Response to

Request for Additional Information 563, Supplement 2

11/30/2012

U. S. EPR Standard Design Certification
AREVA Inc.
Docket Number 52-020

Review Section: 19 – Probabilistic Risk Assessment and Severe Accident

Question 19-356:

Open Item

New Phase 4 RAI - Fukushima

The NRC staff has been directed by the Commission to implement the Fukushima Near-Term Task Force Recommendations, as presented in SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," dated February 12, 2012. This request for additional information specifically addresses Recommendation 4.2 on Mitigating Strategies. The NRC staff requests that you address each of the provisions for mitigating strategies as described in Attachment 2 to Order EA-12-049, including any proposals for changes to your current application. In particular, please also describe the extent to which you intend to follow JLD-ISG-2012-01, or any alternative approaches to satisfy these provisions.

Response to Question 19-356:

NRC Order EA-12-049 (Reference 1) requires a three-phase approach for mitigating beyond design basis external events. The initial phase, referred to as Phase 1, requires the use of installed equipment and resources to maintain or to restore core cooling, containment integrity, and spent fuel pool (SFP) cooling capabilities. The transition phase, referred to as Phase 2, requires that sufficient, portable, onsite equipment and consumables be available to maintain or restore these functions until they can be achieved with resources brought from offsite. The final phase, referred to as Phase 3, requires that sufficient offsite resources be provided to sustain the Phase 1 and Phase 2 functions indefinitely.

On August 29, 2012, the NRC issued Interim Staff Guidance (ISG) JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (Reference 3). This ISG endorses, with clarifications, the methodologies described in the industry guidance document, NEI 12-06 (Reference 2), as an acceptable means to comply with Order EA-12-049. NEI 12-06 provides diverse and flexible coping strategies (FLEX) to establish an indefinite coping capability to prevent damage to the fuel in the reactor and SFPs, and to maintain the containment function by using installed equipment, onsite portable equipment, and offsite resources. This coping capability is based on strategies that focus on an assumed simultaneous extended loss of all AC power (ELAP) plus the loss of normal access to the ultimate heat sink (UHS) caused by unspecified events. These mitigating strategies must be implementable for all modes of operation.

The U.S. EPR design complies with Attachment 2 to Order EA-12-049 as follows:

(1) Licensees or construction permit (CP) holders shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and SFP cooling capabilities following a beyond-design-basis external event.

For the U.S. EPR design, the plant features, analyses, and mitigation strategies for maintaining or restoring core cooling, containment, and SFP cooling capabilities following a beyond-design-basis external event are described in AREVA Technical Report, ANP-10329, Revision 1 (Reference 4).

(2) These strategies must be capable of mitigating a simultaneous loss of all alternating current (AC) power and loss of normal access to the UHS and have adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site subject to this Order.

The mitigation strategies for the U.S. EPR design, described in AREVA Technical Report, ANP-10329, Revision 1 (Reference 4), consider a simultaneous loss of all AC power and loss of normal access to the UHS and have adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site. Design features and mitigation strategies, described in AREVA Technical Report, ANP-10329, Revision 1, are based on licensing of a single unit site.

(3) Licensees or CP holders must provide reasonable protection for the associated equipment from external events. Such protection must demonstrate that there is adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site subject to this Order.

Reasonable protection of installed and portable mitigation equipment is described in Section 4.1.4 of AREVA Technical Report, ANP-10329, Revision 1 (Reference 4). Reasonable protection requirements for the U.S. EPR design conform with JLD-ISG-2012-01 (Reference 3) and NEI 12-06 (Reference 2). Design features and requirements for portable equipment, described in FSAR Table 19.2-6, COL Applicant Responsibilities for ELAP Event Mitigation, are based on licensing of a single unit site.

(4) Licensees or CP holders must be capable of implementing the strategies in all modes.

The mitigation strategies for the U.S. EPR design, described in AREVA Technical Report, ANP-10329, Revision 1 (Reference 4), consider events initiated in all plant modes.

(5) Full compliance shall include procedures, guidance, training, and acquisition, staging, or installing of equipment needed for the strategies.

