, the spaces containing components for recirculation of loss-of coolant accident fluids, effluent discharge paths, and the plant environs for radioactivity that may be released from normal operations, AOOs, and during post-accident conditions.

Alarms, Displays, and Controls

Monitoring and alarm data from the PERMS are transmitted to the MCR and made accessible to plant operators.

Logic

When the MCR monitors detect radiation levels above predetermined setpoints, the emergency MCR HVAC system is actuated.

Interlocks

When the MCR monitors detect radiation levels above predetermined setpoints, interlocks are activated to maintain the integrity of the MCR envelope.

Class 1E Electrical Power Sources and Divisions

As identified in Table 2.7.6.6-1, the MCR monitors are the only PERMS monitors that are powered from their respective Class 1E divisions. Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cables.

Equipment to be Qualified for Harsh Environments

As identified in Table 2.7.6.6-1, there are no PERMS monitors that need to be able to withstand the harsh environments.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

No selected PERMS numerical performance values are used in the safety analyses.

2.7.6.6.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.6.6-2 describes the ITAAC for process effluent radiological monitoring and sampling system.

Table 2.7.6.6-1 Process Effluent Radiation Monitoring and Sampling System Equipment Characteristics (Sheet 1 of 2)

PERMS Monitor Name	Detector Number	Safety Related	Seismic Category I	Class 1E/ Harsh
Containment Radiation Gas	RMS-RE-041	No	No	No/No
Containment Radiation Particulate	RMS-RE-040	No	Yes	No/No
Containment Low Volume Purge Radiation Gas	RMS-RE-023	No	No	No/No
Containment Exhaust Radiation Gas	RMS-RE-022	No	No	No/No
High Sensitivity Main Steam Line (N-16ch.)	RMS-RE-065A,B, 066A,B, 067A,B, 068A,B	No	No	No/No
Main Steam Line	RMS-RE-087, 088, 089, 090	No	No	No/No
Gaseous Radwaste Discharge	RMS-RE-072	No	No	No/No
Main Control Room Outside Air Intake Gas Radiation	RMS-RE-084A,B	Yes	Yes	Yes/No
Main Control Room Outside Air Intake Iodine Radiation	RMS-RE-085A,B	Yes	Yes	Yes/No
Main Control Room Outside Air Intake Particulate Radiation	RMS-RE-083A,B	Yes	Yes	Yes/No
TSC Outside Air Intake Gas Radiation	RMS-RE-101	No	No	No/No
TSC Outside Air Intake Iodine Radiation	RMS-RE-102	No	No	No/No
TSC Outside Air Intake Particulate Radiation	RMS-RE-100	No	No	No/No
CCW Radiation	RMS-RE-056A,B	No	No	No/No
Auxiliary Steam Condensate Water Radiation	RMS-RE-057	No	No	No/No
Primary Coolant Radiation	RMS-RE-070	No	No	No/No
Turbine Building Floor Drain Radiation	RMS-RE-058	No	No	No/No
SG Blowdown Water Radiation	RMS-RE-055	No	No	No/No
SG Blowdown Return Water Radiation	RMS-RE-036	No	No	No/No
Plant Vent Radiation Gas (Normal Range)	RMS-RE-021A,B	No	No	No/No
Plant Vent Extended Radiation Gas (Accident Mid Range)	RMS-RE-080A	No	No	No/No
Plant Vent Extended Radiation Gas (Accident High Range)	RMS-RE-080B	No	No	No/No
Condenser vacuum pump exhaust line radiation (Normal Range)	RMS-RE-043A,B	No	No	No/No
Condenser vacuum pump exhaust line radiation (Accident Mid Range)	RMS-RE-081A	No	No	No/No
Condenser vacuum pump exhaust line radiation (Accident High Range)	RMS-RE-081B	No	No	No/No

Table 2.7.6.6-1 Process Effluent Radiation Monitoring and Sampling System Equipment Characteristics (Sheet 2 of 2)

PERMS Monitor Name	Detector Number	Safety Related	Seismic Category I	Class 1E/ Harsh
GSS exhaust fan discharge line radiation (Normal Range)	RMS-RE-044A,B	No	No	No/No
GSS exhaust fan discharge line radiation (Accident Mid Range)	RMS-RE-082A	No	No	No/No
GSS exhaust fan discharge line radiation (Accident High Range)	RMS-RE-082B	No	No	No/No
Liquid Radwaste Discharge	RMS-RE-035	No	No	No/No
ESW Radiation	RMS-RE-074A,B,C,D	No	No	No/No

Table 2.7.6.6-2 Process Effluent Radiation Monitoring and Sampling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the PERMS is as described in the Design Description of Subsection 2.7.6.6 and Table 2.7.6.6-1.	1. An inspection of the as-built PERMS will be performed.	1. The functional arrangement of the as-built PERMS is as described in the Design Description of Subsection 2.7.6.6 and Table 2.7.6.6-1.
2. The seismic Category I radiation monitors identified in Table 2.7.6.6-1 are designed to withstand seismic design basis loads without loss of safety function.	2.i Inspections will be performed to verify that the as-built, seismic Category I radiation monitors, identified in Table 2.7.6.6-1, are located in a seismic Category I structure.	2.i The as-built seismic Category I radiation monitors identified in Table 2.7.6.6-1 are located in a seismic Category I structure.
	2.ii Type tests and/or analyses of the seismic Category I radiation monitors will be performed.	2.ii The seismic Category I radiation monitors identified in Table 2.7.6.6-1 can withstand seismic design basis loads without loss of safety function.
	2.iii An inspection will be performed on the as-built radiation monitors including anchorage.	2.iii The as-built radiation monitors identified in Table 2.7.6.6-1 including anchorage are seismically bounded by the tested or analyzed conditions.
3.a The Class 1E radiation monitors identified in Table 2.7.6.6-1 are powered from their respective Class 1E division.	3.a A test will be performed on each division of the as-built radiation monitors by providing a simulated test signal only in the Class 1E division under test.	3.a The simulated test signal exists at the as-built Class 1E radiation monitors, identified in Table 2.7.6.6-1,under test.
3.b Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	3.b Inspections of the as-built Class 1E divisional cables will be performed.	3.b Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.

Table 2.7.6.6-2 Process Effluent Radiation Monitoring and Sampling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4. Each division of the Class 1E radiation monitors identified in Table 2.7.6.6-1 is physically separated from the other divisions.	4. Inspections of the as-built Class 1E radiation monitors of the PERMS will be performed.	4. Each division of the as-built Class 1E radiation monitors identified in Table 2.7.6.6-1 is physically separated from other divisions by structural barriers.
5. Data and alarm signals, including control logic, annunciation, and power failure alarms, from the Class 1E monitors identified in Table 2.7.6.6-1 are transmitted to the main control room and made accessible to plant operators.	5. An inspection will be performed for retrievability of data and alarms in the as-built MCR.	5. The as-built data and alarm signals, including control logic, annunciation, and power failure alarms, from the Class 1E monitors identified in Table 2.7.6.6-1 are transmitted to the main control room and made accessible to plant operators.

2.7.6.7 Process and Post-accident Sampling System (PSS)

2.7.6.7.1 Design Description

System Purpose and Functions

These systems contain equipment to collect representative samples of the various process fluids in a safe and convenient manner and provide the means to monitor the unit and various system conditions using the collected and analyzed samples. These systems include sample lines, pressure reduction valves, sample heat exchangers, sampling units and automatic analysis equipment.

The PSS serves no safety function, and therefore has no safety design basis, except for providing containment isolation. The containment isolation function is described in Subsection 2.11.2.

Location and Functional Arrangement

The PSS is located in the auxiliary building, reactor building, access control building and turbine building. The functional arrangement of the containment isolation capabilities of the PSS is shown on Figure 2.7.6.7-1.

Key Design Features

The PSS is designed to cool and depressurize samples collected at high temperature and high pressure, ensure that containment isolation is not violated while collecting samples following an accident. The PSS permits the collection of liquid and gas samples from various locations during normal plant operation.

The PSS is also designed to obtain post-accident liquid and gaseous samples following the accident for the purpose of analyzing the post accident conditions to augment the monitoring capability in the long term.

Seismic and ASME Code Classifications

The seismic and ASME code classifications of the containment isolation components and piping for the PSS are identified in Table 2.7.6.7-1 and Table 2.7.6.7-3. The ASME Code Section III requirements for system components and piping are also identified in Table 2.7.6.7-1 and Table 2.7.6.7-3. Pressure boundary welds in ASME Code Section III components and piping meet ASME Code Section III requirements.

System Operation

The PSS is manually initiated and adjusting the sample conditions for collecting the samples and collects the liquid and gaseous samples during normal operation and post accident.

Alarms, Displays, and Controls

The valves identified in table 2.7.6.7-1 as having PSMS control perform an active safety function after receiving a signal from PSMS. Table 2.7.6.7-4 identifies the alarms, displays and controls associated with the PSS that are located in the MCR.

Logic

The containment isolation valves in the PSS operate properly with receipt of a containment isolation signal as described in Subsection 2.11.1.

Interlocks

There are no interlocks needed for direct safety functions related to the PSS.

Class 1E Electrical Power Sources and Divisions

The PSS equipment identified in Table 2.7.6.7-1 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

The equipment identified in Table 2.7.6.7-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.6.7.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.6.7-5 describes the ITAAC for process and post-accident sampling system.

The ITAAC associated with the PSS equipment, components, and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.7.6.7-1 Process and Post-accident Sampling System Equipment Characteristics

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Isolation valves on RHR down stream of containment spray and residual heat removal heat exchanger	PSS-MOV-052A,B,C,D	2	Yes	Yes	Yes / No	—	Transfer Closed	As Is
Containment isolation valves inside CV on sample from RCS Hot Leg	PSS-MOV-013,023	2	Yes	Yes	Yes/Yes	Containment Isolation Phase A	Transfer Closed	As Is
Containment isolation valves outside containment on sample from RCS Hot Leg	PSS-MOV-031A,B	2	Yes	Yes	Yes/ No	Containment Isolation Phase A	Transfer Closed	As Is
Containment isolation valve outside CV on post-accident liquid sample return to containment sump	PSS-MOV-071	2	Yes	Yes	Yes/ No	Containment Isolation Phase A	Transfer Closed	As Is
Containment isolation valve inside CV on post-accident liquid sample return to containment sump	PSS-VLV-072	2	Yes	No	— / —	—	Transfer Closed	—
Containment isolation valve inside CV on gas sample from Pressurizer	PSS-AOV-003	2	Yes	Yes	Yes/Yes	Containment Isolation Phase A	Transfer Closed	Closed
Containment isolation valve inside CV on liquid sample from Pressurizer	PSS-MOV-006	2	Yes	Yes	Yes/Yes	Containment Isolation Phase A	Transfer Closed	As Is
Containment isolation valves inside CV on sample from Accumulator	PSS-AOV-062A,B,C,D	2	Yes	Yes	Yes /Yes	Containment Isolation Phase A	Transfer Closed	Closed
Containment isolation valve outside CV on sample from Accumulator	PSS-AOV-063	2	Yes	Yes	Yes /No	Containment Isolation Phase A	Transfer Closed	Closed

Note: Dash (-) indicates not applicable

Table 2.7.6.7-2 Process and Post-accident Sampling System Location of the Equipment

System and Components	Location
Isolation valves on RHR downstream of containment spray and residual heat removal heat exchanger	Reactor Building
Containment isolation valves inside CV on sample from RCS Hot Leg	Containment
Containment isolation valves outside containment on sample from RCS Hot Leg	Reactor Building
Containment isolation valve outside CV on post-accident liquid sample return to containment sump	Reactor Building
Containment isolation valve inside CV on post-accident liquid sample return to containment sump	Containment
Containment isolation valve inside CV on gas sample from Pressurizer	Containment
Containment isolation valve inside CV on liquid sample from Pressurizer	Containment
Containment isolation valves inside CV on sample from Accumulator	Containment
Containment isolation valve outside CV on sample from Accumulator	Reactor Building

Table 2.7.6.7-3 Process and Post-accident Sampling System Piping Characteristics

Pipe Line Name	ASME Code Section III Class	Seismic Category I
Accumulator sampling piping and valves from accumulator up to and including the outermost containment isolation valve PSS-AOV-063	2	Yes
Hot leg sampling piping and valves from hot leg up to and including the outermost containment isolation valve PSS-MOV-031A,B	2	Yes
Pressurizer liquid sampling piping and valves from hot leg up to and including the outermost containment isolation valve PSS-MOV-031A,B	2	Yes
Containment isolation valves PSS-MOV-071and 072 and piping between them	2	Yes
RHS loop sampling piping and valves up to and including the valves PSS-MOV-052A,B,C,D	2	Yes

Table 2.7.6.7-4 Process and Post-accident Sampling System Equipment Alarms, Displays, and Control Functions

Equipment/Instrument Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
Containment isolation valve inside CV on gas sample from Pressurizer (PSS-AOV-003)	No	Yes	Yes	Yes
Containment isolation valve inside CV on liquid sample from Pressurizer (PSS-MOV-006)	No	Yes	Yes	Yes
Containment isolation valves inside CV on sample from RCS Hot Leg (PSS-MOV-013, 023)	No	Yes	Yes	Yes
Containment isolation valves outside containment on sample from RCS Hot Leg (PSS-MOV-031 A,B)	No	Yes	Yes	Yes
Containment isolation valves inside CV on sample from Accumulator (PSS-AOV-062A,B,C,D)	No	Yes	Yes	Yes
Containment isolation valve outside CV on sample from Accumulator (PSS-AOV-063)	No	Yes	Yes	Yes
Containment isolation valve outside CV on post-accident liquid sample return to containment sump (PSS-MOV-071)	No	Yes	Yes	Yes
Isolation valves on RHR down stream of containment spray and residual heat removal heat exchanger (PSS-MOV-052A,B,C,D)	No	Yes	Yes	Yes

Table 2.7.6.7-5 Process and Post-accident Sampling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the PSS is as described in the Design Description of Subsection 2.7.6.7.1 and Figure 2.7.6.7-1.	1. An inspection of the as-built PSS will be performed.	1. The as-built PSS conforms with the functional arrangement as described in Design Description of this Subsection 2.7.6.7.1 and Figure 2.7.6.7-1.
2.a.i The ASME Code Section III components of the PSS identified in Table 2.7.6.7-1are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.a.i An inspection of the as-built ASME Code Section III components of the PSS will be performed.	2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built components of the PSS identified in Table 2.7.6.7-1 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.a.ii The ASME Code Section III components of the PSS identified in Table 2.7.6.7-1 are reconciled with the design requirements.	2.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the PSS identified in Table 2.7.6.7-1 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.

Table 2.7.6.7-5 Process and Post-accident Sampling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.b.i The ASME Code Section III piping of the PSS, including supports, identified in Table 2.7.6.7-3 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.b.i An inspection of the as-built ASME Code Section III piping of the PSS, including supports, will be performed.	2.b.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the PSS, including supports, identified in Table 2.7.6.7-3 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.b.ii The ASME Code Section III piping of the PSS, including supports, identified in Table 2.7.6.7-3 is reconciled with the design requirements.	2.b.ii A reconciliation analysis of the piping of the PSS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.b.ii The ASME Code Section III design report(s) (certified when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the PSS, including supports, identified in Table 2.7.6.7-3 is reconciled with the design requirements. The report documents the results of the reconciliation analysis.
3.a Pressure boundary welds in ASME Code Section III components identified in Table 2.7.6.7-1 meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.

Table 2.7.6.7-5 Process and Post-accident Sampling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3.b Pressure boundary welds in ASME Code Section III piping identified in Table 2.7.6.7-3 meet ASME Code Section III requirements for non-destructive examination of welds.	3.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
4.a The ASME Code Section III components, identified in Table 2.7.6.7-1, retain their pressure boundary integrity at their design pressure.	4.a Hydrostatic tests will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	4.a The results of the hydrostatic tests of the as-built components identified in Table 2.7.6.7-1 as ASME Code Section III conform with the requirements of the ASME Code Section III.
4.b The ASME Code Section III piping, identified in Table 2.7.6.7-3, retains its pressure boundary integrity at its design pressure.	4.b Hydrostatic tests will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the hydrostatic tests of the as-built piping as ASME Code Section III conform with the requirements of the ASME Code Section III.
5.a The seismic Category I equipment identified in Table 2.7.6.7-1 is designed to withstand seismic design basis loads without loss of safety function.	5.a.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.7.6.7-1, is located in the containment or the reactor building.	5.a.i The seismic Category I as-built equipment identified in Table 2.7.6.7-1 is located in the containment or the reactor building.
	5.a.ii Type tests and/or analyses of the seismic Category I equipment will be performed.	5.a.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.a.iii Inspections will be performed on the as-built equipment including anchorage.	5.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.

Table 2.7.6.7-5 Process and Post-accident Sampling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5.b Each of the seismic Category I piping, including supports, identified in Table 2.7.6.7-3 is designed to withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table 2.7.6.7-3 are supported by a seismic Category I structure(s).	5.b.i Reports(s) document that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.6.7-3 is supported by a seismic Category I structure(s).
	5.b.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, identified in Table 2.7.6.7-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, identified in Table 2.7.6.7-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.
6.a The Class 1E equipment identified in Tables 2.7.6.7-1 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.a.i Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	6.a.i The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.7.6.7-1 as being qualified for a harsh environment withstands the environmental conditions that would exist before, during, and following a design basis event without loss of their safety function, for the time required to perform the safety function.
	6.a.ii An inspection will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.7.6.7-1 as being qualified for a harsh environment are bounded by type tests, and/or analyses.
6.b The Class 1E equipment identified in Table 2.7.6.7-1 is powered from their respective Class 1E division.	6.b A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	6.b The simulated test signal exists at the as-built Class 1E equipment, identified in Table 2.7.6.7-1, under test.

Table 2.7.6.7-5 Process and Post-accident Sampling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6.c Separation is provided between PSS Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	6.c Inspections of the as-built Class 1E divisional cables will be performed.	6.c Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.
7. Deleted.	7. Deleted.	7. Deleted.
8. The PSS provides the non safety-related function of providing the capability of obtaining reactor coolant and containment atmosphere samples.	8. Tests of the as-built system will be performed to obtain samples of the reactor coolant and containment atmosphere.	8. The as-built PSS provides the non-safety related function of providing the capability of obtaining reactor coolant and containment atmosphere samples.
9. The valves, identified in Table 2.7.6.7-1 perform an active safety function to change position as indicated in the table.	9.i Tests or type tests of remotely operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	9.i Each remotely operated valve changes position as indicated in Table 2.7.6.7-1 under design condition.
	9.ii Tests of the as-built remotely operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	9.ii Each as-built remotely operated valve changes position as indicated in Table 2.7.6.7-1 under the pre-operational test conditions.
	9.iii Tests of the as-built check valves with active safety functions identified in Table 2.7.6.7-1 will be performed under preoperational test pressure, temperature, and fluid flow conditions.	9.iii Each as-built check valve changes position as indicated in Table 2.7.6.7-1.

Table 2.7.6.7-5 Process and Post-accident Sampling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10.a Controls exist in the MCR to close remotely operated valves identified in Table 2.7.6.7-1.	10.a Tests will be performed on the as-built remotely operated valves identified in Table 2.7.6.7-1 using the controls in the MCR.	10.a Controls exist in the as-built MCR to open and close the as-built remotely operated valves identified in Table 2.7.6.7-1.
10.b The valves identified in Table 2.7.6.7-1 as having PSMS control perform an active safety function after receiving a signal from PSMS.	10.b Tests will be performed on the as-built remotely operated valves listed in Table 2.7.6.7-1 using simulated signals.	10.b The as-built remotely operated valves identified in Table 2.7.6.7-1 as having PSMS control, perform the active function identified in the table after receiving a simulated signal.
11. After loss of motive power, the remotely operated valves identified in Table 2.7.6.7-1 assume the indicated loss of motive power position.	11. Tests of the as-built valves will be performed under the conditions of loss of motive power.	11. After loss of motive power, each as-built remotely operated valve identified in Table 2.7.6.7-1 assumes the indicated loss of motive power position.
12. MCR alarms and displays of the parameters identified in Table 2.7.6.7-4 can be retrieved in the MCR.	12. Inspections will be performed for retrievability of the PSS parameters in the as-built MCR.	12. MCR alarms and displays identified in Table 2.7.6.7-4 can be retrieved in the as-built MCR.
13. RSC alarms, displays and controls are identified in Table 2.7.6.7-4.	13. Inspections of the as-built RSC alarms, displays and controls will be performed.	13. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.7.6.7-4.

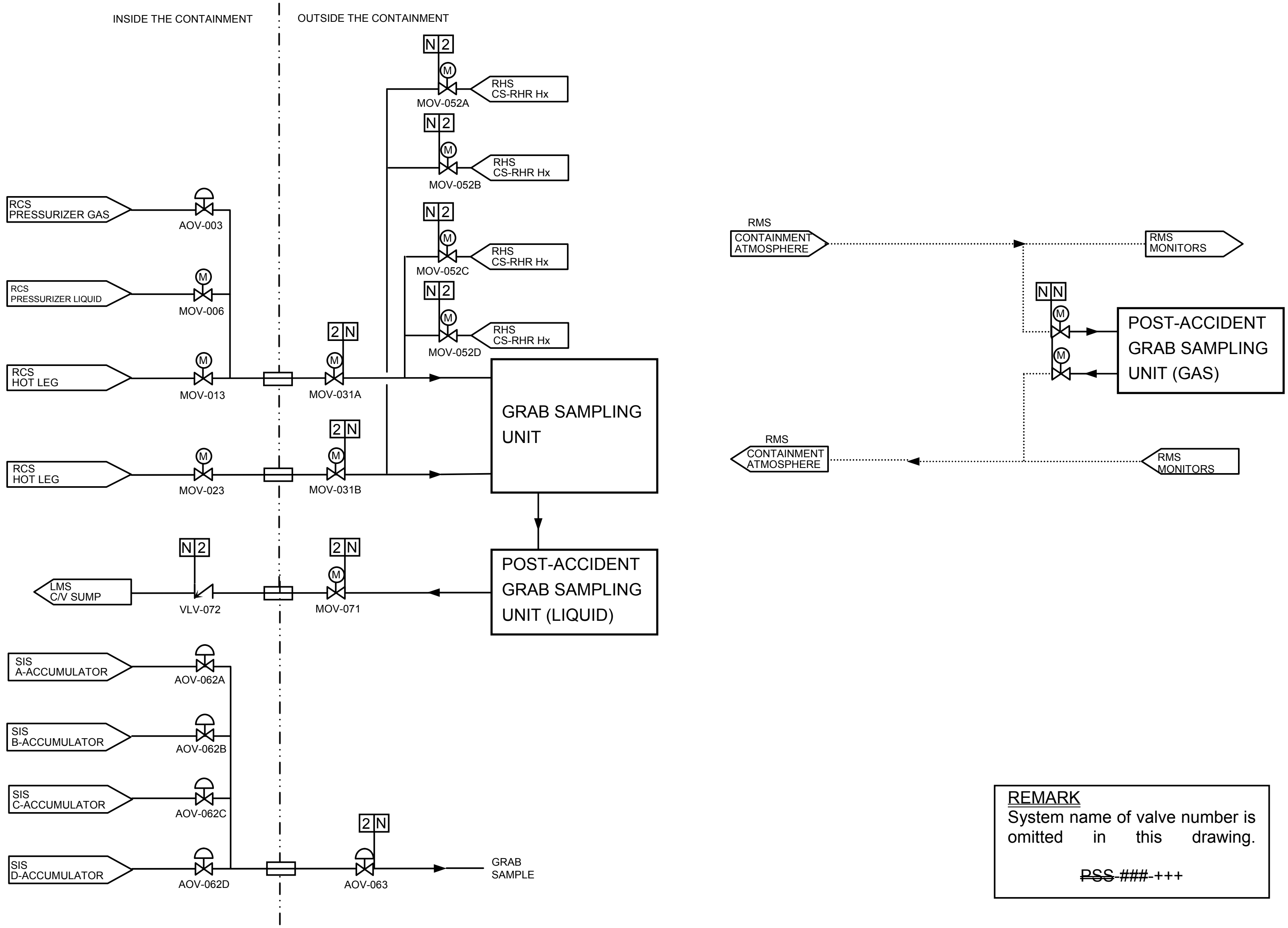


Figure 2.7.6.7-1 Process and Post-accident Sampling System

2.7.6.8 Equipment and Floor Drainage Systems

2.7.6.8.1 Design Description

System purpose and functions

The equipment and floor drainage systems are not safety-related systems except for the isolation valves installed in the drainage piping from engineered safety features (ESF) equipment rooms. The equipment and floor drainage systems collect liquid waste from equipment and floor drains during all modes of operation. The equipment and floor drainage systems collect liquid waste from equipment and floor drains during all modes of operation, separate the contaminated effluents and transfer them to the proper processing and disposal systems. The systems are designed to prevent flooding and excess water accumulation due to backflow.

Location and Functional Arrangement

The equipment and floor drains include drains of the containment vessel (C/V), the auxiliary building (A/B), the reactor building (R/B), the power source building (PS/B), the turbine building (T/B), and the access building (AC/B). Floor drains and equipment drains are piped from plant equipment to the collection sumps, where sump pumps, piping, and instrumentation connect to the waste water system (WWS), for non-radioactive drainage, and the liquid waste management system (LWMS), for radioactive drainage. The functional arrangement of the equipment and floor drain system is shown on Figure 2.7.6.8-1.

Key Design Features

The drain systems from ESF equipment rooms are designed to prevent flooding due to backflow by the virtue of a difference in elevation of the ESF equipment rooms and the collection sump. Additionally, isolation valves are also provided on the ESF equipment rooms drainage piping in order to protect against flooding due to backflow.

Equipment and floor drainage systems failures do not prevent the proper function of any safety-related equipment.

Equipment and floor drainage is classified and segregated by type, being (1) radioactive liquid waste, (2) non-radioactive liquid waste, (3) chemical and detergent liquid waste, and (4) oily liquid waste.

The drain systems are designed with no cross-connection between the radioactive and non-radioactive drainage system to prevent contamination due to possible backflow.

Seismic and ASME Code Classifications

The seismic Category I and ASME code Section III requirements are applied to these isolation valves installed in the drainage piping from engineered safety features (ESF) equipment rooms.

System Operation

Liquid wastes is directed and collected to tanks or sumps in their respective buildings. The radioactive waste is discharged to the LWMS for further processing prior to release to the environment.

Alarms, Displays, and Controls

The radioactive contamination in the T/B sump is detected by a radiation monitor in the sump discharge and alarmed in the main control room. T/B sump discharge radiation instrumentation and controls automatically divert flow from the waste water system to the LWMS on a pre-determined radiation set point. Furthermore ESF equipment rooms have provisions for detection of a flooded condition to provide indication in the main control room. A common alarm in the main control room is provided indication of a leak.

Logic

There is no logic needed for direct safety functions related to the equipment and floor drainage systems.

Interlocks

There are no interlocks needed for direct safety functions related to the equipment and floor drainage systems.

Class 1E Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.6.8.2 Inspections, Tests, Analyses, and Acceptance Criteria.

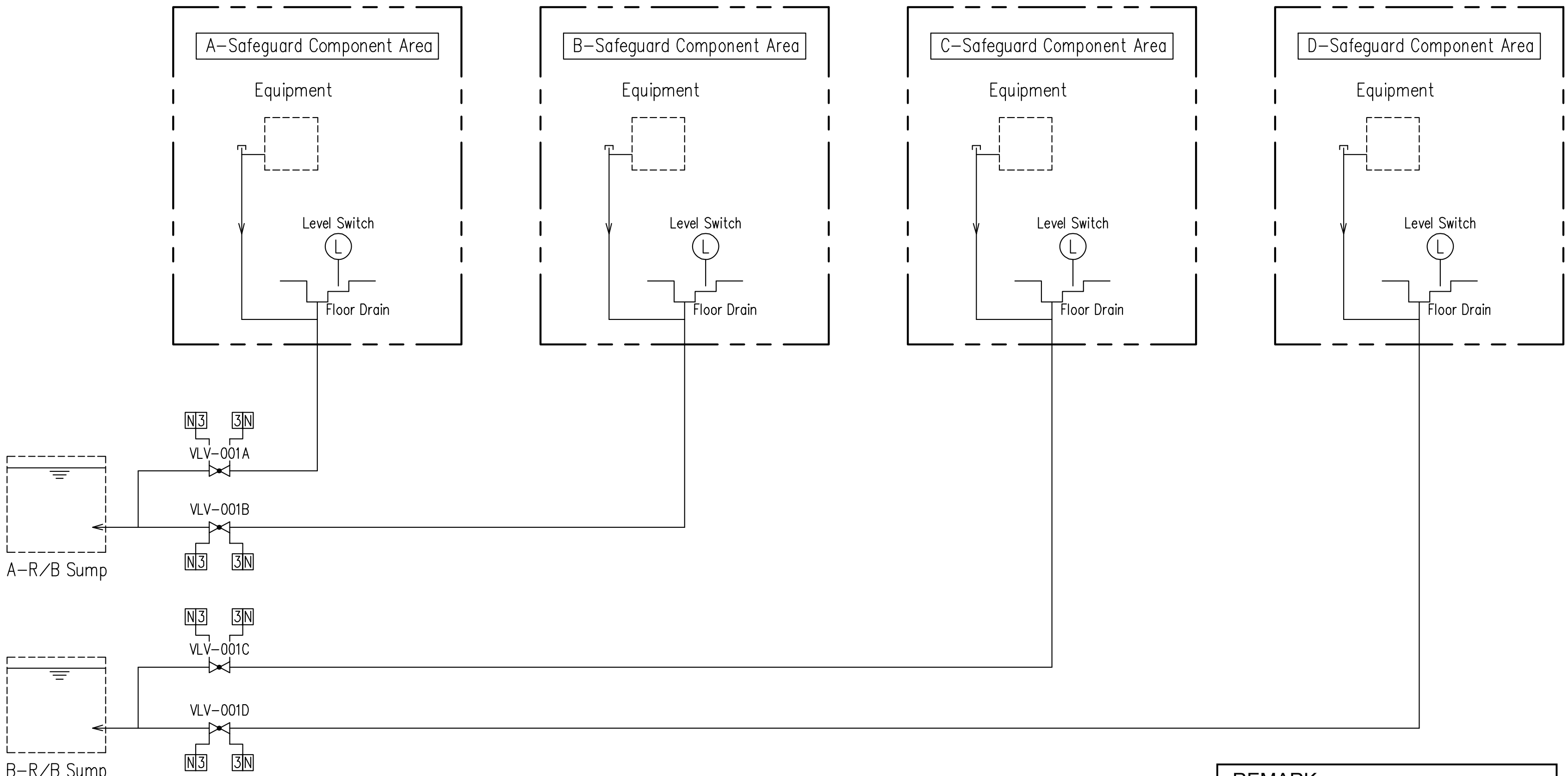
Table 2.7.6.8-1 describes the ITAAC for the equipment and floor drainage systems.

Table 2.7.6.8-1 Equipment and Floor Drainage Systems Inspections ,Tests , Analyses and Acceptance Criteria (Sheet 1 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the equipment and floor drainage systems is as described in the Design Description of Subsection 2.7.6.8 and as shown on Figure 2.7.6.8-1.	1. Inspections of the as-built equipment and floor drainage systems will be performed.	1. The as-built equipment and floor drainage systems conform to the functional arrangement as described in the Design Description of Subsection 2.7.6.8 and as shown on Figure 2.7.6.8-1.
2. MCR alarms provided for the equipment and floor drainage systems are defined in Subsection 2.7.6.8.	2. Inspections will be performed on the as-built MCR alarms for the equipment and floor drainage systems.	2. The as-built alarms exist in the as-built MCR as defined in Subsection 2.7.6.8.
3. Flow is designed to divert from the waste water system to the LWMS when the T/B sump discharge radiation monitor setpoint is reached.	3. A test will be performed on the as-built T/B sump discharge flow divert function of the as-built Equipment and Floor Drainage Systems.	3. When the as-built T/B sump discharge radiation monitor setpoint is reached, flow diverts from the as-built waste water system to the LWMS.
4. The seismic Category I drain isolation valves from the ESF equipment rooms are designed to withstand seismic design basis loads without loss of safety function.	4.a Inspections will be performed to verify that the seismic Category I as-built drain isolation valves are located in the drain lines from the ESF equipment rooms.	4.a The as-built seismic Category I as-built drain isolation valves are located in the drain lines from the ESF equipment rooms.
	4.b Type tests and/or analyses of the seismic Category I drain isolation valves will be performed.	4.b The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	4.c Inspections will be performed on the as-built drain isolation valves including anchorage.	4.c The as-built drain isolation valves including anchorage are seismically bounded by the tested or analyzed conditions.
5.a Controls exist in the MCR to close the remotely operated drain isolation valves, identified in Subsection 2.7.6.8.1, from the ESF equipment rooms.	5.a Tests will be performed on the as-built remotely operated drain isolation valves from the ESF equipment rooms using controls in the as-built MCR.	5.a Controls exist in the as-built MCR to close the as-built remotely operated drain isolation valves, identified in Subsection 2.7.6.8.1, from the ESF equipment rooms.

Table 2.7.6.8-1 Equipment and Floor Drainage Systems Inspections ,Tests , Analyses and Acceptance Criteria (Sheet 2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5.b Alarms and displays of the remotely operated drain isolation valves, identified in Subsection 2.7.6.8.1, from the ESF equipment rooms can be retrieved from the MCR.	5.b Inspections will be performed for retrievability of the alarms and displays in the as-built MCR.	5.b Alarms and displays of the parameters for the remotely operated drain isolation valves, identified in Subsection 2.7.6.8.1, from the ESF equipment room can be retrieved from the as-built MCR.
6.a The ASME Code Section III drain isolation valves from the ESF equipment rooms are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	6.a An inspection of the as-built ASME Code Section III drain isolation valves from the ESF equipment rooms will be performed.	6.a The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III drain isolation valves from the ESF equipment rooms are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
6.b The ASME Code Section III drain isolation valves from the ESF equipment rooms are reconciled with the design requirements.	6.b A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	6.b The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III drain isolation valves from the ESF equipment rooms are reconciled with the design documents. The report documents the results of the reconciliation analysis.



REMARK:
System name of valve number are omitted in this drawing.
~~FDS-###~~-+++

Figure 2.7.6.8-1 Equipment and Floor Drain System Flow Schematic

2.7.6.9 Fire Protection System

2.7.6.9.1 Design Description

System Purpose and Functions

The purpose of the fire protection system (FPS) is to minimize the adverse effects of fires on structures, systems, and components (SSCs) important to safety. The FPS detects fires and provides the capability to extinguish or control the fire using fixed automatic and manual suppression systems, manual hose streams, and/or portable fire fighting equipment. The FPS also supports the containment isolation function as described in Subsection 2.11.2. The FPS is classified as a non safety-related, non-seismic system with the exception of the containment isolation valves.

Location and Functional Arrangement

The FPS consists of a number of fire detection and suppression subsystems including:

- Detection systems for early detection and notification of a fire occurrence. Fire detection systems are provided where required by the fire hazard analysis (FHA).
- A water supply system including the fire pumps, adequate fire water supply source, yard main, and interior distribution piping.
- Fixed automatic and manual fire suppression systems and equipment, including hydrants, standpipes, hose stations and portable fire extinguishers. Manual fire suppression capability is provided in all areas of the plant including areas that have an automatic suppression system.

Key Design Features

The FPS is designed to perform the following functions:

- Detect and locate fires and provide operator indication of the location. Individual fire detectors provide fire detection capability and can be used to initiate fire alarms in areas containing safety-related equipment.
- Maintain 100 percent of fire pump design capacity, assuming failure of the largest fire pump or the loss of offsite power (LOOP).
- Provide water to hose stations for manual fire fighting in areas containing safe-shutdown equipment following a safe shutdown earthquake. Under safe-shutdown earthquake loading, the standpipe system remains functional in areas containing equipment required for safe-shutdown. The seismic standpipe system can be supplied from a safety-related water source which capacity is at least 18,000 gallons.

- Provide sufficient water for the largest sprinkler system plus manual hose streams to support fire suppression activities for two hours or longer, but not less than 300,000 gallons. Redundant water supply capability is provided.
- Provide FPS fire water supply as an alternative component cooling water source for severe accident prevention.
- Provide FPS fire water supply to the containment spray system and water injection to the reactor cavity for severe accident mitigation.
- Provides containment isolation for the piping penetrating the containment.

Seismic and ASME Code Classifications

The FPS is classified as a non safety-related, non-seismic system. Seismic design requirements are applied to portions of the standpipe system located in areas containing equipment required for safe shutdown. In addition, the FPS containment isolation valves and their associated piping are safety-related (ASME Class 2) and seismic Category I.

System Operation

The FPS normally operates in a standby readiness mode. The fire water supply piping is maintained full and pressurized by operation of a pressure source to allow immediate startup of a fire pump on demand.

Alarms, Displays, and Controls

The FPS provides audible and visual alarms and system trouble annunciation in the MCR. Displays indicated in Table 2.7.6.9-1 exist in the main control room (MCR) that provides indication of fire system status.

Logic

There is no logic needed for direct safety functions related to the FPS.

Interlocks

There are no interlocks needed for direct safety functions related to the FPS.

Class 1E Electrical Power Sources and Divisions

The FPS containment isolation valves are connected to Class 1E buses.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

The seismic standpipe system can be supplied from a safety-related water source which capacity is at least 18,000 gallons. Combined License applicant referencing the certified design is responsible to assure that the site-specific design meets the interface requirement and verify the conformance in the ITAAC process that are similar to those provided in the certified design.

Numeric performance values

Not applicable.

2.7.6.9.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.6.9-2 specifies the inspections, tests, analyses, and associated acceptance criteria for the FPS.

The ITAAC associated with the FPS equipment, components, and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.7.6.9-1 Fire Protection System MCR Displays

Equipment Name	Display	Control Function
Lead Fire Pump	Yes (Run Status)	Start
Secondary Fire Pump	Yes (Run Status)	Start

Table 2.7.6.9-2 Fire Protection System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the FPS is as described in the Design Description of Subsection 2.7.6.9.	1. Inspections will be performed of the as-built FPS.	1. The as-built FPS conforms to the functional arrangement described in the Design Description of this Subsection 2.7.6.9.
2. Individual fire detectors provide fire detection capability and can be used to initiate fire alarms in areas containing safety-related equipment.	2. Tests will be performed on the as-built individual fire detectors.	2. Individual fire detectors provide fire detection capability and can be used to initiate fire alarms in areas containing safety-related equipment.
3. There are two 100 percent capacity fire pumps: one pump is motor driven and one pump is diesel driven.	3. An inspection of the as-built fire pumps will be performed.	3. Two as-built fire pumps each have 100 percent capacity: one pump is motor driven and one pump is diesel driven.
4.a Under safe-shutdown earthquake loading, the standpipe system remains functional in areas containing equipment required for safe shutdown.	4.a An inspection will be performed of the as-built standpipe system as documented in a seismic design report.	4.a The seismic design report exists and concludes that the as-built standpipe system remains functional in areas containing equipment required for safe shutdown under safe-shutdown earthquake loading.
4.b The seismic standpipe system can be supplied from a safety-related water source which capacity is at least 18,000 gallons.	4.b An inspection of the as-built safety-related water source to the standpipe system will be performed.	4.b The as-built seismic standpipe system can be supplied from a safety-related water source which capacity is at least 18,000 gallons.

Table 2.7.6.9-2 Fire Protection System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5. The fire protection water supply system has at least two water sources. Each source can supply the largest US-APWR sprinkler system plus manual hose streams (500 gpm) to support these fire suppression activities for a period of two hours or longer. The capacity of each source is not less than 300,000 gallons.	5. Inspections will be performed of each as-built fire protection water source capability.	5. Each of the two as-built fire protection water supply sources has the capability to supply the largest US-APWR sprinkler system plus manual hose streams (500 gpm) to support these fire suppression activities for a period of two hours or longer, and the capacity of each source is not less than 300,000 gallons.
6.a The FPS fire water supply is available as an alternative component cooling water source for severe accident prevention.	6.a Inspection will be performed of the as-built FPS fire-water supply.	6.a The as-built FPS fire water supply is provided as an alternative component cooling water source for severe accident prevention.
6.b The FPS fire water supply is available to the containment spray system and water injection to the reactor cavity for severe accident mitigation.	6.b Inspection will be performed on the as-built FPS fire water supply.	6.b The as-built FPS fire water supply is provided to the containment spray system and water injection to the reactor cavity for severe accident mitigation.
7. Deleted.	7. Deleted.	7. Deleted.
8. Displays of the system parameters identified in Table 2.7.6.9-1 can be retrieved in the MCR.	8. Inspections will be performed for retrievability of the as-built system parameters in the as-built MCR.	8. The as-built display indications of system parameters identified in Table 2.7.6.9-1 are verified and are retrieved in the as-built MCR.

2.7.6.10 Communication Systems

2.7.6.10.1 Design Description

System Purpose and Functions

The plant's communication systems are not safety related. The communication systems provide for effective interplant and plant-to-offsite communications during normal, transient, fire, accidents, off-normal phenomena (e.g., loss of offsite power), and security related events.

Location and Functional Arrangement

The following locations within the US-APWR facility contain communication system arrangements:

- Reactor building (R/B) and containment structure
- Turbine building (T/B)
- Power source building (PS/B)
- Auxiliary building (A/B)
- Access buildings (AC/B)

The US-APWR communication systems consist of the following physically independent systems:

- Public address system/page
- Telephone system
- Sound powered telephone system (SPTS)
- Plant radio system
- Offsite communications system including emergency communication systems
- Plant security communication systems

The communications are provided from the MCR, TSC, and EOF to the NRC headquarters and regional office emergency operations centers,(including establishment of the emergency response data system (ERDS) [or its successor system] between the onsite computer system and the NRC Operations Center).

Key Design Features

Depending on the specific installed plant location, the selected components are qualified to operate in environments, as applicable.

The plant communication systems are arranged in a redundant fashion to provide for a minimum of two verbal communication paths between all plant locations as well as external communications.

The plant communication systems are independent of each other and either have a built-in dc battery power source (e.g., portable radios) or are powered from non-safety related uninterruptible power supply (UPS) systems.

Seismic and ASME Code Classifications

Not applicable.

System Operation

The plant communication systems are used for conveying verbal information as well as facsimile transmissions and digital based communications. Emergency telephones are color-coded to distinguish them from normal telephones.

Interfaces Requirements

There are no safety-related interfaces with systems outside of the certified design.

2.7.6.10.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.6.10-1 provides the inspections, tests, analyses, and associated acceptance criteria for the Communication Systems.

Table 2.7.6.10-1 Communication Systems Inspections ,Tests ,Analyses and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the communication systems is as described in the design description of this Subsection 2.7.6.10.1	1. Inspection of the as-built communication systems will be performed.	1. The as-built communication systems conform with the functional arrangement as described in the Design Description of Subsection 2.7.6.10.1
2. The means exists for communications among the MCR, TSC, EOF, principal State and local emergency operations centers, and radiological field assessment teams.	2. A test of the as-built communication system will be performed.	2. The as-built communications are established among the as-built MCR, TSC, EOF, principal State and local emergency operations centers, and radiological field assessment teams.
3. The means exist for communications from the MCR, TSC, and EOF to the NRC headquarters and regional office emergency operations centers,(including establishment of the emergency response data system (ERDS) [or its successor system] between the onsite computer system and the NRC Operations Center).	3. A test of the as-built communication system will be performed.	3. The as-built communications are established from the as-built MCR, TSC and EOF to the NRC headquarters and regional office emergency operations centers, and an access port for ERDS [or its successor system] is provided.
4. TSC has voice communication systems.	4. Inspections of the as-built TSC voice communication systems will be performed.	4. The as-built TSC voice communication equipment is installed, and voice transmission and reception are accomplished.

2.7.6.11 Condensate Storage Facilities

2.7.6.11.1 Design Description

System Purpose and Functions

The condensate storage facilities are not a safety-related system.

The condensate storage facilities consist of the following:

- demineralized water system
- condensate storage and transfer system, and
- primary makeup water system (PMWS).

The demineralized water system provides demineralized water for makeup of the condensate storage tank and demineralized water users in the plant.

The condensate storage and transfer system provides secondary side and condenser hotwell makeup water.

The PMWS provides deaerated water to primary plant users.

Location and Functional Arrangement

The major components of the condensate storage facilities are located in the yard.

The demineralized water system consists of a tank, pumps, and associated valves, piping and instrumentation.

The condensate storage and transfer system consists of the condensate storage tank, condensate transfer pumps, and associated valves, piping, and instrumentation.

The PMWS consists of two tanks, pumps, and associated valves, piping and instrumentation.