For new plant designs like the U.S. EPR design, the scope of Order EA-12-049 spans both the design certification and the combined license. The topics cited in Item 5 of Order EA-12-049 (e.g., procedures, guidance, etc.) will be fulfilled by the Combined License applicants. Requirements for COL applicants that reference the U.S. EPR Design Certification are conveyed via COL items as follows:

- General requirements for procedure development and training are provided in U.S EPR FSAR Tier 2, Table 1.8-2, U.S. EPR Combined License Information Items, COL Items 13.5-1 (for procedures), and 13.2-1 and 13.2-2 (for training).
- Unique requirements to comply with Order EA-12-049 are provided in U.S. EPR FSAR Tier 2, Table 19.2-6, COL Applicant Responsibilities for ELAP Event Mitigation.

The U.S. EPR design conforms with JLD-ISG-2012-01 with two clarifications:

1. JLD-ISG-2012-01 and NEI 12-06 only specify that containment integrity must be maintained. To fulfill the containment function, the U.S. EPR mitigation strategy has conservatively

established an acceptance criterion for this beyond design basis event that the containment be maintained below its design basis limits (i.e., pressure below 62.9 psig and temperature below 310°F). This acceptance criterion for the containment function is described further in the response to RAI 598, Question 06.02.01-106.

2. Table D-1 of NEI 12-06 states that Emergency Feedwater/Auxiliary Feedwater should "provide SG makeup sufficient to maintain or restore SG level with installed equipment and power supplies to the greatest extent possible to provide core cooling." For some operating modes, the U.S. EPR mitigation strategy requires dry out of the steam generators (SGs) to enable feedwater delivery from a fire water pump. Core heat removal is then accomplished using the main steam relief trains to maintain the SGs below the shutoff head of the diesel driven fire water pumps. Dryout of the SGs causes a reduction in SG pressure sufficient to allow feed flow. During this brief period when primary to secondary heat transfer is interrupted, reactor coolant system circulation continues due to momentum which facilitates restoration of primary to secondary heat transfer once feedwater is delivered to the SGs. Heat transfer is restored; however, SG levels will not recover until approximately 1.2 hours after feed flow initiation in ELAP events initiated from Mode 1.

Conformance with JLD-ISG-2012-01 is described in further detail in Section 2.1 of AREVA Technical Report, ANP-10329, Revision 1 (Reference 4).

References:

1. NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," March 12, 2012.
2. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Rev. 0, August 2012.
3. NRC Interim Staff Guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," August 29, 2012.
4. AREVA Technical Report ANP-10329, Revision 1,"U.S. EPR Mitigation Strategies for Extended Loss of AC Power Event," November 2014.

FSAR Impact:

RAI 563, Advanced Response to Question 19-356, was submitted to the NRC on May 10, 2013. All FSAR changes included in that response were incorporated into U.S. EPR FSAR Revision 5 that was transmitted to the NRC on July 19, 2013. Additional FSAR changes to respond to this RAI are included in this RAI 563, Supplement 2. The RAI 563, Supplement 2 response and associated FSAR changes, in addition to the U.S. EPR FSAR changes provided in RAI 563, Advanced Response to Question 19-356, provide a complete and final response to this question.

U.S. EPR FSAR Tier 1, Chapters 2 and 3, including relevant tables and figures, were revised as described in the response previously provided.

U.S. EPR FSAR Tier 2, Section 19.2.8 and Chapters 1, 3, 5, 6, 7, 8, 9, 10, 12, 14, 16, 17, and 19, including relevant tables and figures, were revised as described in the response previously provided.

U.S. EPR FSAR Tier 1 and Tier 2 chapters, including relevant tables and figures, were revised as described in the response and as indicated on the enclosed markups.