Key Design Features

The condensate storage and transfer system is a reservoir to supply or receive condensate water as required by the condenser hotwell level control system.

Seismic and ASME Code Classifications

The condensate storage facilities are non-seismic category and are not designed to ASME code specifications.

System Operation

There is no important system operation.

Alarms, Displays, and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the condensate storage facilities.

Interlocks

There are no interlocks needed for direct safety functions related to the condensate storage facilities.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.6.11.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.6.11-1 describes the ITAAC for the condensate storage facilities.

Table 2.7.6.11-1 Condensate Storage Facilities Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the condensate storage facilities are as described in the Design Description of Subsection 2.7.6.11.	1. Inspections of the as-built system will be performed.	1. The as-built condensate storage facilities conform with the functional arrangement as described in the Design Description of this Subsection 2.7.6.11.

2.7.6.12 Potable and Sanitary Water Systems (PSWS)

2.7.6.12.1 Design Description

System Purpose and Functions

The PSWS is not a safety-related system. The PSWS provides water for domestic use and human consumption and to collect site sanitary waste for treatment, dilution and discharge during normal operation.

Location and Functional Arrangement

The system serves all the areas in the turbine building, reactor building, auxiliary building, access building, firehouse and future facilities.

Key Design Features

The potable water system layout is designed with no interconnection and/or sharing between the systems, or between the units, to prevent contamination due to potential radioactivity, or due to backflow, making water unfit for human consumption.

The sanitary drainage system collects sanitary waste from various plant areas such as restrooms and locker room etc., and carries the wastewater for processing to the treatment facility. The sanitary drainage system does not serve any facilities in the radiological controlled areas.

Seismic and ASME Code Classifications

The PSWS is non-seismic category and is not designed to ASME Code Section III requirements.

System Operation

There is no important system operation.

Alarms Displays and Controls

There are no important alarms, displays, and controls.

Logic

There is no logic needed for direct safety functions related to the PSWS.

Interlocks

There are no interlocks needed for direct safety functions related to the PSWS.

Class 1E Electrical Power Sources and Division

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interfaces Requirements

The PSWS are interface systems.

Numeric Performance Values

Not applicable.

2.7.6.12.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.6.12-1 provides the inspections, tests, analyses, and associated acceptance criteria for the Potable and Sanitary Water Systems.

Table 2.7.6.12-1 Potable and Sanitary Water Systems Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the PSWS is as described in the design description of this Subsection 2.7.6.12.	1. Inspection of the as-built PSWS will be performed.	1. The as-built PSWS conforms with the functional arrangement as described in the Design Description of this Subsection 2.7.6.12.

2.7.6.13 Area Radiation and Airborne Radioactivity Monitoring Systems

2.7.6.13.1 Design Description

2.7.6.13.1.1 Area Radiation Monitoring System

System Purpose and Functions

The purpose and functions of the area radiation monitoring system (ARMS) are:

- To record radiation levels in specific areas of the plant
- To warn of uncontrolled or inadvertent movement of radioactive material in the plant
- To provide local and remote indication of ambient gamma radiation and local and remote alarms at key points where substantial change in radiation levels might be of immediate importance to personnel in the area
- To furnish information for making radiation surveys

By meeting the above objectives, the ARMS aids health physics personnel in keeping radiation exposures as low as reasonably achievable (ALARA).

The containment high range area monitors are safety-related, while the remainder of the ARMS is non-safety related. The safety function of ARMS is the isolation of the containment ventilation system when a high radiation alarm is given by the containment high range area monitors.

Location and Functional Arrangement

Considerations for area monitor locations and design are based on the following:

- Areas which are normally accessible, and where changes in plant conditions can cause significant increases in personnel exposure rate above that expected for the area
- Areas which are normally accessible or occasionally accessible where significant increase in exposure rate may result from operational transients or maintenance activities
- Containment areas for indicating the level of radioactivity and detecting the presence of fission products due to a design basis accident
- Area monitor detectors are located such that inadvertent shielding by structural materials is minimized

- In the selection of area monitors, consideration is given to the range of temperature, pressure and humidity of the areas where the detectors or electronics are located.

Key Design Features

The ARMS monitors are located at selected locations throughout the plant to detect, indicate, and store radiation level information through their associated data processing module and, if necessary, annunciate abnormal radiation conditions. The detectors for all ARMS monitors are gamma-sensitive. If exposed to radiation in excess of full-scale indication, the ARMS monitors indicate that the full-scale reading has been exceeded and remain at the full-scale value.

Each division of the Class 1E radiation monitors identified in Table 2.7.6.13-1 is physically separated from the other divisions.

Seismic Classifications

The safety-related containment high range area monitors meet seismic Category I standards.

System Operation

The ARMS is operational during normal operations, anticipated operational occurrences, and post-accident conditions.

Alarms, Displays, and Controls

The ARMS provides direct indication or recording in the main control room (MCR) and locally. When radiation levels exceed preset values indication is provided in the MCR. The Containment High Range Area monitors, which are safety-related, Class 1E, are also indicated and annunciated at the safety-related display console. The radwaste processing facility monitors' alarm gives a visual and audible indication to the personnel near the detector in the radwaste processing facility local control room and in the MCR.

Logic

The control function of the containment high range area monitor is the isolation of the containment ventilation system on a containment high range area monitor high radiation alarm.

Interlocks

When the containment high range area monitors detect radiation levels above predetermined setpoints, interlocks are activated to maintain the isolation of the containment ventilation system.

Class 1E Electrical Power Sources and Divisions

As indicated in Table 2.7.6.13-1, the Class 1E containment high range area monitors are powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cables.

Equipment to be Qualified for Harsh Environments

The monitors identified in Table 2.7.6.13-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

Not applicable.

2.7.6.13.1.2 Airborne Radioactivity Monitoring System

System Purpose and Functions

The purpose and function of the airborne radioactivity monitoring system is to measure and warn operators of excessive airborne radioactivity in the air exhausted from cubicles through HVAC exhaust ducts.

The monitors of the airborne radioactivity monitoring system are non-safety related, as such, the airborne radioactivity monitoring system has no safety function.

Location and Functional Arrangement

Airborne monitor locations are HVAC exhaust ducts which are installed in the radioactive controlled area. The airborne radioactivity monitors are installed at locations where airborne radioactivity may normally exist.

Key Design Features

Key design features of the airborne radioactivity monitoring system are given in Table 2.7.6.13-2.

Seismic and ASME Code Classifications

The airborne radioactivity monitoring system monitors are non-seismic.

System Operation

The airborne radioactivity monitoring system is operational during normal operations, anticipated operational occurrences, and post-accident conditions.

Alarms, Displays, and Controls

Monitoring and alarm data from the airborne radioactivity monitoring system are transmitted to the main control room and made accessible to plant operators.

Logic

The airborne radioactivity monitoring system has no control function.

Interlocks

The airborne radioactivity monitoring system has no interlocks associated with direct safety functions.

Class 1E Electrical Power Sources and Divisions

None of the airborne radioactivity monitoring system monitors is Class 1E.

Equipment to be Qualified for Harsh Environments

None of the airborne radioactivity monitoring system monitors is qualified for harsh environments.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

No selected airborne radioactivity monitoring system numerical performance values are used in the safety analyses.

2.7.6.13.1.3 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.6.13-3 describes the ITAAC for area radiation and airborne radioactivity monitoring systems.

Table 2.7.6.13-1 Area Radiation Monitoring System Equipment Characteristics

ARMS Monitor Name	Detector Number	Safety Related	Seismic Category I	Class 1E/ Harsh
MCR Area Radiation	RMS-RE-001	No	No	No/No
Containment Air Lock Area Radiation	RMS-RE-002	No	No	No/No
Radio Chemical Lab. Area Radiation	RMS-RE-003	No	No	No/No
SFP Area Radiation	RMS-RE-005	No	No	No/No
Nuclear Sampling Room Area Radiation	RMS-RE-006	No	No	No/No
ICIS Area Radiation	RMS-RE-007	No	No	No/No
Waste management system Area Radiation	RMS-RE-008	No	No	No/No
TSC Area Radiation	RMS-RE-009	No	No	No/No
Containment High Range Area Radiation	RMS-RE-091A,B, 092A,B, 093A,B, 094A,B	Yes	Yes	Yes/Yes

Table 2.7.6.13-2 Airborne Radioactivity Monitoring System Equipment Characteristics

Radiation Gas Monitor Name	Detector Number	Safety Related	Seismic Category I	Class 1E/ Harsh
Fuel Handling Area HVAC Radiation Gas	RMS-RE-049	No	No	No/No
Annulus and Safeguard Area HVAC Radiation Gas	RMS-RE-046	No	No	No/No
Reactor Building HVAC Radiation Gas	RMS-RE-048A	No	No	No/No
Auxiliary Building HVAC Radiation Gas	RMS-RE-048B	No	No	No/No
Sample and Lab Area HVAC Radiation Gas	RMS-RE-048C	No	No	No/No

Table 2.7.6.13-3 Area Radiation and Airborne Radioactivity Monitoring Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the area radiation and airborne radioactivity monitoring systems is as described in the Design Description of Subsection 2.7.6.13 and in Tables 2.7.6.13-1 and 2.7.6.13-2.	1. An inspection of the as-built area radiation and airborne radioactivity monitoring systems will be performed.	1. The functional arrangement of the as-built area radiation and airborne radioactivity monitoring systems is as described in the Design Description of Subsection 2.7.6.13 and in Tables 2.7.6.13-1 and 2.7.6.13-2.
2. The seismic Category I radiation monitors identified in Table 2.7.6.13-1 are designed to withstand seismic design basis loads without loss of safety function.	2.i Inspections will be performed to verify that the as-built, seismic Category I radiation monitors, identified in Table 2.7.6.13-1, are located in the containment or the reactor building.	2.i The as-built seismic Category I radiation monitors identified in Table 2.7.6.13-1 are located in the containment or the reactor building.
	2.ii Type tests and/or analyses of the seismic Category I radiation monitors will be performed.	2.ii The results of the type tests and/or analyses conclude that the seismic Category I radiation monitors identified in Table 2.7.6.13-1 can withstand seismic design basis loads without loss of safety function.
	2.iii An inspection will be performed on the as-built radiation monitors including anchorage.	2.iii The as-built radiation monitors identified in Table 2.7.6.13-1 including anchorage are seismically bounded by the tested or analyzed conditions.

Table 2.7.6.13-3 Area Radiation and Airborne Radioactivity Monitoring Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3. The Class 1E radiation monitors identified in Table 2.7.6.13-1 as being designed for harsh environment are designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	3.i Type tests and/or analyses will be performed on the Class 1E radiation monitor located in a harsh environment.	3.i The results of the type tests and/or analyses conclude that the Class 1E radiation monitors identified in Table 2.7.6.13-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	3.ii Inspections will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	3.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.7.6.13-1 as being qualified for a harsh environment are bounded by type test and/or analyses.
4.a The Class 1E radiation monitors identified in Table 2.7.6.13-1 are powered from their respective Class 1E division.	4.a A test will be performed on each division of the as-built radiation monitors by providing a simulated test signal only in the Class 1E division under test.	4.a The simulated test signal exists at the as-built Class 1E radiation monitors, identified in Table 2.7.6.13-1, under test.
4.b Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	4.b Inspections of the as-built Class 1E divisional cables will be performed.	4.b Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.
5. Each division of Class 1E radiation monitors identified in Table 2.7.6.13-1 is physically separated from the other divisions.	5. Inspections of the as-built Class 1E radiation monitors will be performed.	5. Each division of the Class 1E radiation monitors identified in Table 2.7.6.13-1 is physically separated from other divisions.

Table 2.7.6.13-3 Area Radiation and Airborne Radioactivity Monitoring Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6. Data and alarm signals, including control logic, annunciation, and power failure alarms, from the Class 1E radiation monitors identified in Table 2.7.6.13-1 are transmitted to the main control room and made accessible to plant operators.	6. An inspection will be performed for retrievability of data and alarms in the as-built MCR.	6. The as-built data and alarm signals, including control logic, annunciation, and power failure alarms, from the Class 1E radiation monitors identified in Table 2.7.6.13-1 are transmitted to the main control room and made accessible to plant operators.

2.8 RADIATION PROTECTION

2.8.1 Design Description

The US-APWR is designed to keep radiation exposures to plant personnel and off-site members of the public within applicable regulatory limits, and as low as reasonably achievable (ALARA).

The radiation shielding design (as provided by the plant structures or by shielding included in the design) is adequate so that the maximum radiation levels in plant areas are commensurate with the areas access requirements. The presence of this shielding allows radiation exposures to plant personnel to be maintained ALARA during normal plant operations and maintenance.

Adequate shielding is provided for those plant areas that may require occupancy to permit operators to aid in the mitigation of or the recovery from an accident.

The plant provides ventilation flow for the radioactive controlled area to control the concentrations of airborne radioactivity specified in 10 CFR 20 Appendix B.

Area radiation and airborne radioactivity monitoring systems are described in section 2.7.6.13.

2.8.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.8-1 describes the ITAAC or corresponding design acceptance criteria for radiation protection. These ITAAC ensure that all areas of the plant are kept within the limits of each area's radiation zone designation, given in Table 2.8-2.

Table 2.8-1 Radiation Protection
Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a Shielding walls and floors listed in Table 2.2-2 are provided to maintain the maximum radiation levels specified in Table 2.8-2.	1.a Inspections of the as-built shielding walls and floors thicknesses will be performed. Refer to Table 2.2-4 ITAAC Item 1.	1.a The as-built shielding walls and floors listed in Table 2.2-2 are consistent with the designed concrete wall thicknesses. Refer to Table 2.2-4 ITAAC Item 1.
1.b Shielding walls and floors in the auxiliary building are provided to maintain the maximum radiation levels specified in Table 2.8-2.	1.b Inspections of the as-built shielding walls and floors thicknesses will be performed.	1.b The as-built shielding walls and floors in the auxiliary building are consistent with the designed concrete wall thicknesses.
2. Area radiation and airborne radioactivity monitoring systems are provided to monitor radioactivity concentrations.	2. Refer to Table 2.7.6.13-3.	2. Refer to Table 2.7.6.13-3.
3. Ventilation flow for the radioactive controlled area is provided to control the concentrations of airborne radioactivity specified in 10 CFR 20 Appendix B.	3. Tests of the as-built containment purge system and auxiliary building HVAC system will be performed.	3. The as-built containment purge system and auxiliary building HVAC provide ventilation flow to control the concentrations of airborne radioactivity specified in 10 CFR 20 Appendix B.

Table 2.8-2 Radiation Zone Designations

Zone	Dose Rate
I	≤0.25 mrem/h
II	≤1.0 mrem/h
III	≤2.5 mrem/h
IV	≤15.0 mrem/h
V	≤100.0 mrem/h
VI	≤1.0 rem/h
VII	≤10.0 rem/h
VIII	≤100.0 rem/h
IX	≤500.0 rad/h
X	>500.0 rad/h

2.9 HUMAN FACTORS ENGINEERING

2.9.1 Design Description

The human factors engineering (HFE) program ensures that each human-system interface (HSI) reflects the latest human factors principles and satisfies the applicable regulatory requirements. Most of the human-system interface system (HSIS) is fully computerized, although there are some portions that utilize conventional switches and indicators.

2.9.1.1 General HFE Program and Scope

The goals of the US-APWR HFE Program are to ensure that an adequate HFE program is developed and the program is implemented. The general objectives of the HFE program are stated in human-centered terms, which, as the HFE program develops, are defined and used as a basis for HFE test and evaluation activities.

The HFE program addresses the following facilities:

- Main control room (MCR)
- Remote shutdown room (RSR)
- Technical support center (TSC)
- Local control stations (LCSs) - consideration of HFE activities for LCSs are limited to those LCSs that support:
  - On-line testing, radiological protection activities, and required chemical monitoring supporting technical specifications
  - Maintenance required by technical specifications
  - Emergency and abnormal conditions response
- Emergency operations facilities (EOFs) (communications and information requirements only)

2.9.1.2 HFE Analyses

2.9.1.2.1 Operating Experience Review

The objective of the HFE operating experience review (OER) is to identify and analyze HFE-related problems and issues encountered in previous nuclear plant designs that are similar to the US-APWR, so that the negative features are not repeated and the positive features are retained. This review includes information pertaining to the human factors issues related to the predecessor plant(s) or highly similar plants and plant systems, recognized nuclear industry HFE issues, issues related to HFE technology, and issues related to advanced reactor design. Personnel interviews serve to determine operating experience related to predecessor plants or systems. The OER identifies risk-important human action (HA) that have been identified as different or where errors have occurred.

Issues identified during the OER are entered into the HFE issues tracking system. Each OER item that is determined by analysis to be appropriate for incorporation in the design is documented in the HFE issues tracking system. The HFE issues tracking system provides the appropriate level of reviews to ensure that issues are tracked to completion. The OER is documented in the US-APWR operating experience review report.

2.9.1.2.2 Functional Requirements Analysis and Function Allocation

The objective of the functional requirements analysis and function allocation is to ensure that the safety functions of the US-APWR are assigned properly as HAs or to automated systems. The functional requirements analysis and function allocation was assigned for the Japanese APWR design with additional analysis performed to account for the differences in the US-APWR design.

The major function allocation (FA) changes for the US-APWR as compared to the standard Japanese PWR plants are to re-allocate manual actions to automatic actions for:

- Automatic isolation of a failed steam generator (SG)
- Automatic establishment of recirculation for emergency core cooling system (ECCS)

2.9.1.2.3 Task Analysis

The task analysis is based on the Japanese APWR design with additional analysis performed to account for differences in the US-APWR design. The objective of the task analysis is to identify the specific tasks that are needed for function accomplishment and the associated information, control, and task-support requirements.

The scope of the task analysis includes: selected representative and important tasks (from operations, maintenance, testing, inspection, and surveillance areas); full range of plant operating modes (startup, normal operations, abnormal and emergency operations, transient conditions, low-power and shutdown conditions); risk important HAs that have been found to affect plant risk by means of probabilistic risk assessment (PRA) importance and sensitivity analyses; where critical functions are automated, the analysis considers all human tasks, including monitoring of the automated system and execution of backup actions if the system fails; and, identification of information and control requirements to enable specification of detailed requirements for alarms, displays, data processing, and controls.

The task analysis results are documented in the Task Analysis report. The task analysis results provide input to the design of HSIs, procedures, and personnel training programs.

2.9.1.2.4 Staffing and Qualifications

A fundamental US-APWR HFE design assumption is that it is possible to operate the plant with just one reactor operator (RO) and one senior reactor operator (SRO) in the MCR during postulated plant operating modes. The normal MCR staff is supplemented by one additional SRO and one additional RO that are at the plant to accommodate unexpected design conditions such as conditions where the HSIS is degraded. While the HSIS is designed to support the minimum MCR and plant staffing, the space and layout of the MCR is designed to accommodate the foreseen maximum number of operating and temporary staff.

Plant personnel positions that are addressed by the HFE program include licensed control room operators and the following categories of personnel:

- Nonlicensed operators (Note 1)
- Shift supervisor
- Shift technical advisor
- Instrumentation and control (I&C) technician (Note 1)
- Electrical maintenance personnel (Note 1)
- Mechanical maintenance personnel (Note 1)
- Radiological protection technician (Note 1)
- Chemistry technician (Note 1)
- Engineering support personnel (Note 1)

Note 1: Staffing analysis of personnel in these positions is limited to those performing the following activities: on-line testing and maintenance required by technical specifications; radiological protection activities supporting technical specifications, required maintenance, and emergency and abnormal response; and required chemical monitoring supporting technical specifications, and abnormal and emergency response.

In addition, any other plant personnel who perform tasks that are directly related to plant safety are addressed.

A staffing and qualification analysis is developed and documented in the staffing and qualifications analysis report. The staffing and personnel qualifications required for the US-APWR are demonstrated by the V&V process to be adequate for plant personnel who perform tasks that are directly related to plant safety. Changes to staffing levels or personnel used in the HFE development are documented and analyzed for their potential impact on HSIs. Those staffing and qualification program issues that negatively impact human performance are identified as human engineering discrepancies (HEDs) and are tracked and dispositioned.

2.9.1.2.5 Human Reliability Analysis (HRA)

HRA/PRA results are incorporated into the HFE design analysis and the HFE design process interacts iteratively with the HRA/probabilistic risk assessment (PRA). The proper interaction of HFE design process and HRA/PRA most effectively contributes to minimizing personnel errors, allowing human error detection, and providing human error recovery capability. The scope of the HRA/PRA incorporation into the HFE design effort encompasses risk-important HAs. Incorporating HRA/PRA results into the HFE design process involves identifying risk-important HAs, addressing the HAs in the HFE analysis and design process, and validating HSI design changes.

The HFE/HRA integration report documents the following:

- the risk significant HAs
- optimization of the HSI design to minimize human error probabilities
- consistency between the HFE design process and the PRA assumptions for traceability of risk significant tasks into each element of the HFE program, including task analysis, HSI design, procedures and training, V&V, and human performance monitoring

2.9.1.3 HFE Design Process

Applicable HSIs, procedures, and training developed and evaluated by the HFE program include operations, accident management, maintenance, test, inspection and surveillance interfaces (including procedures) for those systems that are important to safety

2.9.1.3.1 HSI Design

The HSI resources include the wall panel information system, alarm system, plant information system (non safety-related displays), qualified data processing system (safety-related displays), and soft and dedicated controls.

The HFE program addresses the design of the MCR, remote shutdown console (RSC), TSC, EOF, and LCSs with a safety-related function as defined by a detailed task analysis.

The MCR provides a suitable workspace environment for use by MCR operators for the safe control and operation of the plant. The MCR includes reactor operator workstations, supervisor workstation(s), safety-related displays, and safety-related controls. The MCR includes a minimum inventory of displays, visual alerts and fixed-position controls to support the following design criteria:

a. Spatially dedicated continuously visible (SDCV) HSI for:

- Bypassed and inoperable status indication
- Type A and B PAM variables
- Safety parameter displays including status of critical safety functions and performance of credited safety systems and preferred non safety systems
- Prompting alarms for credited manual operator actions and risk important HAs identified in the HRA
- Conventional switches for system level actuation of safety functions

b. Class 1E HSI for control of all safety related components and monitoring of all safety-related plant instrumentation

c. HSI for degraded HSI conditions, including:

- Loss of non safety HSI
- Loss of safety and non safety HSI due to CCF
- Evacuation of the MCR
- Single HSI failures

The RSC is used for achieving and maintaining safe shutdown conditions in the event that the MCR is not available due to any conditions, including fire which results in catastrophic damage to I&C equipment located in the MCR. The RSC includes non safety Remote Shutdown VDUs, which provide monitoring and control of process equipment in both safety and non safety divisions. The RSC also provides Safety VDUs as a back-up which provide control for only safety systems.

The mission of the LCSs is to provide the resources, outside of the MCR, for operations personnel to perform local monitoring and control activities.

2.9.1.3.2 Procedure Development

The objective of the procedure development program is to produce procedures that support and guide human interactions with plant systems and control plant-related events and activities. HFE principles and criteria are applied along with all other design requirements to develop procedures that are technically accurate, comprehensive, explicit, easy to use, and validated. The operating and emergency operating procedure (EOP) development program addressed in this section is primarily that necessary to support HSI design engineering and subsequent integrated human factors V&V.

The US-APWR Procedures program includes the development of computer-based procedures (CBP) with corresponding paper procedures and stand-alone paper procedures. CBP generated by this program are an integral part of the HSI V&V process.

All procedures are verified and validated, and include the following:

- Technical reviews to verify that procedures are correct and can be carried out.
- Final validation to be performed in a simulation of the integrated system as part of the V&V activities described in the human factors V&V element.
- Verification of adequate content, format, and integration is performed when procedures are modified. The procedures also are assessed through validation if a modification substantially changes personnel tasks that are significant to plant safety. The validation verifies that the procedures correctly reflect the characteristics of the US-APWR plant, and can be carried out effectively to restore the plant to a safe condition.

2.9.1.3.3 Training Program Development

The objective of the training program is to develop personnel training that incorporates the elements of a systems approach to training, evaluates the knowledge and skill requirements of personnel, coordinates training program development with the other elements of the HFE design process, and implements the training in an effective manner that is consistent with human factors principles and practices. The US-APWR training program addresses applicable requirements that are necessary to ensure that training provided to personnel supporting the HSI design and V&V process is acceptable to permit realistic response to the US-APWR reference plant conditions. The detailed training program development process is documented in the training program report.

2.9.1.4 Human Factors Verification and Validation

The Human Factors Verification and Validation (V&V) program involves design verification activities (HSI task support verification and HSI design verification) and the integrated system validation activities. The development of the integrated US-APWR HSIS is conducted in a specifically established HFE development facility. In addition to HSIS development and testing, a V&V process is conducted. This facility provides the updated proof-of-concept testing and “factory testing”.

HSI task support verification is an evaluation whose purpose is to verify that the HSI supports personnel task requirements as defined by task analyses. HSI task support verification confirms that the HSI provides all alarms, information, and control capabilities required for personnel tasks.

HFE design verification is an evaluation to confirm that the HSI is designed to accommodate human capabilities and limitations as reflected in HFE guidelines. HFE design verification confirms the characteristics of the HSI and environment in which it is used conform to HFE guidelines.

The integrated system validation is performed to determine if the integrated system design (i.e., hardware, software, and personnel elements) acceptably supports safe operation of the plant. Integrated system validation is conducted using actual dynamic HSI with high fidelity plant model simulation.

Human engineering discrepancy (HED) resolution is performed iteratively throughout all V&V activities. HEDs identified during a V&V activity are evaluated to determine if they must be resolved prior to conducting other V&V activities. HED resolution verification is conducted to document that HEDs have been addressed in the final design.

2.9.1.5 Implementation and Operation

2.9.1.5.1 Design Implementation

The objective of the HSI design implementation is to demonstrate that the HSI design that is implemented (i.e., the “as-built” design) accurately reflects the verified and validated design.

The scope of HSI design implementation includes the effect on personnel performance resulting from design changes and provides the necessary support to ensure safe operations and that the as-built design conforms to the verified and validated design that resulted from the HFE process.

The referenced changes after V&V apply to the changes made to the US-APWR design following V&V.

Facility design changes are documented and analyzed for their potential impact on HSIs. Those design implementation issues that negatively impact human performance are identified as HEDs and are tracked and dispositioned. HFE design modifications are documented in a periodic status report.

2.9.1.5.2 Human Performance Monitoring

Human performance monitoring applies after the plant is in operation. Human performance monitoring within the scope of this program specifically applies to the following:

- Time critical operator actions
- Correct diagnosis of abnormal plant events
- Accuracy of procedure execution

Monitoring of human performance in other areas is within the scope of other plant programs (such as, “Fitness for Duty”).

Human Performance issues are identified as HEDs and are tracked and dispositioned in accordance with the site specific QA program. HED disposition is documented in a periodic status report.

2.9.2 Inspection, Tests, Analyses, and Acceptance Criteria

Table 2.9-1 describes the ITAAC for HFE.

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. Deleted.	1. Deleted	1. Deleted
2. Deleted.	2. Deleted.	2. Deleted.
3. Deleted.	3. Deleted.	3. Deleted.
4. Deleted.	4. Deleted.	4. Deleted.
5. Task analysis is performed in accordance with the task analysis implementation plan, and includes the following functions: – selected representative and important tasks that affect plant safety from the areas of operations, maintenance, test, inspection, and surveillance – full range of plant operating modes, including startup, normal operations, abnormal and emergency operations, transient conditions, and low-power and shutdown conditions – risk-important human actions that have been found to affect plant risk by means of HRA and PRA importance and sensitivity analyses – internal and external initiating events and actions affecting the PRA Level I and II analyses – human tasks including monitoring of the automated system and execution of backup actions if the system fails	5. The task analysis will be performed.	5. The function-based task analyses are conducted in conformance with the task analysis implementation plan and include the following functions: – selected representative and important tasks that affect plant safety from the areas of operations, maintenance, test, inspection, and surveillance – full range of plant operating modes, including startup, normal operations, abnormal and emergency operations, transient conditions, and low-power and shutdown conditions – risk-important human actions that have been found to affect plant risk by means of HRA and PRA importance and sensitivity analyses – internal and external initiating events and actions affecting the PRA Level I and II analyses – human tasks including monitoring of the automated system and execution of backup actions if the system fails

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6. A staffing and qualifications analysis is performed to ensure that personnel are acceptable to permit realistic response to normal and emergency plant conditions. The analysis is conducted in accordance with an implementation procedure that reflects the requirements of the Staffing and Qualifications Implementation Plan.	6. The staffing and qualifications analysis will be performed.	6. A report exists that documents the staffing and qualifications analysis, demonstrates that the analysis has been performed in compliance with the Staffing and Qualifications Implementation Plan, and concludes from a human factors point of view that the staffing and qualifications of plant personnel are acceptable to perform safety significant tasks for normal and emergency operations.
7. The scope of HSI design, which is developed and/or evaluated by the HFE program, includes operations, accident management, maintenance, tests, inspections and surveillances that are important to safety. The HSI design process is conducted in accordance with an implementation procedure that reflects the requirements of the HSI Design Implementation Plan.	7. An inspection will be performed of the HSI design for operations, accident management, maintenance, tests, inspections and surveillances	7. A report exists that documents the HSI design for operations, accident management, maintenance, tests, inspections and surveillances that are important to safety, and demonstrates that the design process has been conducted in compliance with the HSI Design Implementation Plan.
7a. HSI panels and associated instrumentation, within the scope of the HFE program, comply with quality standards and records.	7a. An analysis will be performed of the panels and associated instrumentation within the scope of the HFE program.	7a. The design documentation exists to verify that panels and associated instrumentation, within the scope of the HFE program, comply with General Design Criteria 1 in Appendix A to 10 CFR 50 for quality standards and records.
7b. The MCR includes a non safety reactor operator workstation, a non safety supervisor workstation, and a workstation for safety-related displays and controls.	7b. An inspection of the as-built MCR workstations will be performed.	7b. The as-built MCR includes a non safety reactor operator workstation, a non safety supervisor workstation, and a workstation for safety-related displays and controls.
7c. A MCR exists to provide the safety-related and non safety related HSI.	7c. An inspection will be performed of the as-built plant building configuration.	7c. The as-built MCR exists to provide the safety-related and non safety related HSI.
7d. HSI resources available in the MCR include checking the standby condition of equipment before operation, monitoring the plant parameters and identifying plant behavior during operation.	7d. An inspection of the as-built HSI resources available in the as-built MCR will be performed.	7d. The as-built HSI resources in the as-built MCR include the HSI that is needed to check the standby condition of equipment before operation, monitor the plant parameters, and identify plant behavior during operation.

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7e. Means are provided in the MCR for manual initiation of protective functions at the system level.	7e. An inspection of the as-built manual initiation functions in the as-built MCR will be performed.	7e. The capability for the as-built manual initiation of protective functions at the system level exists in the as-built MCR.
7f. Spatially dedicated continuously visible (SDCV) HSI is provided in the MCR for: – Bypassed or inoperable status indication – Type A and B PAM variables – Safety parameter displays including status of critical safety functions and performance of credited safety systems and preferred non safety systems – Prompting alarms for credited manual operator actions and risk important HAs identified in the HRA – Conventional switches for system level actuation of safety functions	7f. An inspection of the as-built SDCV HSI in the as-built MCR will be performed.	7f. The following minimum inventory of SDCV displays, visual alerts and controls exists for the as-built MCR : –Bypassed or inoperable status indicators on the Large Display Panel for each safety system or function. –Numeric indicators for each Type A and B PAM variable on the Safety VDUs –Status indicators for each critical safety function, and numeric indicators for key parameters which represent the performance of credited safety system and performance of preferred non safety systems on the Large Display Panel –Prompting alarms for credited manual operator actions and risk important HAs identified in the HRA on the Large Display Panel. –Conventional switches for system level actuation of safety functions on Operator Console.
7g. Class 1E HSI is provided in the MCR for control of all safety related components and monitoring of all safety-related plant instrumentation.	7g. An inspection of the as-built Class 1E HSI in the as-built MCR will be performed.	7g. The as-built MCR includes the Class 1E HSI for control of all safety related components and monitoring of all safety-related plant instrumentation.
7h. The MCR includes HSI for degraded HSI conditions, including: – Loss of non safety HSI – Loss of safety and non safety HSI due to CCF – Single HSI failures	7h. An inspection of the as-built HSI redundancy and diversity in the as-built MCR will be performed.	7h. The as-built MCR includes alternate HSI for the following degraded HSI conditions: – Loss of non safety HSI – Loss of safety and non safety HSI due to CCF – Single HSI failures

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7i. A remote shutdown console (RSC) is provided to achieve safe shutdown in the event of evacuation of the MCR. The RSC includes operator workstation(s) from which operators could perform remote shutdown operations.	7i. An inspection of the as-built RSC will be performed.	7i. To achieve safe shutdown in the event of MCR evacuation, the as-built RSC has Operator workstation(s) from which operators could perform shutdown operations. These workstations have the same functions as the MCR operator console for conducting safe shutdown.
7j. Manual control and monitoring capability is installed at the LCSs (only manned on demand) for the following functions: – On-line testing, radiological protection activities, and required chemical monitoring supporting technical specifications – Maintenance required by technical specifications – Emergency and abnormal response	7j. An inspection of the as-built local control and monitoring functional capability required for the as-built LCSs will be performed.	7j. The as-built LCSs exist at selected locations throughout the plant for the following required functions; –On-line testing, radiological protection activities, and required chemical monitoring supporting technical specifications where HSI is not provided in the MCR. –Maintenance required by technical specifications where HSI is not provided in the MCR. –Emergency and abnormal response for events where MCR HSI cannot be credited.
7k. A TSC and EOF exist where effective direction can be given and effective command control can be performed during an emergency.	7k. An inspection of the as-built TSC and EOF will be performed.	7k. An as-built TSC and EOF exist from which effective direction can be given and effective command control can be exercised during an emergency.
7l. Provisions exist for communications among the MCR, TSC, and EOF; and between the plant, the state and local emergency operations centers, and the field assessment teams; and the appropriate NRC Regional Office Operations Center.	7l. An inspection of the as-built communications functions will be performed.	7l. The as-built functions are made for communications among the MCR, TSC, and EOF; and between the plant and the state and local emergency operations centers, and the field assessment teams; and the appropriate NRC Regional Office Operations Center.

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8. The scope of procedures, which is developed and/or evaluated by the HFE program, includes operations, accident management, maintenance, tests, inspections and surveillances that are important to safety. The procedures guide and support human interactions with plant systems and control plant-related events and activities. The procedure development is conducted in accordance with an implementation procedure that reflects the requirements of the Procedure Development Implementation Plan.	8. An inspection of the as-built procedures will be performed for operations, accident management, maintenance, tests, inspections and surveillances.	8. A report exists that documents the procedures for accident management, maintenance, tests, inspections and surveillances that are important to safety. The report demonstrates that the procedure development process has been conducted in compliance with the Procedure Development Implementation Plan.
8a. The procedures development process ensures that procedures guide and support human interactions with plant systems and control plant-related events and activities.	8a. An inspection of the as-built procedures development process will be performed.	8a. The as-built procedures exist to support functions important to ensuring plant safety during normal and abnormal operating conditions. These procedures conform to the Procedure Writer's Guide.
9. The scope of training, which is developed and/or evaluated by the HFE program, includes operations, accident management, maintenance, tests, inspections and surveillances that are important to safety. The training provided to operations and maintenance personnel is acceptable to maintain plant safety and respond to abnormal plant conditions. The training program has been development in accordance with an implementation procedure that reflects the requirements of the Training Program Development Implementation Plan.	9. An inspection of the as-built training program will be performed for operations, accident management, maintenance, tests, inspections and surveillances.	9. A report exists that documents the training program for accident management, maintenance, tests, inspections and surveillances that are important to safety. The report demonstrates that the training program has been developed in compliance with the Training Program Development Implementation Plan.

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9a. The training development process ensures that training provided to operations and maintenance personnel is acceptable to maintain plant safety and respond to abnormal plant conditions.	9a. An inspection of the as-built training development process will be performed.	9a. The as-built training program includes plant operations and maintenance activities which are important to maintain plant safety and respond to abnormal plant conditions. The training material conforms the Training Developer's Guide.
10. The HFE verification and validation (V&V) program ensures the following: 1) HSI task analysis encompasses a representative range of risk important operational scenarios, events, transients and accidents 2) The inventory and characteristics of the alarms, information, and controls support the tasks generated by the function-based task analyses and the operational sequence analyses, and the HSI design is consistent with the HSI design style guide. 3) The integrated HSI system supports the safe operation of the plant. The V&V activities are conducted in accordance with an implementation procedure that reflects the requirements of the V&V Implementation Plan.	10. An inspection of the HFE V&V activities will be performed.	10. A report exists that documents the V&V activities, demonstrates that the V&V has been performed in compliance with the V&V Implementation Plan, and concludes that the HSI has been adequately verified and validated.
10a. HED resolution during V&V is performed iteratively throughout all V&V activities.	10a. An inspection of the HED resolution during the HFE V&V process will be performed.	10a. HEDs are identified and addressed iteratively throughout all V&V activities and there are no safety significant unresolved HEDs in the final design.
10b. HSI in the MCR permits execution of tasks by operators to establish operations, accident management, maintenance, test, inspection and surveillances for those systems that are important to safety.	10b. Tests will be performed on the execution of representative tasks by the actual MCR operators.	10b. Test results demonstrate that the as-built MCR HSI can establish operations, accident management, maintenance, test, inspection and surveillances for those systems that are important to safety.
10c. HSI at the RSC permits execution of tasks by operators to establish and maintain cold shutdown.	10c. Tests will be performed on the execution of tasks for the as-built RSC.	10c. Test results demonstrate that actual operators can establish and maintain cold shutdown from the as-built RSC.

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 7 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
11. The design that is implemented (i.e., the “as-built” design, including procedures) accurately reflects the verified and validated design, with appropriate modifications. Conformance to the verified and validated design is confirmed in accordance with an implementation procedure that reflects the requirements of the Design Implementation Plan. Modifications from the verified and validated design, such as resolution of outstanding HFE-related issues from the verification and validation program, changes from the verified and validated design or other design features that were not included in the simulator verification and validation, are evaluated using an appropriate V&V method.	11. An inspection of the as-built HSI design will be performed.	11. A report exists that documents the as-built HSI design, demonstrates that the HSI design has been implemented in accordance with the Design Implementation Plan, and concludes that the as-built HSI design is the same as the design verified and validated in the simulator, or that any changes from the simulator design have been confirmed using adequate supplemental V&V methods.

Table 2.9-1 Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 8 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
12. Human Performance issues are identified as HEDs and are tracked and dispositioned in accordance with the site specific QA program.	12. An inspection of the as-built human performance monitoring process will be performed.	12. A human performance monitoring strategy is developed and documented. The US-APWR HFE procedure guides the human performance monitoring for the life of the plant and the process to identify and disposition human performance issues. This human performance monitoring procedure is applicable after the completion of integrated HSI validation and operator training. This process evaluates the impact of facility design and operating changes and addresses the following topics:. • Human performance monitoring includes confirmation of the following criteria: – Effectiveness of HSIs – Personnel performance impacts of HSI, procedure, and training changes – Operator actions meet time and performance criteria – Human performance criteria established during integrated system validation are maintained • Human Performance Trending includes the following: – Performance degradation – Failures – Detection sensitivity – Safety Importance • Human performance evaluation criteria includes the following: – Specific cause determination – Safety Importance – Feedback of information – Corrective actions

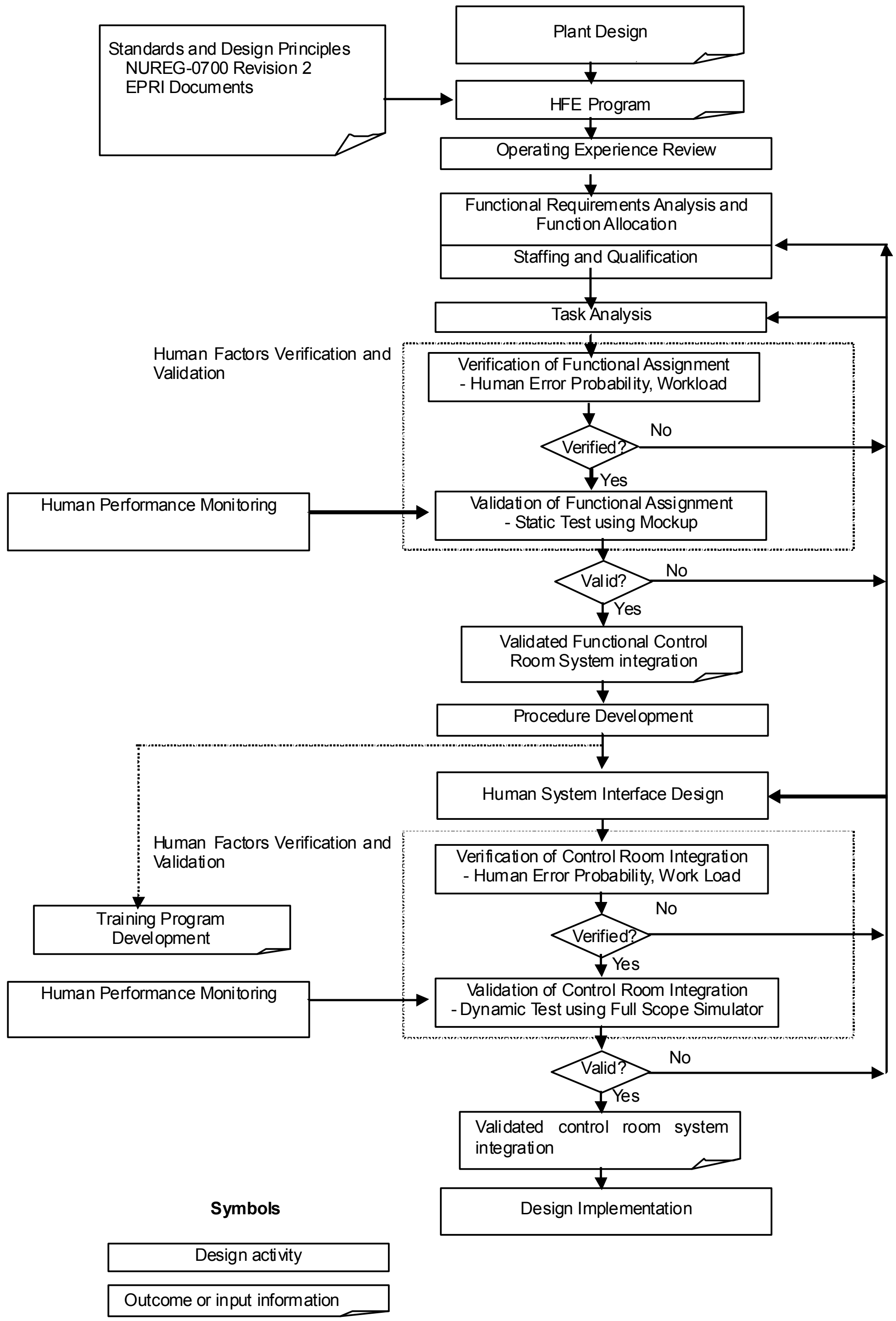


Figure 2.9-1 Overall HFE Design Process

2.10 EMERGENCY PLANNING

This section addresses certain features of the US-APWR plant design that support emergency planning and the capability of the licensee to cope with plant emergencies.

2.10.1 Design Description

Important facilities, design features, and equipment associated with emergency planning include:

- The onsite technical support center (TSC)
- The emergency operations facility (EOF)
- Communication systems for voice and data,
- The emergency response data system (ERDS), and
- The safety parameter display system (SPDS).

The TSC serves as the primary onsite communications center during emergency conditions. Located near the main control room (MCR), it provides floor space of at least 1875 ft^2 (75 ft^2 for each of at least 25 personnel), along with equipment for voice and data communications and for processing and displaying information. In addition, the TSC provides a habitable work space environment in accordance with Subsection 2.7.5.4.1.4.

The EOF is a support facility that provides additional capabilities for managing a plant emergency from a near-site location. This facility houses equipment important to emergency planning as indicated below.

The communication systems include voice communication system and data communication system. The data communication system provides for plant data exchange among the MCR, the TSC, and the EOF. It also supports the ERDS.

The ERDS is an emergency response data system that provides a data link between the licensee's computer system and the NRC Operations Center, with automated transmission of data associated with selected plant parameters to facilitate NRC support in an emergency.

The SPDS in the MCR displays plant parameters that allow operators to rapidly assess plant safety status both during normal operations and in emergencies. This system is duplicated in the TSC and the EOF. This arrangement improves communications among these three areas and facilitates decision making in an emergency.