Tier 1

- Table 2.2.1-5—Reactor Coolant System ITAAC
- Section 2.3.3 – Severe Accident Heat Removal System
- Figure 2.6.8-1—Containment Building Ventilation System Functional Arrangement

Tier 2

- Table 1.6-1—Reports Referenced
- Section 3.2.1.4 – Conventional Seismic
- Section 3.2.1.5 – Non-Seismic
- Table 3.2.2-1—Classification Summary
- Section 3.3 – Wind, Hurricane, and Tornado Loadings
- Section 3.4 – Water Level (Flood) Design
- Section 3.5 – Missile Protection
- Section 3.7.2.8 – Interaction of Non-Seismic Category I Structures with Seismic Category I Structures
- Table 3.10-1—List of Seismically and Dynamically Qualified Mechanical and Electrical Equipment
- Table 3.11-1—List of Environmentally Qualified Electrical/I&C Equipment
- Section 6.3.2.2.2 – System Components
- Section 6.3.6 – References
- Figure 6.3-2—Safety Injection/Residual Heat Removal System Train (Typical)
- Figure 6.3-3—IRWST Layout
- Section 7.1.4 – References
- Section 7.6.1.2.4 – Safety Injection Accumulator Interlocks
- Section 8.3.1.1.7 – Extended Loss of AC Power Diesel Generator
- Section 8.3.3 – References
- Table 8.3-1—Onsite AC Power System Component Data Nominal Values
- Table 8.3-3—Normal Power Supply System Switchgear and Load Center Numbering and Nominal Voltage
- Figure 8.3-2—Emergency Power Supply System Single Line Drawing
- Figure 9.2.2-4—Component Cooling Water System Dedicated CCWS Trains
- Figure 9.2.7-1—Seal Water Supply System

- Section 9.4.7 – Containment Building Ventilation System
- Figure 9.4.7-2—Containment Building Low Flow and Full Flow Purge Exhaust Subsystem
- Section 9.5.1 – Fire Protection
- Section 14.2.12.3.6 – Containment Integrated Leak Rate and Structural Integrity Tests (Test #029)
- Section 14.2.12.6.3 – Primary to Secondary Heat Transfer (ELAP) (Test #053)
- Section 14.2.12.6.8 – Primary Coolant Injection Subsystem (ELAP) (Test #058)
- Section 14.2.12.8.4 – Containment Purge (Test #076)
- Table 14.2-1—List of Initial Tests for the U.S. EPR, Sheet 4 of 14
- Section 19.2.9 – References
- Table 19.2-6—COL Applicant Responsibilities for ELAP Event Mitigation

U.S. EPR Final Safety Analysis Report Markups

Table 2.2.1-5—Reactor Coolant System ITAAC
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Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
7.3	The RCPs provide flow.	A test will be performed to verify the RCPs provide flow.	The RCPs provide flow greater than 124,741 gpm/loop and less than 134,662 gpm/loop.
7.4	The RCP SSSS can be engaged when the RCP is stopped.	A test will be performed to verify the RCP SSSS can be engaged when the RCP is stopped.	The RCP SSSS can be engaged when the RCP is stopped.
7.5	PSRVs listed in Table 2.2.1-2 open.	A test will be performed to verify that upon receipt of a test input signal, each PSRV opens.	Each PSRV opens within 0.70 seconds (including pilot valve opening time) after receipt of a test input signal from the PACS module.
7.6	PSRVs listed in Table 2.2.1-2 open below the maximum setpoint.	Vendor tests will be performed to verify that each PSRV opens below the maximum setpoint.	Each PSRV opens below a maximum lift setting of 2600.4 psia.
7.7	PSRVs listed in Table 2.2.1-2 provide relief capacity.	Vendor tests and analysis will be performed to verify relief capacity of PSRVs listed in Table 2.2.1-2.	Each PSRV listed in Table 2.2.1-2 provides relief capacity ≥ 661,400 lbm/hr at 2535 psig.
7.8	Each RCP breaker and RCP bus breaker is tripped by a protection system signal.	A test will be performed to verify that upon receipt of a protection system signal, each RCP breaker and RCP bus breaker trips.	Each RCP breaker and RCP bus breaker is tripped by a protection system signal.
7.9	The RCP SSSS limits RCP seal leakage following an ELAP event.	Factory tests will be performed to verify that the RCP SSSS limits RCP seal leakage.	The RCP SSSS limits RCP seal leakage to not greater than 0.5 gpm for a period not less than 48 hours.

2.3.3 Severe Accident Heat Removal System

Design Description

1.0 System Description

The severe accident heat removal system (SAHRS) is a dedicated cooling water system for the primary containment to support mitigation of beyond design basis events (BDBEs). The system does not operate during normal plant operations or design basis accidents.