2.10.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.10-1 describes ITAAC for emergency planning.

Table 2.10-1 Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The TSC floor space is at least 1875 ft^2 (75 ft^2 for each of at least 25 persons).	1. An inspection of the as-built TSC floor area will be performed.	1. The as-built TSC has at least 1875 ft^2 of floor space.
2. The TSC is located close to the MCR.	2. An inspection will be performed for the location of the as-built TSC relative to the as-built MCR.	2. Walking between the as-built TSC and MCR takes no more than 2 minutes.
3. The TSC provides a habitable workspace environment.	3. See Table 2.7.5.4-3, ITAAC Item 8.	3. See Table 2.7.5.4-3, ITAAC Item 8.
4. Adequate emergency communications systems are in place.	4. See Table 2.7.6.10-1 and Table 2.9-1, ITAAC Items 7.k and 7.l.	4. See Table 2.7.6.10-1 and Table 2.9-1, ITAAC Items 7.k and 7.l.

2.11 CONTAINMENT SYSTEMS

The containment vessel (C/V), commonly referred to as the containment, is addressed in this section, along with the following related systems:

- The containment isolation system (CIS)
- The containment spray system (CSS)
- The containment hydrogen monitoring and control system (CHS)

2.11.1 Containment Vessel

2.11.1.1 Design Description

System Purpose and Functions

The containment is a safety-related structure. The primary purpose of the containment is to form an essentially leak tight barrier that safely accommodates calculated temperature and pressure conditions resulting from the complete size spectrum of piping breaks, up to and including a double-ended, guillotine type break of a reactor coolant or main steam line.

Location and Functional Arrangement

The containment is located in the center of the reactor building (R/B). Figures 2.2-1 through 2.2-13 of Section 2.2 and Figure 2.11.1-1 show the containment.

Key Design Features

The geometric shape of the prestressed concrete containment vessel (PCCV) is a vertically oriented cylinder topped by a hemispherical dome with no ring girder at the dome/cylinder interface.

The PCCV consists of a prestressed concrete shell containing unbonded tendons and reinforcement steel. Prestressing is obtained through post-tensioning – a method of prestressing in which tendons are tensioned after concrete has hardened. Reinforcing steel is provided overall in the cylinder and dome. Additional reinforcement is provided at discontinuities, such as the cylinder-basemat interface, around penetrations and openings, at buttresses, and at other areas.

The concrete shell inner surface is lined with a minimum 1/4-in. carbon steel plate that is anchored to the concrete shell and dome to provide the required pressure boundary leak tightness. The liner plate system is not designed or considered as a structural member in providing for the overall PCCV load resistance. The liner plate system is attached to the PCCV shell with an anchorage system.

The PCCV is designed to be compatible with all environmental effects to be experienced during normal reactor operations and to withstand the dynamic effects of postulated accidents. Section 2.2 provides details on the containment design features, including the Containment Internal Structures.

The fundamental design concept of the US-APWR for severe accident termination is reactor cavity flooding and cool down of the molten core by the flooded coolant water.

Reactor cavity flooding to enhance the cool down of the molten core ejected into the reactor cavity is achieved by the CSS, whose operation during a design basis accident is described in Subsection 2.11.3. Drain lines are used to drain spray water, which flows into the SG compartments, to the reactor cavity and cools the molten core. Fire protection system (FPS) water injection may also be used to inject water to the drain lines from the SG compartment to the reactor cavity. The FPS water supply is described in Subsection 2.7.6.9.1.

The geometry of the reactor cavity is designed to assure adequate core debris coolability. Reactor cavity floor area and reactor cavity depth provide enhanced spreading of the debris bed for coolability.

The consequences of a postulated high pressure melt ejection (HPME) severe accident are mitigated by the consideration of reactor cavity geometry and containment layout. The consequences of a postulated HPME are mitigated by a core debris trap in the reactor cavity as well as no direct pathway to the upper compartment. These features prevent entrainment of the molten core to the upper part of the containment and impingement of debris on the containment shell.

Reactor cavity floor concrete is provided to protect against challenge to liner plate melt through.

Seismic and ASME Code Classifications

The PCCV is designed and constructed in accordance with ASME Code, Section III, and the PCCV is classified as seismic Category I structure.

System Operation

The containment itself is passive in nature. The related active functions are performed by other systems, and include containment isolation described in Subsection 2.11.2, actuation of containment spray described in Subsection 2.11.3, and hydrogen monitoring and control described in Subsection 2.11.4.

Alarms, Displays, and Controls

Instruments are installed to monitor conditions inside the containment and actuate appropriate safety functions when an abnormal condition is sensed. These instruments monitor containment pressure, temperature, hydrogen concentration, radioactivity, and air effluent for containment depressurization. Their design features include the following:

- Containment pressure activates logic to initiate a variety of engineered safety feature (ESF) functions.

- Containment temperature is indicated and alarmed in the main control room (MCR), as well as stored in the process computer.
- Hydrogen concentration is continuously indicated in the MCR following a beyond design basis accident.
- Containment high range area monitor is alarmed in MCR.
- Narrow-range containment pressure is indicated and alarmed in the MCR.
- Wide-range containment pressure is indicated in the MCR.

Logic

The reactor protection system uses the narrow-range containment pressure transmitters to automatically actuate:

- Containment spray
- Containment isolation
- Main steam isolation
- Containment ventilation isolation

Interlocks

There are no interlocks needed for direct safety functions related to the C/V.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

The PCCV is designed for a harsh environment, with the environmental conditions described in Subsection 2.2.1.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

The PCCV is designed to accommodate conditions during and following postulated accidents, such as the design basis LOCA. This design enables it to perform its basic safety function of containing radioactive fission products that could be released in an accident. Key containment design and performance characteristics are provided in Table 2.11.1-1.

2.11.1.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.11.1-2 describes the ITAAC for the PCCV.

Table 2.11.1-1 Key Containment Design and Performance Characteristics

Characteristic	Value
Containment internal design pressure (psig)	68
Containment design temperature (degrees F)	300
Containment external design pressure (psig)	3.9
Containment free volume (cubic feet)	2,800,000
Containment design leakage rate (%/day)	0.1
Assumed leak rate of containment during LOCA analyses [0-24 hours] (%/day)	0.15

Table 2.11.1-2 Containment Vessel Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The PCCV pressure boundary is designed to meet ASME Code, Section III requirements.	1. Refer to Table 2.2-4 ITAAC Item 5.	1. Refer to Table 2.2-4 ITAAC Item 5.
2. The PCCV retains structural integrity at the design pressures of 68 psig.	2. Refer to Table 2.2-4 ITAAC Item 3.	2. Refer to Table 2.2-4 ITAAC Item 3.
3. The PCCV structural configuration is as shown in Table 2.2-2 and Figure 2.11.1-1.	3. Inspections of the as built PCCV will be performed.	3. The as-built PCCV configuration is reconciled with descriptions in Table 2.2-2 and Figure 2.11.1-1.
4. A set of drain lines from the SG compartments to the reactor cavity exists.	4. Inspections of the as-built drain lines to the reactor cavity will be performed.	4. A report exists and concludes that the as-built drain lines from the SG compartments to the as-built reactor cavity exist.
5. The reactor cavity includes a core debris trap.	5. Inspections of the as-built reactor cavity will be performed.	5. A report exists and concludes that the as-built reactor cavity includes a core debris trap.
6. The reactor cavity floor area and depth provide enhanced spreading of the debris bed for coolability.	6. Inspections of the as-built reactor cavity will be performed.	6. A report exists and concludes that the sufficient floor area and appropriate depth exists in the as-built reactor cavity.
7. Reactor cavity floor concrete is provided to protect against challenge to liner plate melt through.	7. Inspections of the as-built reactor cavity will be performed.	7. A report exists and concludes that the as-built reactor cavity includes cavity floor concrete which is provided to protect against challenge to liner plate melt through.

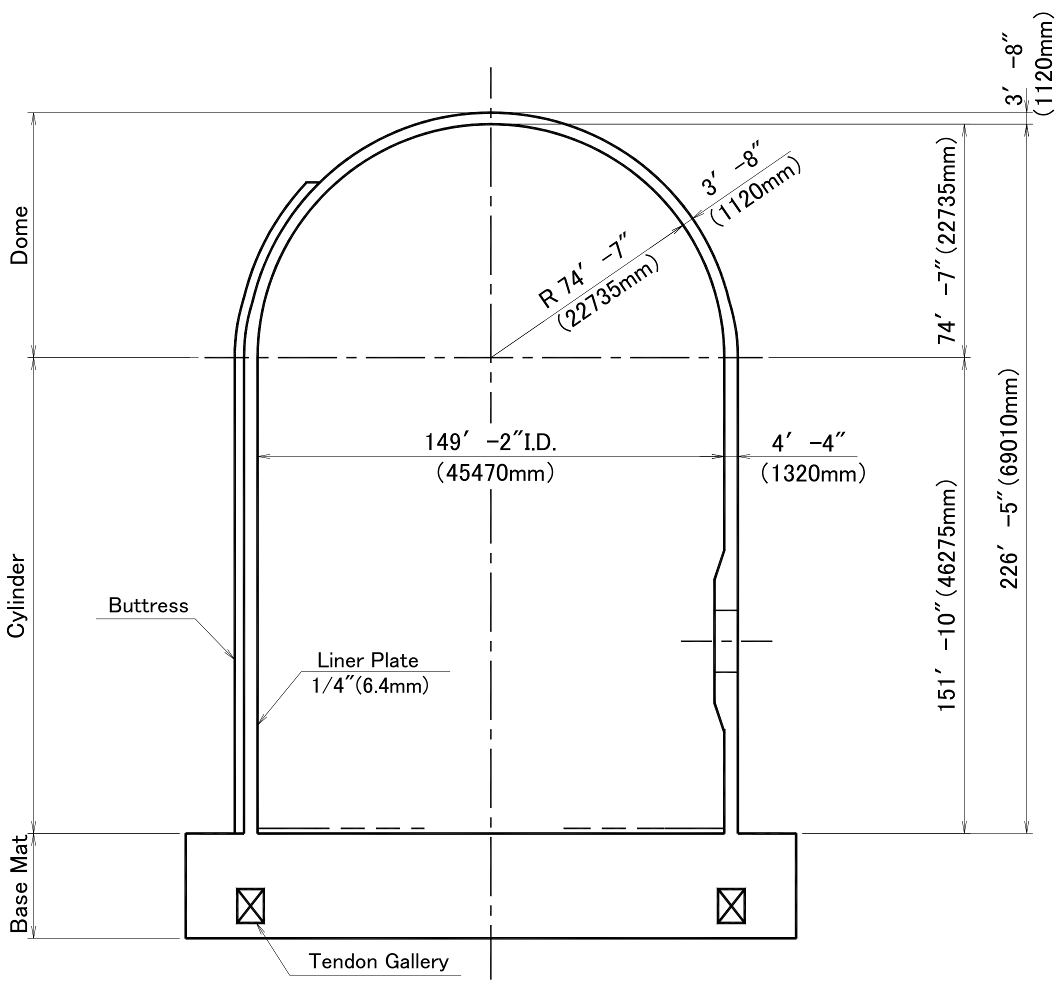


Figure 2.11.1-1 Configuration of Prestressed Concrete Containment Vessel

2.11.2 Containment Isolation System

2.11.2.1 Design Description

System Purpose and Functions

The Containment Isolation System (CIS) provides a safety-related function of containment isolation to prevent or limit the release of fission products to the environment in the event of an accident. The functions of the CIS are to

- Establish and preserve containment boundary integrity when this is required.
- Allow the free flow of normal or emergency-related fluids through the containment boundary in support of reactor operations.

Location and Functional Arrangement

All containment isolation valves are located inside the containment or inside the reactor building (R/B). Figure 2.11.2-1 illustrates the functional arrangement of the containment isolation valves. The system includes piping, valves, and the actuation logic necessary to establish and preserve containment boundary integrity.

Key Design Features

Key design features include:

- The capability to accommodate wind and tornado loadings
- The capability to withstand flood levels
- Protection from the effects of pipe rupture and missiles
- The capability to withstand containment design temperature, pressure and LOCA conditions.

The environmental qualification program for containment isolation components located inside the containment considers the effects of:

- High radiation levels related to a LOCA
- Differential pressure
- A high temperature, steam-laden atmosphere
- A wetting spray of mixed borated water and sodium tetra-borate decahydrate solution.

Valve closure times are established to limit potential releases of radioactivity to amounts as low as reasonably achievable.

Where remote-manual valves are acceptable and employed, local and remote position indication is provided.

Fluid system mechanics (e.g., erosion and water hammer) and the possible effects of too-rapid closure time on valve reliability are considered in the system design.

All pneumatic containment isolation valves fail in the closed position.

Mechanical redundancy is provided by two barriers, and where actuation of two power-operated isolation valves on the same penetration (in series) is required, electrical redundancy is provided by independent power sources.

Main containment penetrations are isolated automatically even when SBO occurs and alternative ac generators are not available.

Seismic and ASME Code Classifications

The CIS is designed and constructed to meet seismic Category I and ASME Code Section III requirements, as indicated in Table 2.11.2-1. Pressure boundary welds in CIS components identified in Table 2.11.2-1 meet ASME Code Section III requirements and the welding materials used are qualified to these requirements.

System Operation

Penetrations that are normally open and are required to close have remote operated valves for isolation that close automatically on a containment isolation signal. Containment isolation valve operator data is included in Table 2.11.2-1.

Alarms, Displays, and Controls

Table 2.11.2-1 includes cross-references to tables identifying alarms, displays and controls for CIVs that are also described in other Tier 1 sections. Table 2.11.2-3 identifies the MCR alarms, displays and controls for CIVs that are not included on similar tables in other Tier 1 sections.

Logic

The containment isolation signal is generated and actuated by the protection and safety monitoring system (PSMS).

Interlocks

There are no interlocks needed for direct safety functions related to the CIS.

Class 1E Electrical Power Sources and Divisions

The equipment identified in Table 2.11.2-1 as Class 1E is powered from their respective Class 1E division. Separation is provided between these Class 1E divisions and between non-Class 1E divisions and non-Class 1E electrical cable.

Equipment to be Qualified for Harsh Environments

The components identified in Table 2.11.2-1 as being qualified for a harsh environment can withstand the environmental conditions and provided with assurance that component can maintain functional operability under all service conditions, including the design basis accident.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specific as ITAAC acceptance criteria in Table 2.11.2-2.

2.11.2.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.11.2-2 describes the ITAAC for the CIS.

The MSIVs and MSBIVs ITAAC for closure times and testing in response to a closure signal are described in ITAAC Table 2.7.1.2-5 Items 8.b and 14.

Table 2.11.2-1 Containment Isolation System Equipment Characteristics (Sheet 1 of 10)

System Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	Safety-Related Display	PSMS Control	Active Safety Function	Loss of Motive Power Position
RCS	RCS-VLV-133	2	Yes	No	-/-	No	-	Transfer Closed	-
RCS	RCS-AOV-132	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	Closed
RCS	RCS-VLV-139	2	Yes	No	-/-	No	-	Transfer Closed	-
RCS	RCS-VLV-140	2	Yes	No	-/-	No	-	-	-
RCS	RCS-AOV-138	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	Closed
RCS	RCS-AOV-147	2	Yes	Yes	Yes/ Yes	Yes	Containment Isolation Phase A	Transfer Closed	Closed
RCS	RCS-AOV-148	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	Closed
WMS	LMS-AOV-052	2	Yes	Yes	Yes/Yes	Yes	Containment Isolation Phase A	Transfer Closed	Closed
WMS	LMS-AOV-053	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	Closed
WMS	LMS-AOV-055	2	Yes	Yes	Yes/Yes	Yes	Containment Isolation Phase A	Transfer Closed	Closed

Table 2.11.2-1 Containment Isolation System Equipment Characteristics (Sheet 2 of 10)

System Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	Safety-Related Display	PSMS Control	Active Safety Function	Loss of Motive Power Position
WMS	LMS-AOV-056	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	Closed
WMS	LMS-AOV-060	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	Closed
WMS	LMS-LCV-010A	2	Yes	Yes	Yes/Yes	Yes	Containment Isolation Phase A	Transfer Closed	Closed
WMS	LMS-LCV-010B	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	Closed
WMS	LMS-AOV-104	2	Yes	Yes	Yes/Yes	Yes	Containment Isolation Phase A	Transfer Closed	Closed
WMS	LMS-AOV-105	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	Closed
RWS	RWS-MOV-002	2	Yes	Yes	Yes/Yes	Yes	Containment Isolation Phase A	Transfer Closed	As Is
RWS	RWS-MOV-004	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	As Is
RWS	RWS-VLV-003	2	Yes	No	-/-	No	-	Transfer Closed	-

Table 2.11.2-1 Containment Isolation System Equipment Characteristics (Sheet 3 of 10)

System Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	Safety-Related Display	PSMS Control	Active Safety Function	Loss of Motive Power Position
RWS	RWS-VLV-023	2	Yes	No	-/-	No	-	Transfer Closed	-
RWS	RWS-AOV-022	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	Closed
PMWS	DWS-VLV-005	2	Yes	No	-/-	No	-	-	-
PMWS	DWS-VLV-004	2	Yes	No	-/-	No	-	-	-
IAS	IAS-VLV-003	2	Yes	No	-/-	No	-	Transfer Closed	-
IAS	IAS-MOV-002	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	As Is
FSS	FSS-VLV-003	2	Yes	No	-/-	No	-	Transfer Closed	-
FSS	FSS-AOV-001	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	Closed
FSS	FSS-VLV-006	2	Yes	No	-/-	No	-	-	-
FSS	FSS-MOV-004	2	Yes	Yes	Yes/No	Yes	-	-	As Is
SSAS	SAS-VLV-103	2	Yes	No	-/-	No	-	-	-
SSAS	SAS-VLV-101	2	Yes	No	-/-	No	-	-	-
CVVS	VCS-AOV-306	2	Yes	Yes	Yes/Yes	Yes	Containment Purge Isolation	Transfer Closed	Closed

Table 2.11.2-1 Containment Isolation System Equipment Characteristics (Sheet 4 of 10)

System Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	Safety-Related Display	PSMS Control	Active Safety Function	Loss of Motive Power Position
CVVS	VCS-AOV-307	2	Yes	Yes	Yes/No	Yes	Containment Purge Isolation	Transfer Closed	Closed
CVVS	VCS-AOV-305	2	Yes	Yes	Yes/Yes	Yes	Containment Purge Isolation	Transfer Closed	Closed
CVVS	VCS-AOV-304	2	Yes	Yes	Yes/No	Yes	Containment Purge Isolation	Transfer Closed	Closed
CVVS	VCS-AOV-356	2	Yes	Yes	Yes/Yes	Yes	Containment Purge Isolation	Transfer Closed	Closed
CVVS	VCS-AOV-357	2	Yes	Yes	Yes/No	Yes	Containment Purge Isolation	Transfer Closed	Closed
CVVS	VCS-AOV-355	2	Yes	Yes	Yes/Yes	Yes	Containment Purge Isolation	Transfer Closed	Closed
CVVS	VCS-AOV-354	2	Yes	Yes	Yes/No	Yes	Containment Purge Isolation	Transfer Closed	Closed
CWS	VCS-PT-2390,2391	-	Yes	-	No/No	No	-	-	-
VWS	VWS-MOV-407	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	As Is

Table 2.11.2-1 Containment Isolation System Equipment Characteristics (Sheet 5 of 10)

System Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	Safety-Related Display	PSMS Control	Active Safety Function	Loss of Motive Power Position
VWS	VWS-MOV-403	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	As Is
VWS	VWS-MOV-422	2	Yes	Yes	Yes/Yes	Yes	Containment Isolation Phase A	Transfer Closed	As is
VWS	VWS-VLV-421	2	Yes	No	-/-	No	-	Transfer Closed	-
VWS	VWS-VLV-423	2	Yes	No	-/-	No	-	Transfer Closed	-
RMS	RMS-VLV-005	2	Yes	No	-/-	No	-	Transfer Closed	-
RMS	RMS-MOV-003	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	As Is
RMS	RMS-MOV-001	2	Yes	Yes	Yes/Yes	Yes	Containment Isolation Phase A	Transfer Closed	As Is
RMS	RMS-MOV-002	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	As Is
ICIGS	IGS-AOV-002	2	Yes	Yes	Yes/Yes	Yes	Containment Isolation Phase A	Transfer Closed	Closed
ICIGS	IGS-AOV-001	2	Yes	Yes	Yes/No	Yes	Containment Isolation Phase A	Transfer Closed	Closed

Table 2.11.2-1 Containment Isolation System Equipment Characteristics (Sheet 6 of 10)

<table>
<tr><th>System Name</th><th>Tag No.</th><th>ASME Code Section III Class</th><th>Seismic Category I</th><th>Remotely Operated Valve</th><th>Class 1E/ Qual. For Harsh Envir.</th><th>Safety-Related Display</th><th>PSMS Control</th><th>Active Safety Function</th><th>Loss of Motive Power Position</th></tr>
<tr><td>LRTS</td><td>LTS-VLV-002</td><td>2</td><td>Yes</td><td>No</td><td>-/-</td><td>No</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>LRTS</td><td>LTS-VLV-001</td><td>2</td><td>Yes</td><td>No</td><td>-/-</td><td>No</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>SIS</td><td>SIS-VLV-115</td><td rowspan="5" colspan="8">Refer to Tables 2.4.4-2 and 2.4.4-4</td></tr>
<tr><td>SIS</td><td>SIS-AOV-114</td></tr>
<tr><td>SIS</td><td>SIS-VLV-010 A,B,C,D</td></tr>
<tr><td>SIS</td><td>SIS-MOV-009 A,B,C,D</td></tr>
<tr><td>SIS</td><td>SIS-MOV-001 A,B,C,D</td></tr>
<tr><td>CVCS</td><td>CVS-AOV-005</td><td rowspan="9" colspan="8">Refer to Tables 2.4.6-2 and 2.4.6-4</td></tr>
<tr><td>CVCS</td><td>CVS-AOV-006</td></tr>
<tr><td>CVCS</td><td>CVS-MOV-152</td></tr>
<tr><td>CVCS</td><td>CVS-VLV-153</td></tr>
<tr><td>CVCS</td><td>CVS-MOV-178 A, B, C, D</td></tr>
<tr><td>CVCS</td><td>CVS-VLV-179 A,B,C,D</td></tr>
<tr><td>CVCS</td><td>CVS-MOV-203</td></tr>
<tr><td>CVCS</td><td>CVS-VLV-202</td></tr>
<tr><td>CVCS</td><td>CVS-MOV-204</td></tr>
</table>