The SAHRS provides the following safety-related functions:

- Containment isolation.
- Provides integrity of the IRWST boundary.

The SAHRS provides the following non-safety-related functions:

- Passive cooling of the core melt stabilization system (CMSS).
- Active spray for environmental control of the containment atmosphere.
- Active recirculation cooling of the CMSS and containment.
- Removal of containment heat following an Extended Loss of AC Power (ELAP) event.

2.0 Arrangement

2.1 The functional arrangement of the SAHRS is as described in the Design Description of Section 2.3.3, Tables 2.3.3-1—SAHRS Equipment Mechanical Design. and 2.3.3-2—SAHRS Equipment I&C and Electrical Design, and as shown on Figure 2.3.3-1—SAHRS Functional Arrangement.

2.2 Deleted.

3.0 Mechanical Design Features

3.1 Pumps and valves listed in Table 2.3.3-1 will be functionally designed and qualified such that each pump and valve is capable of performing its intended function under the full range of fluid flow, differential pressure, electrical conditions, and temperature conditions up to and including design basis accident conditions.

3.2 Check valves listed in Table 2.3.3-1 will function to change position as listed in Table 2.3.3-1 under normal operating conditions.

3.3 Deleted.

Figure 2.6.8-1—Containment Building Ventilation System Functional Arrangement

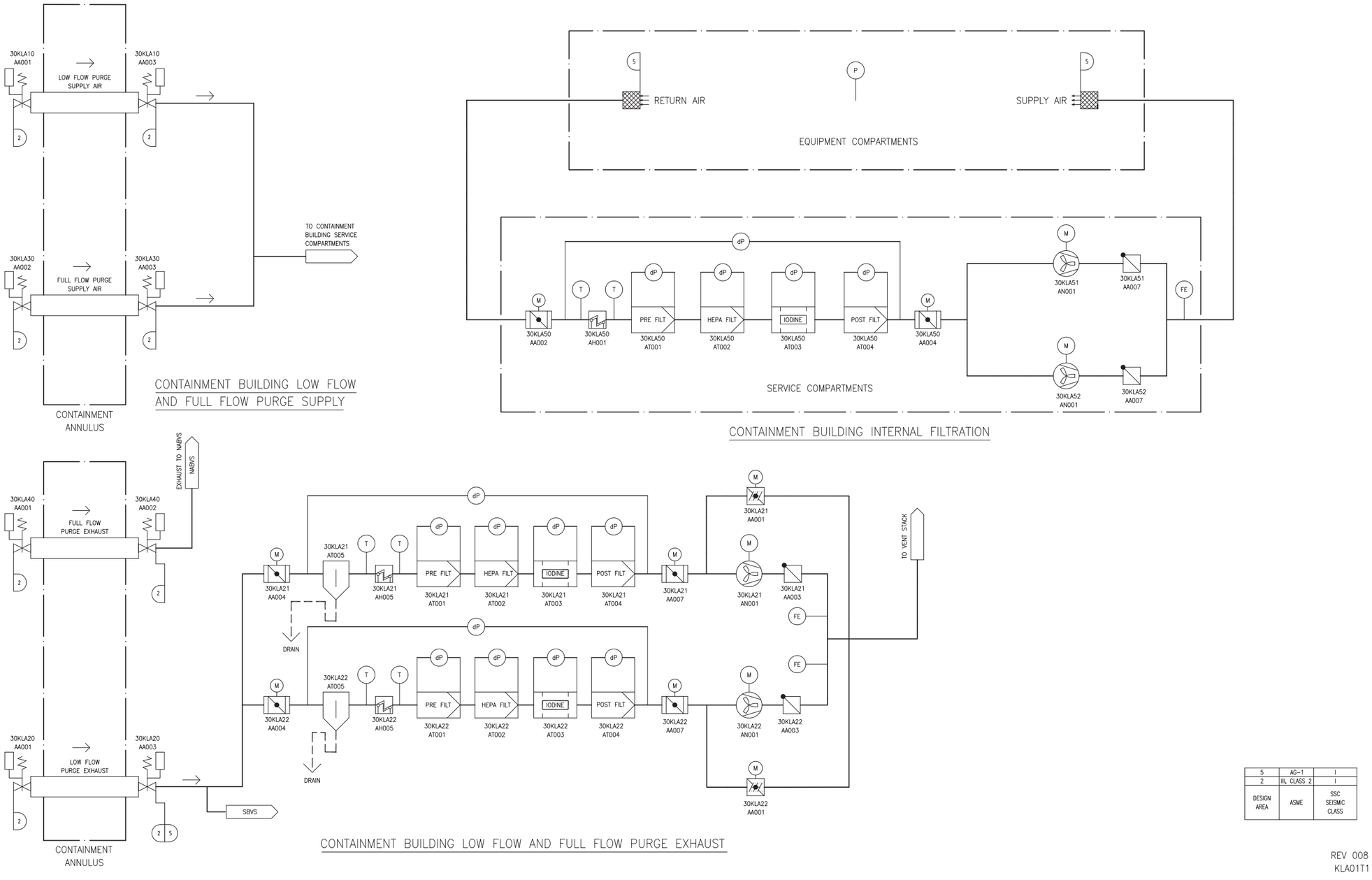

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Table 1.6-1—Reports Referenced
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Report No. (See Notes 1, 2, and 3)	Title	Date Submitted to NRC	FSAR Section Number(s)
ANP-10317 Revision 3	Design Requirements for the U.S. EPR Aircraft Hazard Protection Structures	7/13	19.2.7.4
ANP-10318P Revision 3~~2~~	Pipe Rupture External Loading Effects on U.S. EPR Essential Structures, Systems, and Components Technical Report	10/14~~12/13~~	3.6.2
ANP-10322P Revision 1	Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner	6/13	6.2.5 and 6.2.6
[ANP-10324P	*U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) with the Human Factors Engineering (HFE) Program]**	1/13	18.6
ANP-10325P ANP-10325NP	U.S. EPR Fuel Assembly - Faulted Condition Analysis	5/23/2013	4.0, 15.6
[ANP-10327P	*U.S. EPR HFE Program Management Plan]**	4/13	18.0