NOTE:
Dash (-) indicates not applicable

Table 2.11.2-1 Containment Isolation System Equipment Characteristics (Sheet 7 of 10)

System Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	Safety-Related Display	PSMS Control	Active Safety Function	Loss of Motive Power Position
RHRS	RHS-MOV-002 A,B,C,D	Refer to Tables 2.4.5-2 and 2.4.5-4							
RHRS	RHS-SRV-003 A,B,C,D								
RHRS	RHS-MOV-021 A,B,C,D								
RHRS	RHS-VLV-022 A,B,C,D								
MSS	MSS-SMV-515 A, B, C, D	Refer to Tables 2.7.1.2-2 and 2.7.1.2-4							
MSS	MSS-HCV-565, 575, 585, 595								
MSS	MSS-SRV-509 A,B,C,D MSS-SRV-510 A,B,C,D MSS-SRV-511 A,B,C,D MSS-SRV-512 A,B,C,D MSS-SRV-513 A,B,C,D MSS-SRV-514 A,B,C,D								

Table 2.11.2-1 Containment Isolation System Equipment Characteristics (Sheet 8 of 10)

System Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	Safety-Related Display	PSMS Control	Active Safety Function	Loss of Motive Power Position
MSS	MSS-MOV-507 A,B,C,D	Refer to Tables 2.7.1.2-2 and 2.7.1.2-4							
MSS	MSS-MOV-701 A,B,C,D								
FWS	FWS-SMV-512 A,B,C,D	Refer to Tables 2.7.1.9-2 and 2.7.1.9-4							
SGBDS	SGS-AOV-001 A,B,C,D	Refer to Tables 2.7.1.10-1 and 2.7.1.10-3							
SGBDS	SGS-AOV-031 A,B,C,D								
EFWS	EFS-MOV-101 A,B,C,D	Refer to Tables 2.7.1.11-2 and 2.7.1.11-4							
EFWS	EFS-MOV-019 A,B,C,D								

Table 2.11.2-1 Containment Isolation System Equipment Characteristics (Sheet 9 of 10)

System Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	Safety-Related Display	PSMS Control	Active Safety Function	Loss of Motive Power Position
CCWS	NCS-MOV-402 A, B	Refer to Tables 2.7.3.3-2 and 2.7.3.3-4							
CCWS	NCS-VLV-403 A, B								
CCWS	NCS-MOV-445 A, B								
CCWS	NCS-MOV-436 A, B								
CCWS	NCS-VLV-437 A, B								
CCWS	NCS-MOV-447 A, B								
CCWS	NCS-MOV-438 A, B								
CCWS	NCS-MOV-448 A, B								
CCWS	NCS-MOV-531								
CCWS	NCS-MOV-537								
CCWS	NCS-MOV-511								
CCWS	NCS-MOV-517								

Table 2.11.2-1 Containment Isolation System Equipment Characteristics (Sheet 10 of 10)

<table>
<tr><th>System Name</th><th>Tag No.</th><th>ASME Code Section III Class</th><th>Seismic Category I</th><th>Remotely Operated Valve</th><th>Class 1E/ Qual. For Harsh Envir.</th><th>Safety-Related Display</th><th>PSMS Control</th><th>Active Safety Function</th><th>Loss of Motive Power Position</th></tr>
<tr><td>PSS</td><td>PSS-MOV-013,023</td><td rowspan="8" colspan="8">Refer to Table 2.7.6.7-1 and 2.7.6.7-4</td></tr>
<tr><td>PSS</td><td>PSS-MOV-031A,B</td></tr>
<tr><td>PSS</td><td>PSS-MOV-071</td></tr>
<tr><td>PSS</td><td>PSS-VLV-072</td></tr>
<tr><td>PSS</td><td>PSS-AOV-003</td></tr>
<tr><td>PSS</td><td>PSS-MOV-006</td></tr>
<tr><td>PSS</td><td>PSS-AOV-062A,B,C,D</td></tr>
<tr><td>PSS</td><td>PSS-AOV-063</td></tr>
<tr><td>CSS</td><td>CSS-MOV-001 A, B, C, D</td><td rowspan="3" colspan="8">Refer to Table 2.11.3-2 and 2.11.3-4</td></tr>
<tr><td>CSS</td><td>CSS-MOV-004 A, B, C, D</td></tr>
<tr><td>CSS</td><td>CSS-VLV-005 A, B, C, D</td></tr>
</table>

Table 2.11.2-2 Containment Isolation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the CIS is as described in Subsection 2.11.2 Design Description and as shown on Figure 2.11.2-1.	1. Inspections of the as-built CIS will be performed.	1. The as-built CIS conforms to the functional arrangement as described in the Design Description of this Subsection and as shown in Figure 2.11.2-1.
2.a.i The ASME Code Section III components of the CIS, identified in Table 2.11.2-1, are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.a.i An inspection of the as-built ASME Code Section III components of the CIS will be performed.	2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the CIS identified in Table 2.11.2-1 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.a.ii The ASME Code Section III components of the CIS identified in Table 2.11.2-1 are reconciled with the design requirements.	2.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the CIS identified in Table 2.11.2-1 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.
2.b.i The ASME Code Section III piping of the CIS, including supports, is designed and fabricated in accordance with ASME Code Section III requirements.	2.b.i An inspection of the as-built ASME Code Section III piping of the CIS, including supports, will be performed.	2.b.i The ASME Code Section III data report(s) (certified when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the CIS, including supports, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

Table 2.11.2-2 Containment Isolation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.b.ii The ASME Code Section III piping of the CIS, including supports, is reconciled with the design requirements.	2.b.ii A reconciliation analysis of the piping of the CIS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA3550) will be performed.	2.b.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the CIS, including supports, is reconciled with the design requirements. The report documents the results of the reconciliation analysis.
3.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.11.2-1, meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non- destructive examination of as-built pressure boundary welds.
3.b Pressure boundary welds in ASME Code Section III piping meet ASME Code Section III requirements for non-destructive examination of welds.	3.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non- destructive examination of as-built pressure boundary welds.
4.a The ASME Code Section III components, identified in Table 2.11.2-1, retain their pressure boundary integrity at their design pressure.	4.a A hydrostatic test will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	4.a The results of the hydrostatic test of the as-built components identified in Table 2.11.2-1 as ASME Code Section III conform with the requirements of the ASME Code Section III.
4.b The ASME Code Section III piping retains its pressure boundary integrity at its design pressure.	4.b A hydrostatic test will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the hydrostatic test of the as-built piping conform to the requirements of the ASME Code Section III.

Table 2.11.2-2 Containment Isolation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5.a The seismic Category I equipment is designed to withstand seismic design basis loads without loss of safety function.	5.a.i Inspections will be performed to verify that the seismic Category I as-built equipment are located in the containment and the reactor building.	5.a.i The seismic Category I as-built equipment is located in the containment and the reactor building.
	5.a.ii Type tests and/or analyses of seismic Category I equipment will be performed.	5.a.ii The results of the type tests and/or analyses concludes that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.a.iii Inspections will be performed the as-built equipment including anchorage.	5.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.
5.b Each of the seismic Category I piping, including supports, is designed to withstand combined normal and seismic design basis loads without loss of its safety function.	5.b.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, are supported by a seismic Category I structure(s).	5.b.i Reports(s) document that each of the as-built seismic Category I piping, including supports, is supported by a seismic Category I structure(s).
	5.b.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, can withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, can withstand combined normal and seismic design basis loads without a loss of its safety function.
6.a The Class 1E equipment identified in Table 2.11.2-1 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.a.i Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	6.a.i The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.11.2-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.

Table 2.11.2-2 Containment Isolation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	6.a.ii An inspection will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.11.2-1 as being qualified for a harsh environment are bounded by type tests and/or analyses.
6.b The Class 1E equipment, identified in Table 2.11.2-1, is powered from their respective Class 1E division.	6.b A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.11.2-1 under test.
6.c Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	6.c Inspections of the as-built Class 1E divisional cables will be conducted.	6.c Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.
7. CIS isolates containment upon receipt of a containment isolation signal.	7. Tests will be performed to verify that the as-built containment isolation air operated valves and motor operated valves close on receipt of an isolation signal.	7. The as-built containment isolation air operated valves and motor operated valves close on receipt of an isolation signal.
8.i The RCS CIVs close within the containment isolation response time.	8.i Tests will be performed to verify as-built RCS CIVs close within the isolation response times.	8.i The following as-built RCS CIVs close within the required times: ≤ 15 seconds RCS-AOV-132, RCS-AOV-138, RCS-AOV-147, RCS-AOV-148
8.ii The WMS CIVs listed in Table 2.11.2-1 close within the containment isolation response time.	8.ii Tests will be performed to verify as-built WMS CIVs listed in Table 2.11.2-1 close within the isolation response times.	8.ii The as-built WMS CIVs listed in Table 2.11.2-1 close within 15 seconds.

Table 2.11.2-2 Containment Isolation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8.iii The RWS CIVs close within the containment isolation response time.	8.iii Tests will be performed to verify as-built RWS CIVs close within the isolation response times.	8.iii The following as-built RWS CIVs close within the required times: ≤ 20 seconds RWS-AOV-022 ≤ 30 seconds RWS-MOV-002, RWS-MOV-004
8.iv The IAS CIVs close within the containment isolation response time.	8.iv Tests will be performed to verify as-built IAS CIVs close within the isolation response times.	8.iv The following as-built IAS CIVs close within the required times: ≤ 15 seconds IAS-MOV-002
8.v The FSS CIVs close within the containment isolation response time.	8.v Tests will be performed to verify as-built FSS CIVs close within the isolation response times.	8.v The following as-built FSS CIVs close within the required times: ≤ 15 seconds FSS-AOV-001
8.vi The CVVS CIVs listed in Table 2.11.2-1 close within the containment isolation response time.	8.vi Tests will be performed to verify as-built CVVS CIVs listed in Table 2.11.2-1 close within the isolation response times.	8.vi The as-built CVVS CIVs listed in Table 2.11.2-1 close within 5 seconds.
8.vii The VWS CIVs listed in Table 2.11.2-1 close within the containment isolation response time.	8.vii Tests will be performed to verify as-built VWS CIVs listed in Table 2.11.2-1 close within the isolation response times.	8.vii The following as-built VWS CIVs close within the required times: ≤ 50 seconds VWS-MOV-422, VWS-MOV-407, VWS-MOV-403
8.viii The RMS CIVs close within the containment isolation response time.	8.viii Tests will be performed to verify as-built RMS CIVs close within the isolation response times.	8.viii The following as-built RMS CIVs close within the required times: ≤ 15 seconds RMS-MOV-001, RMS-MOV-002, RMS-MOV-003
8.ix The ICIGS CIVs listed in Table 2.11.2-1 close within the containment isolation response time.	8.ix Tests will be performed to verify as-built ICIGS CIVs listed in Table 2.11.2-1 close within the isolation response times.	8.ix The as-built ICIGS CIVs listed in Table 2.11.2-1 close within 15 seconds.

Table 2.11.2-2 Containment Isolation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8.x The SIS CIVs close within the containment isolation response time.	8.x Tests will be performed to verify as-built SIS CIVs close within the isolation response times.	8.x The following as-built SIS CIVs close within the required times: ≤ 15 seconds SIS-AOV-114
8.xi The CVCS CIVs close within the containment isolation response time.	8.xi Tests will be performed to verify as-built CVCS CIVs close within the isolation response times.	8.xi The following as-built CVCS CIVs close within the required times: ≤ 15 seconds CVS-MOV-203, CVS-MOV-204 ≤ 20 seconds CVS-AOV-005, 006 CVS-MOV-152
8.xii The FWS CIVs close within the containment isolation response time.	8.xii Tests will be performed to verify as-built FWS CIVs close within the isolation response times.	8.xii The following as-built FWS CIVs close within the required times: ≤ 5 seconds FWS-SMV-512 A,B,C,D ≤ 15 seconds EFS-MOV-019 A,B,C,D
8.xiii The SGBS CIVs close within the containment isolation response time.	8.xiii Tests will be performed to verify as-built SGBS CIVs close within the isolation response times.	8.xiii The following as-built SGBS CIVs close within the required times: ≤ 15 seconds SGS-AOV-031 A,B,C,D ≤ 20 seconds SGS-AOV-001 A,B,C,D

Table 2.11.2-2 Containment Isolation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 7 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8.xiv The CCWS CIVs close within the containment isolation response time.	8.xiv Tests will be performed to verify as-built CCWS CIVs close within the isolation response times.	8.xiv The following as-built CCWS CIVs close within the required times: ≤ 20 seconds NCS-MOV-511, NCS-MOV-517 ≤ 40 seconds NCS-MOV-402 A, B, NCS-MOV-436 A,B, NCS-MOV-438 A,B, NCS-MOV-531, NCS-MOV-537
8.xv The PSS CIVs close within the containment isolation response time.	8.xv Tests will be performed to verify as-built PSS CIVs close within the isolation response times.	8.xv The following as-built PSS CIVs close within the required times: ≤ 15 seconds PSS-AOV-003, PSS-MOV-006, PSS-MOV-013, PSS-MOV-023, PSS-MOV-031 A,B PSS-AOV-062 A,B,C,D, PSS-AOV-063
9. The systems penetrating containment retain their containment inventory during containment isolation.	9. Tests will be performed to verify the as-built containment isolation valve leakage in accordance with 10 CFR 50, Appendix J, Type C tests.	9. The as-built containment isolation valve leakage is within design limits and is less than the allowable leakage rate specified in 10 CFR 50, Appendix J.
10. Controls exist in the MCR to open and close the remotely operated valves identified in Table 2.11.2-3.	10. Tests will be performed on the as-built remotely operated valves listed in Table 2.11.2-3 using controls in the as-built MCR.	10. Controls exist in the as-built MCR operate to open and close the as-built remotely operated valves listed in Table 2.11.2-3.
11.a MCR alarms and displays of the parameters identified in Table 2.11.2-3 can be retrieved in the MCR.	11.a Inspections will be performed for retrievability of the CIS parameters in the as-built MCR.	11.a The as-built MCR alarms and displays identified in Table 2.11.2-3 can be retrieved in the as-built MCR.
11.b RSC alarms, displays and controls are identified in Table 2.11.2-3.	11.b Inspections of the as-built RSC alarms, displays and controls will be performed.	11.b Alarms, displays and controls exist on the as-built RSC as identified in Table 2.11.2-3.

Table 2.11.2-2 Containment Isolation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 8 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
12. The motor-operated, air-operated and check valves, identified in Table 2.11.2-1, perform an active safety function to change position as indicated in the table.	12.a Tests or type tests of motor-operated and air-operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	12. Each motor-operated and air-operated valves changes position as indicated in Table 2.11.2-1 under design conditions.
	12.b Tests of the as-built motor-operated and air-operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	12.b Each as-built motor-operated and air-operated valves changes position as indicated in Table 2.11.2-1 under pre-operational test conditions.
	12.c Tests of the as-built check valves with active safety functions identified in Table 2.11.2-1 will be performed under pre-operational test pressure, temperature, and fluid flow conditions.	12.c Each as-built check valve change position as indicated in Table 2.11.2-1.
13. After loss of motive power, the remotely operated valves, identified in Table 2.11.2-1, assume the indicated loss of motive power position.	13. Tests of the as-built valves will be performed under the conditions of loss of motive power	13. Upon loss of motive power, each as-built remotely operated valve identified in Table 2.11.2-1 assumes the indicated loss of motive power position.
14. Main containment penetrations are isolated automatically even when SBO occurs and alternative ac generators are not available.	14. Tests of the as-built valves will be performed under the conditions that SBO occurs and alternative ac generators are not available.	14. Upon loss of ac power condition, each as-built remotely operated valve identified as the following can be closed automatically. - CVS-MOV-203, 204 - LMS-AOV-104, 105 - IAS-MOV-002 - VCS-AOV-306, 307, 356, 357
15. CIVs listed in Table 2.11.2-1 for which actuation of two power-operated isolation valves on the same penetration (in series) is required, have electrical redundancy provided by independent power sources.	15. Inspection of the as-built CIVs will be performed.	15. A report exists and concludes that the CIVs listed in Table 2.11.2-1 for which actuation of two power-operated isolation valves on the same penetration (in series) is required, have electrical redundancy provided by independent power sources.

Table 2.11.2-3 Containment Isolation System Equipment Alarms, Displays, and Control Functions

Equipment Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
N2 Supply Line valve (RCS-AOV-132)	No	Yes	Yes	Yes
Primary Makeup Water Supply line valve (RCS-AOV-138)	No	Yes	Yes	Yes
Pressurizer Relief Tank Gas Analyzer line valves (RCS-AOV-147 and RCS-AOV-148)	No	Yes	Yes	Yes
C/V Reactor Coolant Drain Tank Gas Analysis Line valves (LMS-AOV-052 and LMS-AOV-053)	No	Yes	Yes	Yes
C/V Reactor Coolant Drain Tank N2 Supply line valves (LMS-AOV-055 and LMS-AOV-060)	No	Yes	Yes	Yes
C/V Reactor Coolant Drain Tank N2 vent line valve (LMS-AOV-056)	No	Yes	Yes	Yes
C/V Reactor Coolant Drain Pump Discharge Line valves (LMS-LCV-010A and LMS-LCV-010B)	No	Yes	Yes	Yes
C/V Sump Pump Discharge Line valves (LMS-AOV-104 and LMS-AOV-105)	No	Yes	Yes	Yes
Refueling Water Recirculation Pump Suction Line valves (RWS-MOV-002 and RWS-MOV-004)	No	Yes	Yes	Yes
Refueling Water Recirculation Pump Discharge Line valve (RWS-AOV-022)	No	Yes	Yes	Yes
Instrument Air Line valve (IAS-MOV-002)	No	Yes	Yes	Yes
Water Supply Line to Standpipe and Hose Station inside containment (FSS-AOV-001)	No	Yes	Yes	Yes
Injection Line to Reactor Cavity valve (FSS-MOV-004)	No	Yes	Yes	Yes
Containment High Volume Purge Exhaust line valves (VCS-AOV-306 and VCS-AOV-307)	No	Yes	Yes	Yes
Containment High Volume Purge Supply line valves (VCS-AOV-305 and VCS-AOV-304)	No	Yes	Yes	Yes
Containment Low Volume Purge Exhaust line valves (VCS-AOV-356 and VCS-AOV-357)	No	Yes	Yes	Yes
Containment Low Volume Purge Supply line Valves (VCS-AOV-355 and VCS-AOV-354)	No	Yes	Yes	Yes
Containment Fan Cooler Return Line valve (VWS-MOV-407 and VWS-MOV-422)	No	Yes	Yes	Yes
Containment Fan Cooler Supply Line valve (VWS-MOV-403)	No	Yes	Yes	Yes
Containment Air Sampling Return Line valve (RMS-MOV-003)	No	Yes	Yes	Yes
Containment Air Sampling Supply Line valves (RMS-MOV-001 and RMS-MOV-002)	No	Yes	Yes	Yes
CO2 Purge Line valves (IGS-AOV-002 and IGS-AOV-001)	No	Yes	Yes	Yes

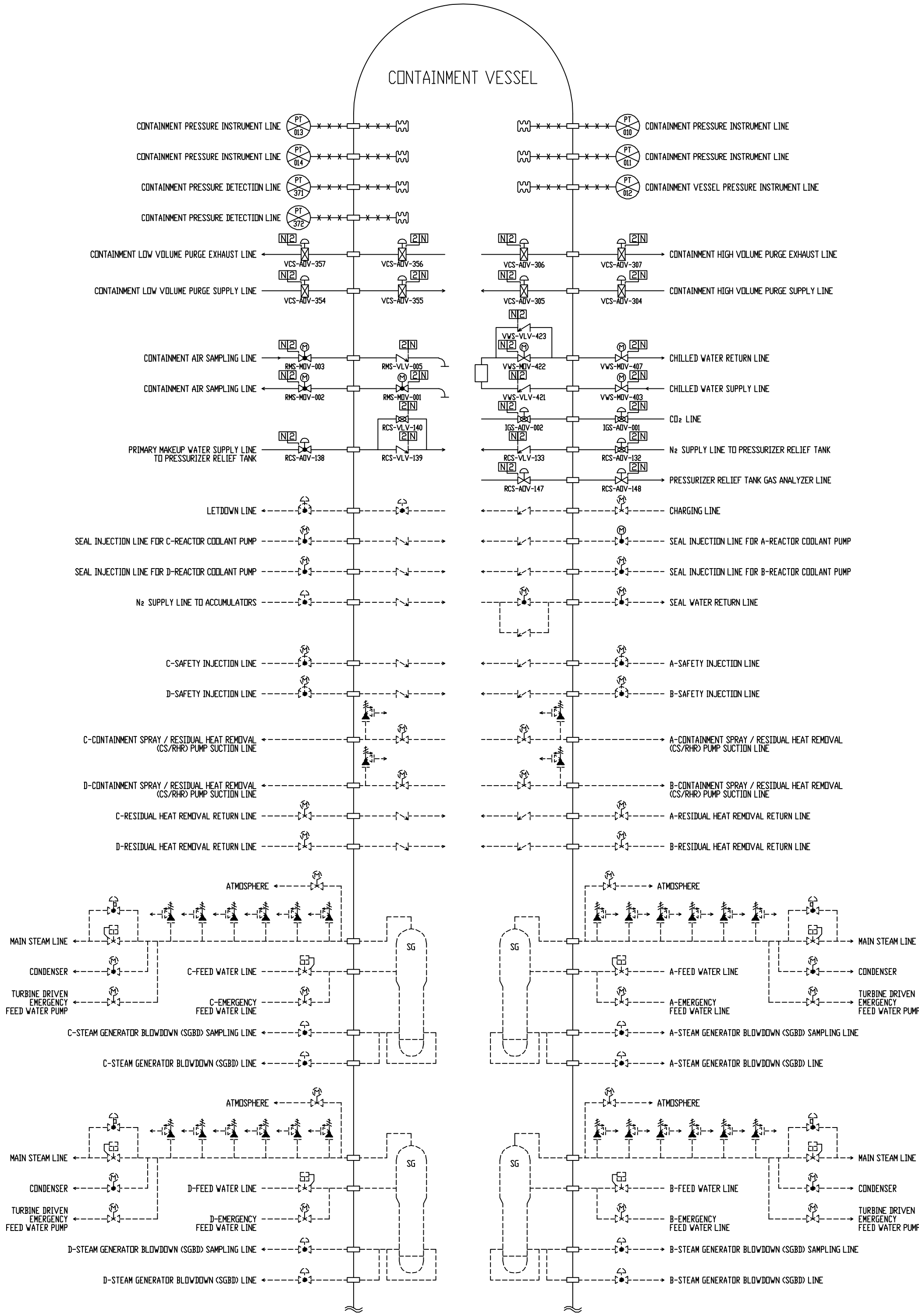


Figure 2.11.2-1 Containment Isolation Valves Basic Configuration (Sheet 1 of 2)