[ANP-10328P	*U.S. EPR Human System Interface Design Implementation Plan]**	4/13	18.0
ANP-10329 Revision 1	U.S. EPR Mitigation Strategies for Extended Loss of AC Power Event Technical Report	~~5/13~~11/14	6.3, 7.1, 8.3, 19.2
BAW-10132-A	Analytical Methods Description – Reactor Coolant System Hydrodynamic Loadings During a Loss-of-Coolant Accident	7/20/79	Appendix 3C
BAW-10133P-A BAW-10133-A Revision 1, Addendum 1 and 2	Mark-C Fuel Assembly LOCA-Seismic Analysis	12/00	3.7.1
BAW-10147P-A BAW-10147-A Revision 1	Fuel Rod Bowing in Babcock & Wilcox Fuel Designs	6/28/83	4.2, 4.4
BAW-10156-A Revision 1	LYNXT, Core Transient Thermal-Hydraulic Program	8/18/93	4.0
BAW-10163P-A BAW-10163-A	Core Operating Limit Methodology for Westinghouse Designed PWRs	6/2/89	4.3

3.2.1.4 Conventional Seismic

Some non-safety-related U.S. EPR SSC do not fall within the criteria for classification as Seismic Category I or II, but may still be subject to seismic design criteria that are incorporated in, or invoked by, an applicable commercial or industry code. These SSC are classified as conventional seismic (CS).

Some supplemented grade U.S. EPR SSC do not fall within the criteria for classification as Seismic Category I or II, but may be subject to "significant licensing requirements or commitments" that specify consideration of seismic design criteria that are less demanding than either a full or ½ SSE. Those SSC that are classified as RW-IIb or RW-IIc per RG 1.143 are included in this group. Similarly, those SSC that only have seismic requirements from RG 1.189 for Fire Protection or from NEI 12-06 for Diverse and Flexible Coping Strategies (FLEX) are included in this group. These SSC are also seismically categorized as CS.

3.2.1.5 Non-Seismic

The U.S. EPR SSC that do not fall within the RG 1.29 criteria for classification as Seismic Category I or II, do not fall within the RG 1.143 criteria for RW-IIa, RW-IIb, or RW-IIc, are not subject to the RG 1.189 seismic design requirements for fire protection, are not subject to the NEI 12-06 guidance for seismic design in regard to FLEX, and are not subject to any seismic design criteria invoked by the applicable commercial or industrial codes and standards~~,~~ are classified as non-seismic (NSC).