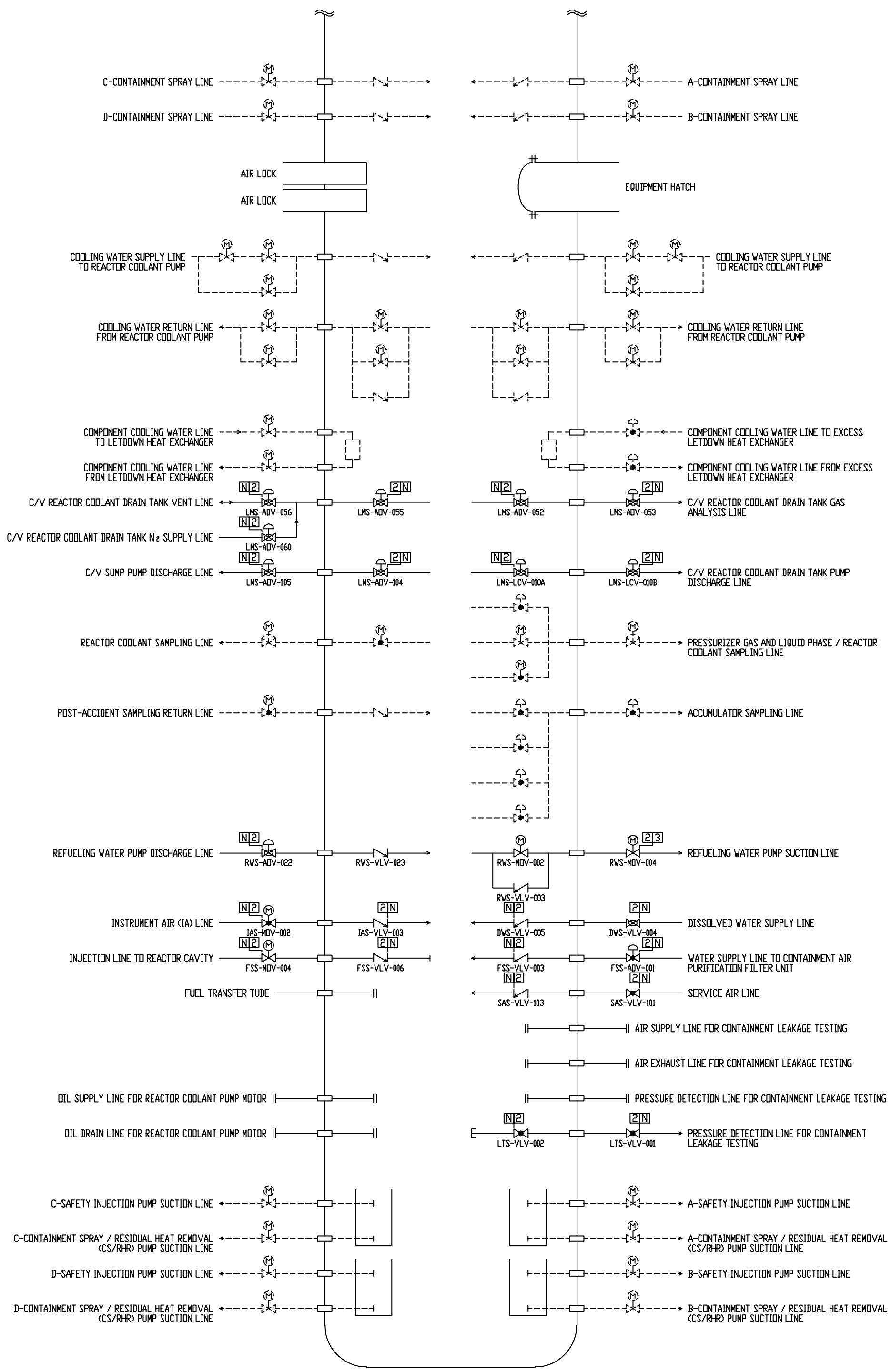


Figure 2.11.2-1 Containment Isolation Valves Basic Configuration (Sheet 2 of 2)

2.11.3 Containment Spray System (CSS)

2.11.3.1 Design Description

System Purpose and Functions

The CSS is a safety-related system. The purposes of the CSS are to cool the containment and remove fission products following an accident, thus the system serves as a dual-function engineered safety feature (ESF).

The CSS functions by automatically spraying borated water into the containment upon receipt of a containment spray signal. This action limits the containment internal peak pressure to well below the design pressure and reduces it to approximately atmospheric pressure in a design basis LOCA or secondary system piping failure.

The CSS provides the containment isolation function, as described in Section 2.11.2, of the lines penetrating the containment.

Location and Functional Arrangement

The refueling water storage pit (RWSP) and the containment spray header are located inside the containment. All other major CSS components are located in the reactor building (R/B). Figure 2.11.3-1 illustrates the CSS, showing the arrangement of the equipment and piping. Table 2.11.3-1 also provides a tabulation of the location of CSS equipment. The CSS and the residual heat removal system (RHRS) share major components which are containment spray/residual heat removal (CS/RHR) pumps and heat exchangers. The CSS includes:

- four CS/RHRS pumps (included in RHRS)
- four CS/RHRS heat exchangers (included in RHRS)
- a spray ring header composed of four concentric interconnected rings, piping, spray nozzles and valves

Key Design Features

The CSS includes four 50% capacity CS/RHR pumps trains, assuming one is out of service for maintenance and one becomes inoperative due to a single failure upon the initiation of the CSS. Other key design features include:

- The emergency power source supplies electrical power to the essential components of the CSS, so that safety functions can be maintained during a loss of offsite power.
- The CSS design permits periodical tests and inspections to verify integrity and operability.

- To ensure reliable containment spray pattern coverage, each spray ring is located at a different containment elevation, and spray rings are supplied from the four 50% capacity trains of containment spray.
- For each train, the discharge line to the containment spray rings is provided with a normally closed, motor-operated containment isolation gate valve.
- The water in the RWSP is cooled by the CS/RHRS heat exchangers and is delivered to the spray header located in the top of the containment in a LOCA.
- Fission product removal is accomplished by increasing the pH of the borated water in the RWSP.
- The CSS can withstand a range of dynamic and environmental effects (including accident environment).
- Each recirculation sump pit of the RWSP contains paired suction piping for the CS/RHRS pump and the safety injection pump.
- The open end of each suction pipe is equipped with a debris strainer to preclude debris clogging. The debris strainers are made of stainless steel and use perforated plates in a layered disc design to limit the maximum pass through debris size. Additional design features of the ECC/CS suction strainers are described in Subsection 2.4.4.1.
- Provides containment isolation for the piping penetrating the containment.
- Each mechanical division of the CSS is physically separated from the other divisions by a structural barrier, which also serves as a fire barrier. The piping and components inside the containment are exceptions.

Seismic and ASME Code Classifications

The CSS (CS/RHR) components, identified in Table 2.4.5-2 and Table 2.11.2-1, are designed and constructed to ASME Code Section III and seismic Category I requirements.

All surfaces of the CCS (CS/RHRS) components and piping in contact with borated reactor coolant are austenitic stainless steel. The pressure boundary welds in ASME Code Section III components and piping meet ASME Code Section III requirements.

System Operation

System operation is as described under key design features.

Alarms, Displays, and Controls

Table 2.4.5-4 identifies alarms, displays, and controls associated with the CSS (CS/RHRS) that are located in the MCR.

Logic

All four CS/RHR pumps automatically start and the containment spray header containment isolation valves containment isolation valves automatically open on receipt of a containment spray signal.

Interlocks

An interlock is provided to preclude the simultaneous opening of both the RHR discharge line containment isolation valves and the corresponding containment spray header containment isolation valve. System interlocks allow opening of the containment spray header containment isolation valve only if the corresponding two in-series CS/RHR pump hot leg Isolation valves are closed.

Class 1E Electrical Power Sources and Divisions

The CSS equipment identified in Table 2.11.3-2 as Class 1E is powered from their respective Class 1E divisions, and separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.

Equipment to be Qualified for Harsh Environments

The equipment identified in Table 2.11.3-2 as being qualified for a harsh environment can withstand the environmental conditions that can exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

When necessary to demonstrate satisfaction of a design commitment, numeric performance values for selected components have been specified as ITAAC acceptance criteria in Table 2.11.3-5.

2.11.3.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.11.3-5 describes the ITAAC for the CSS. ITAAC Item 7 in Table 2.4.4-5 describes ITAAC for ECC/CS suction strainer performance.

The ITAAC associated with the CSS equipment, components, and piping and that comprise a portion of the CIS are described in Table 2.11.2-2.

Table 2.11.3-1 Containment Spray System Piping Location

Equipment and Piping Name	Location
All CSS piping and valves and including the valves interfacing with systems of a lower classification.	Containment and Reactor Building
Containment Spray Nozzles	Containment

Table 2.11.3-2 Containment Spray System Equipment Characteristics

Equipment Name	Tag No.	ASME Code Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Containment Spray Nozzles	-	2	Yes	-	-/-	-	-	-
CS/RHR Pump RWSP Suction Isolation Valves	CSS-MOV-001 A, B, C, D	2	Yes	Yes	Yes/ Yes	Remote Manual	Transfer Closed	As Is
Containment Spray Header Containment Isolation Valves	CSS-MOV-004 A, B, C, D	2	Yes	Yes	Yes/ No	Containment Spray Actuation	Transfer Open	As Is
						Remote Manual	Transfer Closed	
Containment Spray Header Containment Isolation Check Valves	CSS-VLV-005 A, B, C, D	2	Yes	-	-/-	-	Transfer Open/ Transfer Closed	-
Containment Pressure	CSS-PT-010, 011, 012, 013	-	Yes	-	Yes/Yes	-	-	-
Containment Pressure	CSS-PT-014	-	Yes	-	No/No	-	-	-
Containment Temperature	CSS-TE-020	-	Yes	-	Yes/Yes	-	-	-

Table 2.11.3-3 Containment Spray System Piping Characteristics

Pipe Line Name	ASME Code Section III Class	Seismic Category I
All CSS piping and valves and including the valves interfacing with systems of a lower classification.	2	Yes

Table 2.11.3-4 Containment Spray System Equipment Alarms, Displays, and Control Functions

Equipment Name	MCR/RSC Alarm	MCR Display	MCR/RSC Control Function	RSC Display
CS/RHR Pump RWSP Suction Isolation Valves (CSS-MOV-001 A, B, C, D)	No	Yes	Yes	Yes
Containment Spray Header Containment Isolation Valves (CSS-MOV-004 A, B, C, D)	No	Yes	Yes	Yes
Containment Pressure (CSS-PT-010, 011, 012, 013)	Yes	Yes	No	Yes
Containment Temperature (CSS-TE-020)	No	Yes	No	Yes

Table 2.11.3-5 Containment Spray System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a The functional arrangement of the CSS is as described in Subsection 2.11.3.1 Design Description and as shown in Figure 2.11.3-1	1.a An Inspection of the as-built system will be performed.	1.a The as-built CSS conforms to the functional arrangement as described in the Design Description of this Subsection 2.11.3.1 and as shown in Figure 2.11.3-1.
1.b Each mechanical division of the CSS (Divisions A, B, C & D) is physically separated from the other divisions with the exception of inside the containment.	1.b Inspections of the as-built CSS will be performed.	1.b Each mechanical division of the as-built CSS is physically separated from other mechanical divisions of the system by structural barriers with the exception of inside the containment.
2.a.i The ASME Code Section III components of the CSS, identified in Table 2.11.3-2, are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.a.i An inspection of the as-built ASME Code Section III components of the CSS will be performed.	2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the CSS identified in Table 2.11.3-2 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.a.ii The ASME Code Section III components of the CSS identified in Table 2.11.3-2 are reconciled with the design requirements.	2.a.ii A reconciliation analysis of the components using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.a.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III components of the CSS identified in Table 2.11.3-2 are reconciled with the design requirements. The report documents the results of the reconciliation analysis.

Table 2.11.3-5 Containment Spray System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.b.i The ASME Code Section III piping of the CSS, including supports, identified in Table 2.11.3-3, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.b.i An inspection of the as-built ASME Code Section III piping of the CSS, including supports, will be performed.	2.b.i The ASME Code Section III data report(s) (certified when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III piping of the CSS, including supports, identified in Table 2.11.3-3 is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
2.b.ii The ASME Code Section III piping of the CSS, including supports, is reconciled with the design requirements.	2.b.ii A reconciliation analysis of the piping of the CSS, including supports, using as-designed and as-built information and ASME Code Section III design report(s) (NCA3550) will be performed.	2.b.ii The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and conclude that the as-built ASME Code Section III piping of the CSS, including supports, identified in Table 2.11.3-3 is reconciled with the design requirements. The report documents the results of the reconciliation analysis.
3.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.11.3-2, meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds.
3.b Pressure boundary welds in ASME Code Section III piping, identified in Table 2.11.3-3, meet ASME Code Section III requirements for non-destructive examination of welds.	3.b Inspections of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III.	3.b The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of as-built pressure boundary welds.

Table 2.11.3-5 Containment Spray System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4.a The ASME Code Section III components, identified in Table 2.11.3-2, retain their pressure boundary integrity at their design pressure.	4.a A hydrostatic test will be performed on the as-built components required by the ASME Code Section III to be hydrostatically tested.	4.a The results of the hydrostatic test of the as-built components identified in Table 2.11.3-2 as ASME Code Section III conform with the requirements of the ASME Code Section III.
4.b The ASME Code Section III piping, identified in Table 2.11.3-3, retains its pressure boundary integrity at its design pressure.	4.b A hydrostatic test will be performed on the as-built piping required by the ASME Code Section III to be hydrostatically tested.	4.b The results of the hydrostatic test of the as-built piping identified in Table 2.11.3-3 as ASME Code Section III conform with the requirements of the ASME Code Section III.
5.a The seismic Category I equipment, identified in Table 2.11.3-2, is designed to withstand seismic design basis loads without loss of safety function.	5.a.i Inspections will be performed to verify that the seismic Category I as-built equipment identified in Table 2.11.3-1 is located in the containment and reactor building.	5.a.i The seismic Category I as-built equipment identified in Table 2.11.3-2 is located in the containment and reactor building.
	5.a.ii Type tests and/or analyses of seismic Category I equipment will be performed.	5.a.ii The results of the type tests and/or analyses conclude that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.a.iii Inspections will be performed on the as-built equipment including anchorage.	5.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.
5.b Each of the seismic Category I piping, including supports, identified in Table 2.11.3-3 is designed to withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.i Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table 2.11.3-3 are supported by a seismic Category I structure(s).	5.b.i Report(s) documents that each of the as-built seismic Category I piping, including supports, identified in Table 2.11.3-3 is supported by a seismic Category I structure(s).

Table 2.11.3-5 Containment Spray System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	5.b.ii Inspections will be performed for the existence of a report verifying that the as-built seismic Category I piping, including supports, identified in Table 2.11.3-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.	5.b.ii A report exists and concludes that each of the as-built seismic Category I piping, including supports, identified in Table 2.11.3-3 can withstand combined normal and seismic design basis loads without a loss of its safety function.
6.a The Class 1E equipment identified in Table 2.11.3-2 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.a.i Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	6.a.i The results of the type tests and/or analyses concludes that the Class 1E equipment identified in Table 2.11.3-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	6.a.ii Inspections will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.11.3 -2 as being qualified for a harsh environment are bounded by type tests and/or analyses.
6.b The Class 1E equipment, identified in Table 2.11.3-2, is powered from their respective Class 1E division.	6.b A test will be performed on each division of the as-built equipment by providing a simulated test signal only in the Class 1E division under test.	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.11.3-2 under test.
6.c Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	6.c Inspections of the as-built Class 1E divisional cables will be conducted.	6.c Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.
7.a Deleted.	7.a Deleted.	7.a Deleted.

Table 2.11.3-5 Containment Spray System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7.b The CSS provides containment spray during design basis events.	7.b The as-built CS/RHR pump full flow tests will be performed. Analysis will be performed to convert the test results from the test conditions to the design condition.	7.b Two as-built CS/RHR pumps deliver no less than 5290 gpm of RWSP water into the containment.
7.c The CS/RHR pumps have sufficient net positive suction head (NPSH).	7.c Tests to measure the as-built CS/RHR pump suction pressure will be performed. Inspection and analysis to determine NPSH available to each safety injection pump will be performed. The analysis will consider the effects of: - pressure losses for pump inlet piping and components, - pressure losses for pump suction strainers due to debris blockage, - suction from the RWSP water level at the minimum value, - vendor test results of required NPSH.	7.c The as-built system meets the design, and the analysis confirms that the NPSH available is at least 17.9 feet at 3650 gpm.
8. Controls exist in the MCR to open and close the remotely operated valves identified in Table 2.11.3-2.	8. Tests will be performed on the as-built remotely operated valves listed in Table 2.11.3-2 using controls in the as-built MCR.	8. Controls exist in the as-built MCR to open and close the as-built remotely operated valves listed in Table 2.11.3-2.

Table 2.11.3-5 Containment Spray System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9.a The motor-operated and check valves, identified in Table 2.11.3-2 to perform an active safety-related, function to change position as indicated in the table.	9.a.i Tests or type tests of motor-operated valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	9.a.i Each motor-operated valve changes position as indicated in Table 2.11.3-2 under design conditions.
	9.a.ii Tests of the as-built motor-operated valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	9.a.ii Each as-built motor-operated valve changes position as indicated in Table 2.11.3-2 under pre-operational test conditions.
	9.a.iii Test of the as-built check valves with active safety functions identified in Table 2.11.3-2 will be performed under pre-operational test pressure, temperature, and fluid flow conditions.	9.a.iii Each as-built check valve changes position as indicated in Table 2.11.3-2.
9.b After loss of motive power, the remotely operated valves, identified in Table 2.11.3-2, assume the indicated loss of motive power position.	9.b. Tests of the as-built valves will be performed under the conditions of loss of motive power.	9.b Upon loss of motive power, each as-built remotely operated valve identified in Table 2.11.3-2 assumes the indicated loss of motive power position.
10.a The CS/RHR pump starts after receiving a containment spray actuation signal.	10.a Tests of the as-built CS/RHR pump will be performed using a simulated signal.	10.a The as-built CS/RHR pump starts after receiving a simulated signal.
10.b The containment spray header containment isolation valve opens upon receipt of a containment spray actuation signal.	10.b Tests of the as-built containment spray header containment isolation valve will be performed using a simulated signal.	10.b The as-built containment spray header containment isolation valve opens upon receipt of a simulated signal.

Table 2.11.3-5 Containment Spray System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 7 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10.c An interlock is provided for each division of CS/RHR to preclude the simultaneous opening of both the RHR discharge line containment isolation valves and the corresponding containment spray header containment isolation valve.	10.c Tests will be performed on each as-built interlock for the RHR discharge line containment isolation valves and the containment spray header containment isolation valve.	10.c Each as-built interlock for the RHR discharge line containment isolation valves and the corresponding containment spray header containment isolation valve preclude the simultaneous opening of both the RHR discharge line containment isolation valves and the corresponding containment spray header containment isolation valve.
10.d An interlock is provided for each division of CS/RHR to allow opening of the containment spray header containment isolation valve only if either or both of the corresponding two in-series CS/RHR pump hot leg isolation valves are closed.	10.d Tests will be performed on each as-built interlock for the containment spray header containment isolation valves and CS/RHR pump hot leg isolation valves.	10.d Each as-built interlock for the containment spray header containment isolation valve and corresponding two in-series CS/RHR pump hot leg isolation valves will allow opening of the containment spray header containment isolation valve only if either or both of the corresponding two in-series CS/RHR pump hot leg isolation valves are closed.
11. MCR alarms and displays of the parameters identified in Table 2.11.3-4 can be retrieved in the MCR.	11. Inspections will be performed for retrievability of the CSS parameters in the as-built MCR.	11. MCR alarms and displays identified in Table 2.11.3-4 can be retrieved in the as-built MCR.
12. RSC alarms, displays and controls are identified in Table 2.11.3-4.	12. Inspections of the as-built RSC alarms, displays and controls will be performed.	12. Alarms, displays and controls exist on the as-built RSC as identified in Table 2.11.3 -4.

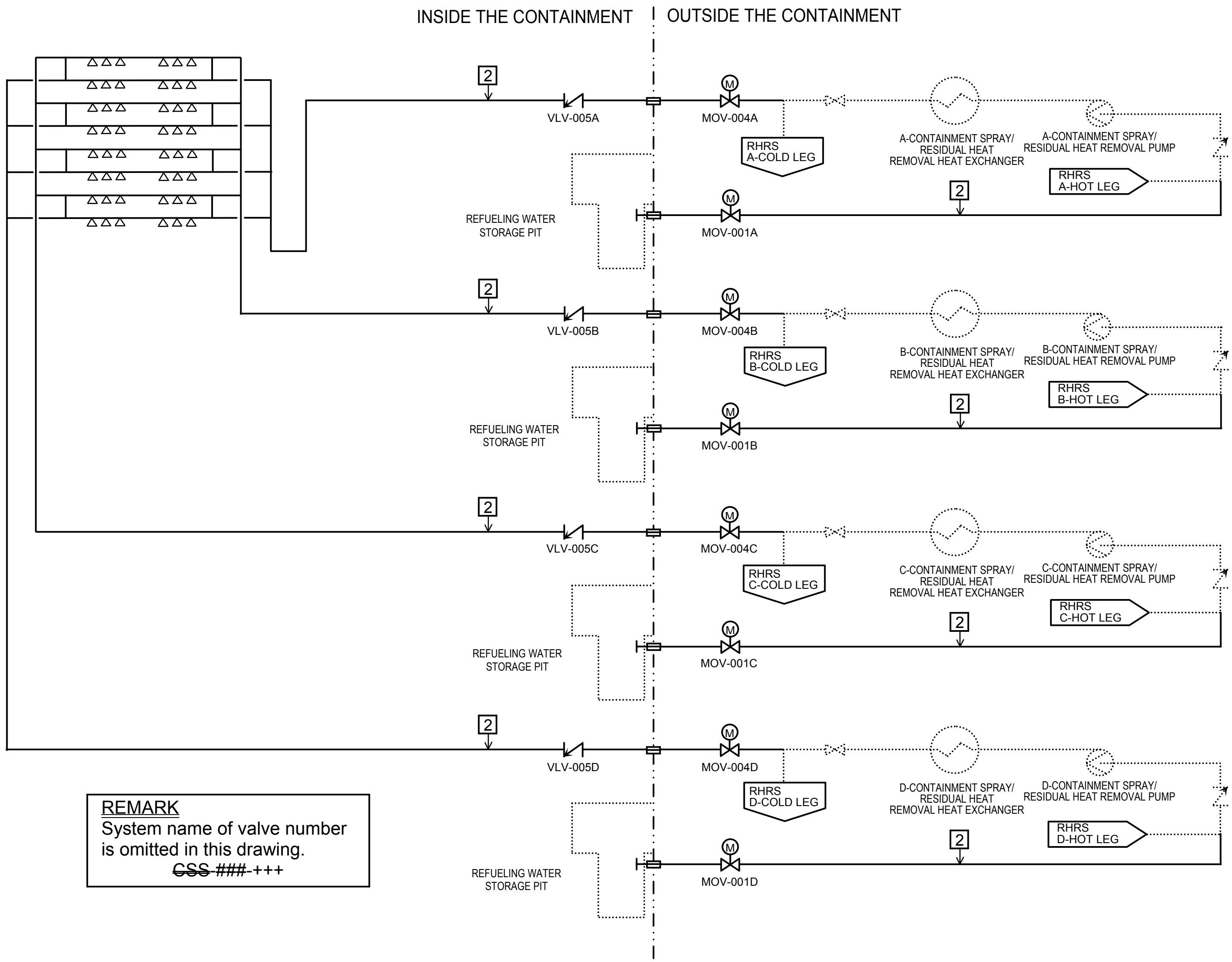


Figure 2.11.3-1 Containment Spray System

2.11.4 Containment Hydrogen Monitoring and Control System (CHS)

2.11.4.1 Design Description

System Purpose and Functions

The CHS is non safety-related system. The purpose of the CHS is to continuously monitor hydrogen concentration within the containment and to reduce the concentration of this combustible gas. The potential for hydrogen gas to be generated may arise from an accident that is more severe than a postulated design-basis accident (DBA).

Location and Functional Arrangement

As shown in Figure 2.11.4-1, there are a set of 20 igniters strategically located in containment areas and subcompartments where hydrogen may be produced, transit or collect. The hydrogen detector is located outside of containment and measures hydrogen concentration in containment air extracted from the containment. The CHS includes a single hydrogen monitor with MCR alarm and display capability and a set of igniters.

Key Design Features

The CHS consists of the hydrogen monitoring system and the hydrogen ignition system. The hydrogen monitoring system consists of a single hydrogen detector. The hydrogen ignition system consists of 20 igniters installed inside the containment, designed to burn hydrogen continuously at a low concentration. The hydrogen igniters burn off hydrogen to maintain hydrogen concentration below the low limit of global burn (approximately 10% hydrogen in air), thereby preventing further hydrogen accumulation that could become a threat to containment integrity. The CHS will automatically actuate upon the receipt of an ECCS actuation signal.

Seismic and ASME Code Classifications

The CHS is not designed for seismic Category I requirements. The components of the CHS are not designed or constructed to ASME Code Section III requirements.

System Operation

The CHS operates during accident conditions.

Alarms, Displays, and Controls

The following CHS variables are monitored in the MCR:

- Display of hydrogen concentration.
- Display of hydrogen igniter status.

An MCR alarm is provided for high hydrogen concentration in containment. Remote manual controls are provided in the MCR to start and stop the hydrogen igniters.

Logic

There is no logic needed for direct safety functions related to the CHS.

Interlocks

There are no interlocks needed for direct safety functions related to the CHS.

Class 1E Electrical Power Sources and Divisions

Not applicable.

Equipment to be Qualified for Harsh Environments

Not applicable.

Interface Requirements

There are no safety-related interfaces with systems outside of the certified design.

Numeric Performance Values

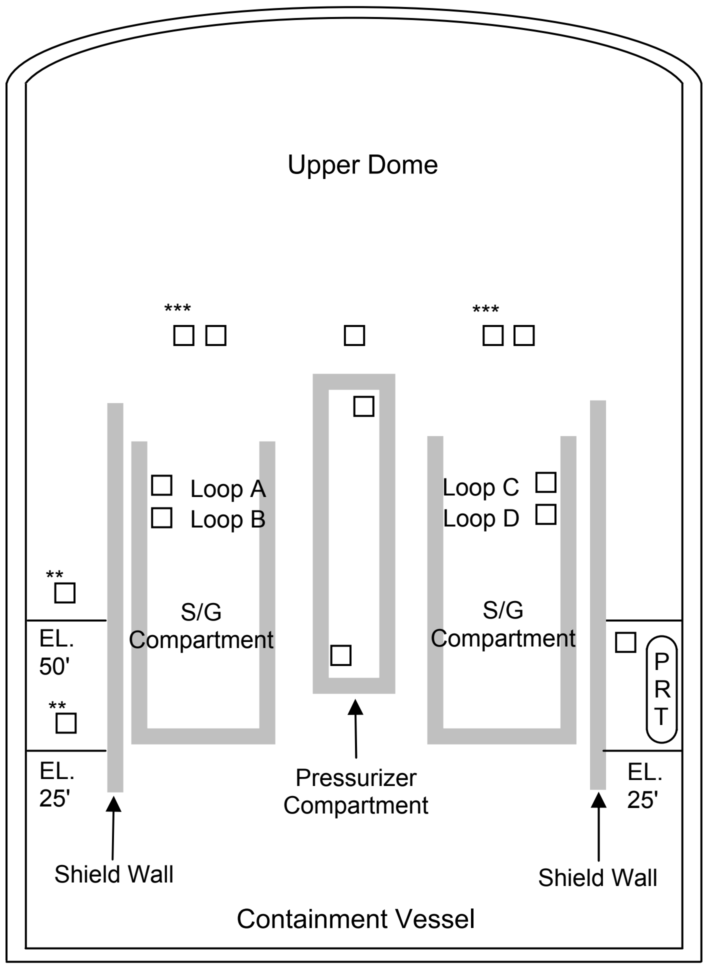
Not applicable.

2.11.4.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.11.4-1 describes the ITAAC for the CHS.

Table 2.11.4-1 Containment Hydrogen Monitoring and Control System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the CHS is as described in the Design Description of this Subsection 2.11.4 and as shown in Figure 2.11.4-1.	1. Inspections of the as-built CHS will be performed.	1. The as-built CHS conforms with the functional arrangement as described in the Design Description of this Subsection 2.11.4 and as shown in Figure 2.11.4-1.
2. The hydrogen igniters are located in the PCCV as shown in Figure 2.11.4-1.	2. An inspection of the as-built hydrogen igniters will be performed.	2. The as-built hydrogen igniters are located in the PCCV as shown in Figure 2.11.4-1.
3. The hydrogen igniters, identified on Figure 2.11.4-1, start after receiving an ECCS actuation signal.	3. Tests will be performed on the as-built hydrogen igniters, identified on Figure 2.11.4-1, using a simulated signal.	3. The as-built hydrogen igniters, identified on Figure 2.11.4-1, start after receiving a simulated signal.
4. MCR alarms and displays for containment hydrogen concentration can be retrieved in the MCR.	4. Inspections will be performed for retrievability of the hydrogen concentration parameters in the as-built MCR.	4. MCR alarms and displays for containment hydrogen concentration can be retrieved in the as-built MCR.
5. Controls exist in the MCR to start and stop the hydrogen igniters shown in Figure 2.11.4-1.	5. Tests will be performed on the as-built hydrogen igniters using controls in the as-built MCR.	5. Controls exist in the as-built MCR to start and stop the as-built hydrogen igniters shown in Figure 2.11.4-1.
6. The hydrogen igniters shown in Figure 2.11.4-1 are powered by two non-class 1E buses (i.e., 10 igniters per bus), with non-class 1E alternate ac (AAC) power sources.	6. Tests will be performed on the as-built hydrogen igniters.	6. The as-built hydrogen igniters shown in Figure 2.11.4-1 are powered by two non-class 1E buses (i.e., 10 igniters per bus), with non-class 1E AAC power sources.



Notes:

This schematic provides only approximate location of Igniters and is not to scale

** Igniters located in ~90^0 locations around the CV, two each are powered from separate power supply panels

*** Igniters installed above S/G and Pressurizer compartments

☐ Hydrogen Igniters

Figure 2.11.4-1 Containment Hydrogen Monitoring and Control System

2.12 PHYSICAL SECURITY HARDWARE

2.12.1 Design Description

The physical security system provides physical features to detect, delay, assist response to, and defend against the design basis threat (DBT) for radiological sabotage. Key elements of the physical security system design for the US-APWR standard plant certified design are:

- Vital equipment is located only within vital areas.
- The external walls, doors, ceiling and floors in the main control room and the central alarm station are bullet resistant.
- Unoccupied vital areas are locked and alarmed with activated intrusion detection systems that annunciate in the central alarm station.
- Security alarm annunciation and video assessment information are available in the central alarm station.
- The central alarm station is located inside a protected area and the interior of the alarm station is not visible from the perimeter of the protected area.
- The secondary security power supply system for alarm annunciator equipment and non-portable communications equipment is located within a vital area.
- Security alarm devices including transmission lines to annunciators are tamper indicating and self-checking (i.e., an automatic indication is provided when failure of the alarm system or a component occurs or when on standby power), and alarm annunciation indicates the type of alarm (e.g., intrusion alarms, emergency exit alarm, etc.) and location.
- Intrusion detection and assessment systems are designed to provide visual display and audible annunciation of alarms in the central alarm station.
- Intrusion detection systems equipment exists to record onsite security alarm annunciation including the location of the alarm, false alarm, alarm check, and tamper indication and the type of alarm, location, alarm circuit, date, time and disposition of each alarm is recorded.
- Emergency exits through vital area boundaries are alarmed and secured by locking devices that allow prompt egress during an emergency.
- The central alarm station has conventional (land line) telephone service with local law enforcement authorities and a system for communication with the main control room and is capable of continuous communication with security personnel.

2.12.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.12-1 provides the ITAAC for the physical security hardware.

Table 2.12-1 Physical Security Hardware Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.a Vital Equipment Vital equipment is located only within a vital area.	1.a Inspections will be performed of vital equipment locations.	1.a. Vital equipment is located only within a vital area.
1.b Reserved.	1.b Reserved.	1.b. Reserved.
2.a Reserved.	2.a Reserved.	2.a Reserved.
2.b Reserved.	2.b Reserved.	2.b. Reserved.
2.c Reserved.	2.c Reserved.	2.c. Reserved.
3.a Reserved.	3.a Reserved.	3.a Reserved.
3.b Reserved.	3.b Reserved.	3.b Reserved.
4.a Reserved.	4.a Reserved.	4.a Reserved.
4.b Reserved.	4.b Reserved.	4.b Reserved.
4.c Reserved.	4.c Reserved.	4.c Reserved.
5. Reserved.	5. Reserved.	5. Reserved.
6.a The external walls, doors, ceiling and floors in the main control room and the central alarm station are bullet resistant.	6.a Type test, analysis or a combination of type test and analysis of the external walls, doors, ceilings, floors in the main control room and the central alarm station will be performed.	6.a A report exists and concludes that the external walls, doors, ceilings, floors in the main control room and the central alarm station are bullet resistant to UL 752 (2006) level 4.
6.b Reserved.	6.b Reserved.	6.b Reserved.
7. Reserved.	7. Reserved.	7. Reserved.

Table 2.12-1 Physical Security Hardware Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8.a Reserved.	8.a Reserved.	8.a Reserved.
8.b Reserved.	8.b Reserved.	8.b Reserved.
9. Reserved.	9. Reserved.	9. Reserved.
10.a Unoccupied vital areas are locked and alarmed with activated intrusion detection systems that annunciate in the central alarm station.	10.a Tests, inspections, or a combination of tests and inspections of unoccupied vital areas intrusion detection equipment and locking devices will be performed.	10.a Unoccupied vital areas are locked and intrusion is detected and annunciated in the central alarm station.
10.b Reserved.	10.b Reserved.	10.b Reserved.
11.a.i Security alarm annunciation and video assessment information are available in the central alarm station	11.a.i Tests, inspections or a combination of tests and inspections of alarm annunciation and video assessment equipment will be performed.	11.a.i Security alarm annunciation and video assessment information is available in the central alarm station. .
11.a.ii Reserved	11.a.ii Reserved	11.a.ii Reserved
11.b.i The central alarm station is located inside a protected area and the interior is not visible from the perimeter of the protected area	11.b.i Inspection of the central alarm station location will be performed.	11.b.i The central alarm station is located inside a protected area and the interior of the central alarm station is not visible from the perimeter of the protected area.
11.b.ii Reserved	11.b.ii Reserved	11.b.ii Reserved
11.c Reserved	11.c Reserved	11.c Reserved
11.d Reserved	11.d Reserved	11.d Reserved

Table 2.12-1 Physical Security Hardware Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
12. Secondary security power supply system for alarm annunciator equipment and non-portable communications equipment is located within a vital area.	12. Inspections of the secondary security power supply system will be performed.	12. The secondary security power system for alarm annunciator equipment and non-portable communications equipment is located within a vital area.
13.a Security alarm devices including transmission lines to annunciators are tamper indicating and self-checking, (e.g. an automatic indication is provided when failure of the alarm system or a component occurs or when on standby power), and alarm annunciation indicates the type of alarm, (e.g., intrusion alarms, emergency exit alarm, etc.) and location.	13.a Tests will be performed on security alarm devices and transmission lines.	13.a Security alarm devices including transmission lines to annunciators are tamper indicating and self-checking (e.g., an automatic indication is provided when failure of the alarm system or a component occurs, or when the system is on standby power) and the alarm annunciation indicates the type of alarm, (e.g., intrusion alarms, emergency exit alarm, etc.) and location.
13.b.i Intrusion detection and assessment systems are designed to provide visual display and audible annunciation of alarms in the central alarm station.	13.b.i Tests will be performed on Intrusion detection and assessment systems.	13.b.i The intrusion detection system provides a visual display and audible annunciation of alarms in the central alarm station.
13.b.ii Reserved	13.b.ii Reserved	13.b.ii Reserved
14. Intrusion detection systems equipment exists to record onsite security alarm annunciation including the location of the alarm, false alarm, alarm check, and tamper indication and the type of alarm, location, alarm circuit, date, time and disposition of each alarm is recorded.	14. Tests will be performed on the intrusion detection systems recording equipment	14. Intrusion detection systems recording equipment is capable of recording each onsite security alarm annunciation including the location of the alarm, false alarm, alarm check, and tamper indication and the type of alarm, location, alarm circuit, date, time and disposition of each alarm is recorded.

Table 2.12-1 Physical Security Hardware Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 4 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
15.a Emergency exits through vital area boundaries are alarmed and secured by locking devices that allow prompt egress during an emergency.	15.a Test, inspection or a combination of tests and inspections of emergency exits through vital area boundaries will be performed.	15.a Emergency exits through vital area boundaries are alarmed. and secured by locking devices that allow prompt egress during an emergency.
15.b Reserved.	15.b Reserved.	15.b Reserved.
16.a.i The central alarm station has conventional (land line) telephone service with local law enforcement authorities and a system for communication with the main control room.	16.a.i Tests, inspections or a combination of tests and inspections of the central alarm station communications capability with local law enforcement authorities and main control room will be performed.	16.a.i The central alarm station is equipped with conventional (land line) telephone service with local law enforcement authorities and has a system for continuous communication with the main control room.
16.a.ii Reserved	16.a.ii Reserved	16.a.ii Reserved
16.b.i The central alarm station is capable of continuous communication with security personnel.	16.b.i Tests, inspections or a combination of tests and inspections of the central alarm station continuous communication capabilities will be performed.	16.b.i The central alarm station is capable of continuous communication with security officers, watchmen or armed response individuals, or other security personnel that have responsibilities during a contingency event.
16.b.ii Reserved	16.b.ii Reserved	16.b.ii Reserved

2.13 DESIGN RELIABILITY ASSURANCE PROGRAM

2.13.1 Design Description

The purposes of the US-APWR design reliability assurance program (D-RAP) are to provide reasonable assurance that:

- The US-APWR is designed, constructed, and operated in a manner that is consistent with the assumptions and risk insights for the risk-significant structures, systems, and components (SSCs).
- The risk-significant SSCs do not degrade to an unacceptable level during plant operations.
- The frequency of transients that challenge risk-significant SSCs is minimized.
- The risk-significant SSCs function reliably when challenged.

The risk-significant SSCs including both safety-related and non safety-related SSCs are identified through utilizing the result of a probabilistic risk assessment (PRA), expert panel, deterministic or other methods for inclusion in the program.

2.13.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.13-1 describes the ITAAC for the D-RAP.

Table 2.13-1 Design Reliability Assurance Program Inspections, Tests, analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The D-RAP provides reasonable assurance that the plant is designed and constructed in a manner that is consistent with the key assumptions and risk insights for risk-significant SSCs.	1. An analysis will confirm the adequacy of the D-RAP.	1. A report exists that includes the following three (3) major elements: · Identification of all as-built SSCs in the scope of the D-RAP · Description of the methodology used to identify the as-built SSCs in scope of the D-RAP · For the as-built SSCs in scope of D-RAP, identify and describe the reliability assurance activities that are accomplished prior to the initial fuel load, which provide reasonable assurance that the plant is designed and constructed in a manner that is consistent with the key assumptions (including reliability and availability assumptions in PRA, when applicable) and risk insights for the risk-significant SSCs.

2.14 INITIAL TEST PROGRAM

2.14.1 Design Description

The initial test program (ITP) of the US-APWR is described in this section. Activities associated with the ITP are part of the initial plant startup. The ITP consists of preoperational and initial startup tests and is conducted in accordance with an approved manual containing ITP administrative controls. The successful completion of inspections, tests, analyses, and acceptance criteria (ITAAC) is a prerequisite for fuel loading.

The ITP administrative manual controls the qualification of the ITP participants, test procedure development, review, approval, and evaluation of test results and test record retention including test procedures. The manual also assures that qualified personnel manage, develop, and conduct the ITP. Tests are conducted in accordance with individual approved test procedures. The approved test procedures are made available to the NRC personnel prior to their intended use for the preoperational tests and prior to the scheduled initial fuel loading for the startup tests.

Construction and preliminary tests and inspections typically consist of activities such as hydrostatic pressure tests, flushing, cleaning, wiring continuity and separation checks, initial instrument calibrations, valve functional checks, motor rotational checks, and functional tests of components.

Following plant construction and construction tests, preoperational tests are conducted to demonstrate that SSCs operate in accordance with the design. The preoperational tests include, as appropriate, functional tests, system operational and performance tests, and expansion and vibration measurements.

The initial fuel loading marks the beginning of startup tests. Startup tests are performed after completion of preoperational tests to demonstrate that plant systems meet performance requirements and design criteria and that the plant can operate in an integrated fashion. Startup tests include initial fuel loading, initial criticality, low power test (less than 5% power) and power ascension test.

Power ascension tests are performed once the operating characteristics of the reactor are verified during low power tests. During power ascension, the power level is increased to full licensed power in prescribed stages defined in approved test procedures.

2.14.2 Inspections, Tests, Analyses, and Acceptance Criteria

This section does not include ITAAC.

3.0 INTERFACE REQUIREMENTS

3.1 Design Description

This section identifies the safety significant interfaces between the US-APWR standard plant design and the Combined License (COL) applicant.

The US-APWR standard plant design consists of several buildings (reactor building including the prestressed concrete containment vessel and containment internal structure, power source buildings, auxiliary building, turbine building and access building); the equipment located in those buildings, and structures (power source fuel storage vaults and essential service water pipe tunnel). As allowed by the regulations, conceptual designs for systems that are not part of the US-APWR standard design are included in the DCD for purposes of allowing the NRC to evaluate the overall acceptability of the design. However, the final details of these conceptual designs are subject to change due to site-specific conditions.

Although the system descriptions of the PSFSVs and ESWPT are within the scope of the US-APWR standard design, the structural design of the PSFSVs and ESWPT, including seismic and dynamic qualification as applicable, are to be finalized based on the site-specific arrangement.

An interface requirement as specified in this section is the portion of a system that must be added to the standard design package to complete the design of the US-APWR at a specific site.

COL applicant referencing the certified design is responsible to assure that the site-specific design meets the interface requirement and verify the conformance in the ITAAC process that is similar to those provided in the certified design.

3.2 Interface Requirements

3.2.1 Ultimate Heat Sink

Ultimate heat sink (UHS) is a safety-related system and is site-specific. The maximum supply water temperature is 95 °F under the peak heat loads condition to provide sufficient cooling capacity to ESWS.

The UHS keeps the water level at a net positive suction head (NPSH) greater than the pump's required NPSH.

3.2.2 Fire Protection System

The seismic standpipe system can be supplied from a safety-related water source which capacity is at least 18,000 gallons.

3.2.3 Electrical System

The offsite power system and components are site-specific. The following features are important interface requirements:

a. The electrical system has a minimum of two independent offsite transmission circuits from the transmission network (TN) to the safety buses with no intervening non-safety buses (direct connection).

b. The offsite TN voltage variations during steady state operation do not cause voltage variations beyond an acceptable tolerance of the loads' nominal ratings.

c. The offsite TN normal steady state frequency is within an acceptable tolerance of 60Hz during recoverable periods of instability.

d. The offsite transmission circuits have the capacity and capability to power the required loads during steady state, transient, and postulated events and accident conditions.

e. There is physical separation and electrical independence between the offsite circuits and onsite class 1E electrical system and components.

f. Lightning protection and grounding features exist for the systems and components of the offsite circuits from the TN to the safety buses.

g. The electrical system has alarms and displays for monitoring the switchyard status.

h. The electrical system has the capability to automatically fast transfer from the preferred power supply to the non-preferred power supply.

i. The switchyard agreement and protocols between the NPP and the TN owner/operator assess the risk and probability of a loss of offsite power due to performing maintenance activities on the electrical system.

j. The electrical system design assesses the probability of losing power during the loss of power generated by the nuclear unit, the loss of power from the TN, or the loss of the largest load.