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Table 3.2.2-1—Classification Summary
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KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
30JEG10	Pressurizer Relief Tank and Associated Piping & Valves (downstream of PSRV and PDS Valves)	NS-AQ	D	II	Yes	UJA	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7], ASME VIII[8] RG 1.29[25] ASCE 43-05
30JEF10	Pressurizer Sampling Line & Valve	S	B	I	Yes	UJA	ASME Class 2[2]
30JEC30 BR004	Pressurizer Surge Line	S	A	I	Yes	UJA	ASME Class 1[1]
30JEG10	Pressurizer Vacuum Pump/Nitrogen Piping & Valves (downstream of Valve 30JEF10 AA502)	NS-AQ	D	II	Yes	UJA	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7] RG 1.29[25]
30JEF10 BR501	Pressurizer Vacuum Pump/Nitrogen Supply Line	S	A	I	Yes	UJA	ASME Class 1[1]
30JEF10 AA501/502	Pressurizer Vacuum Pump/Nitrogen Valves	S	A	I	Yes	UJA	ASME Class 1[1]
30JEF10 AA191-193	PSRVs	S	A	I	Yes	UJA	ASME Class 1[1]
30JEB10/20/30/40	RCP Motors - Rotating Assemblies/Bearings/ Bearing Supports/Motor Frames	S	N/A	I	Yes	UJA	ASME III Allowables as applicable

Table 3.2.2-1—Classification Summary
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KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
30JMQ42	Piping and associated valves inside Containment (except Passive Flooding Line)	NS-AQ	D	II	Yes	UJA	ANSI/ASME B31.1[6]; Located in close proximity to safety-related piping and equipment RG 1.29[25]
30JMQ40 AC001	SAHRS Heat Exchanger (Shell 1)	NS-AQ	D	II	Yes	UJH	ASCE 43-05, ASME VIII[8], RG 1.29[25]
30JMQ40 AC004	SAHRS Heat Exchanger (Shell 2)	NS-AQ	D	II	Yes	UJH	ASCE 43-05, ASME VIII[8], RG 1.29[25]
30JMQ40 AC002	SAHRS Pump Motor Cooler	NS-AQ	D	II	Yes	UJH	ASCE 43-05, ASME VIII[8], RG 1.29[25]
30JMQ40 AC003	SAHRS Pump Seal Cooler	NS-AQ	D	II	Yes	UJH	ASCE 43-05, ASME VIII[8], RG 1.29[25]
30JMQ40 AC005	SAHRS Pump Bearing Cooler	NS-AQ	D	II	Yes	UJH	ASCE 43-05, ASME VIII[8], RG 1.29[25]
30JMQ40 AP001	SAHRS Pump	NS-AQ	D	II	Yes	UJH	ASCE 43-05, Manufacturer Standards, RG 1.29[25]
JMB	**Core Melt Stabilization System**						
JMB40 AC	Cooling Structure	NS	N/A	NSC	No	UJA	
JMB20 AB001	Gate	NS	N/A	NSC	No	UJA	

Table 3.2.2-1—Classification Summary
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KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
31/32BBH	Non-Class 1E 6.9 kV Switchgear	NS-AQ	N/A	NSC	No	UBA	RG 1.155[25]
31/32BHZ01	Non-Class 1E 480 V Motor Control Centers	NS-AQ	N/A	NSC	No	UBA	RG 1.155[25]
33/34BBH	Non-Class 1E 6.9 kV Switchgear	NS	N/A	NSC	No	UBA	
[[31/32/33/34BFT06/07	Non-Class 1E 13.8 kV - 480 V Transformer	NS	N/A	NSC	No	UQA]]	
33/34BBG	Non-Class 1E 6.9 kV Switchgear	NS	N/A	NSC	No	Site Specific	
30BBH	Non-Class 1E 6.9kV Switchgear	NS-AQ	N/A	CS	No	USG	ASCE 43-05, RG 1.189[25]
~~30BFT02~~	~~Non-Class 1E6.9 kV to 480 V Transformer~~	~~NS-AQ~~	~~N/A~~	~~H~~	~~Yes~~	~~UJK~~	~~ASCE 43-05, RG 1.29[25]~~
~~30BFT01~~	~~Non-Class 1E 480 V to 6.9 kV Transformer~~	~~NS-AQ~~	~~N/A~~	~~CS~~	~~No~~	~~USG~~	~~ASCE 43-05, RG 1.189[25]~~
ACD	**Offsite Power System**						
30BBT01/02	[[500 kV]] - 13.8 kV Offsite Transformers	NS	N/A	NSC	No	UBE	
30BDT01/02	[[500 kV]] - 6.9 kV Offsite Transformers	NS	N/A	NSC	No	UBE	

Table 3.2.2-1—Classification Summary
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KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
GHC	System Components in UJA, UFA, UBP, and UJH	NS	E	NSC	No	UJA, UFA, UBP, UJH	ANSI/ASME B31.1[6]
GHC	System Components in the Conventional Island, UKS, and UKA	NS	E	NSC	No	UBA, UMA, UKS, UKA	ANSI/ASME B31.1[6]
GHW	**Seal Water Supply System**						
GHW44	All GHW44 components and piping downstream of 30GHW44 AA001 and 30GHW44 AA005.	NS-AQ	D	CS	No	4UJH	ANSI/ASME B31.16, ANSI/ASME B16.34[7]
GHW	Remaining Seal Water Components and Piping Inside Safeguard Building 4UJH and the Fuel Building UFA	NS	E	NSC	No	4UJH, UFA	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]
GHW	Remaining Seal Water Components and Piping Outside Safeguard Building 4UJH and the Fuel Building UFA	NS	E	NSC	No	UKS, UKA, UBA, UMZ	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]
30GHW44 BB001	Seal Water Buffer Tank	NS-AQ	~~E~~D	~~NS~~CS	No	4UJH	ASME VIII[8], ASCE 43-05

Table 3.2.2-1—Classification Summary
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KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
30GHW45 BB001	Seal Water Buffer Tank	NS	E	NSC	No	UFA	ASME VIII[8]
30GHW45 AA005	Seal Water Buffer Tank Isolation Valve	NS	E	NSC	No	UFA	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]
30GHW44 AA003	Seal Water Check Valve	NS-AQ	~~E~~D	~~NS~~CS	No	4UJH	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]
30GHW45 AA003	Seal Water Check Valve	NS	E	NSC	No	UFA	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]
30GHW46 AA002	Seal Water Check Valve	NS	E	NSC	No	UKS	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]
30GHW11/12 AA002	Seal Water Check Valves	NS	E	NSC	No	UBA	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]
30GHW11/12 AA011	Seal Water Check Valves	NS	E	NSC	No	UBA	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]
30GHW46 AA012	Seal Water Check Valve	NS	E	NSC	No	UKS	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]
30GHW46 AA013	Seal Water Check Valve	NS	E	NSC	No	UKS	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]
30GHW46 AA014	Seal Water Check Valve	NS	E	NSC	No	UKS	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]

Table 3.2.2-1—Classification Summary
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KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
30GHW46 AA027	Seal Water Check Valve	NS	E	NSC	No	UKS	ANSI/ASME B31.1[6], ANSI/ ASME B16.34[7]
30GHW46 AA028	Seal Water Check Valve	NS	E	NSC	No	UKS	ANSI/ASME B31.1[6], ANSI/ ASME B16.34[7]
30GHW46 AA029	Seal Water Check Valve	NS	E	NSC	No	UKS	ANSI/ASME B31.1[6], ANSI/ ASME B16.34[7]
30GHW46 AA030	Seal Water Check Valve	NS	E	NSC	No	UKS	ANSI/ASME B31.1[6], ANSI/ ASME B16.34[7]
30GHW46 AA031	Seal Water Check Valve	NS	E	NSC	No	UKS	ANSI/ASME B31.1[6], ANSI/ ASME B16.34[7]
30GHW44 AA191	Seal Water Pressure Protection Relief Valve	NS-AQ	~~E~~D	~~NS~~CS	No	4UJH	ANSI/ASME B31.1[6], ANSI/ ASME B16.34[7]
30GHW45 AA191	Seal Water Pressure Protection Relief Valve	NS	E	NSC	No	UFA	ANSI/ASME B31.1[6], ANSI/ ASME B16.34[7]
30GHW40 AA002	Seal Water NI Isolation Motor-Operated Valve	NS	E	NSC	No	UKA	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]
30GHW46 AA003/ 011	Seal Water Pressure Reducing Valves	NS	E	NSC	No	UKS	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]
30GHW46 AA191/ 193	Seal Water Pressure Relief Valves	NS	E	NSC	No	UKS	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]

Table 3.2.2-1—Classification Summary
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KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
30GHW11/12 AP001	Seal Water Pumps	NS	E	NSC	No	UBA	Manufacturer Standards
30GHW44 AA002	Seal Water Solenoid Valve	NS-AQ	~~E~~D	~~NS~~CS	No	4UJH	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]
30GHW45 AA002	Seal Water Solenoid Valve	NS	E	NSC	No	UFA	ANSI/ASME B31.1[6], ANSI/ASME B16.34[7]
30GHW44 BB302	Seal Water Tank	NS	E	NSC	No	4UJH	ASME VIII[8]
GK	**Potable & Sanitary Water Systems**						
GK	Potable and Sanitary Water Systems	NS	N/A	NSC	No	UBA, UKA, UKE, UKS, UJK, UMA	ANSI/ASME B31.1[6], ASME VIII[8]
GK	GK System Piping and Associated Valves located in the UJH and UBP	NS	E	NSC	No	UJH, UBP	ANSI/ASME B31.1[6]

Table 3.2.2-1—Classification Summary
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KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
UKH	**Vent Stack**	S	N/A	I	Yes	UKH	
[[UMA, UBA	**Turbine Building (Switchgear Building)**	NS-AQ	N/A	II	Yes	UMA, UBA]]	RG 1.29[25]
[[UKE	**Access Building**	NS-AQ	N/A	II	Yes	UKE]]	RG 1.29[25]
[[USG	**Fire Protection Building and Fire Water Storage Tanks**	NS-AQ	N/A	CS	No	USG	ASCE ~~7-10~~43-05, AWWA D100 (Tanks only), RG 1.189[25]]] NEI 12-06 (Note 25), ASCE 7-10 for non-seismic loads
SM, SN	**Cranes, Hoists, and Elevators**						
SMJ06	Assembly Crane	NS-AQ	N/A	II	Yes	UJA	ASME NUM-1 RG 1.29[25]
SM	Balance of Cranes and Hoists	NS	N/A	NSC	No	All	ASME NOG-1, ASME NUM-1
SMB11/12/21/31/41/42	Diesel Hall Cranes	NS-AQ	N/A	II	Yes	UBP	ASME NUM-1 RG 1.29[25]
SMK12	Drum Storage Area Crane	NS	N/A	NSC	No	UKS	ASME NOG-1
SN	Elevators	NS	N/A	NSC	No	UJA	ASME A17.1
SMK11	Entrance Area Crane	NS	N/A	NSC	No	UKS	ASME NOG-1

Table 3.2.2-1—Classification Summary
Sheet 188 of 199

KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
30KLA21/22 AT005	Moisture Separators	S	N/A	I	Yes	UFA	ASME AG-1[14] ASME N510, RG 1.52
30KLA71 AC001-012	Local Air Cooling Units w/ QNJ Cooling Water	NS	E	NSC	No	UJA	ANSI/ASME B31.1[6]
30KLA50 AT001	Pre-Filter (KLA 5)	NS-AQ	N/A	I	Yes	UJA	ASME AG-1[14], ASME N510 RG 1.45[25]
30KLA21/22 AT001	Pre-Filters	S	N/A	I	Yes	UFA	ASME AG-1[14], ASME N510, RG 1.52
30KLA65/66 AN001-AN002	Reactor Pit Fans (4 x 50%)	NS-AQ	N/A	II	Yes	UJA	ASME AG-1[14] RG 1.29[25] RG 1.155[25]
30KLA71 AN001-012	Supply Air Fans (Axial, Direct Drive)	NS	N/A	NSC	No	UJA	
30KLA20 AA003C/ 003D/003E	KLA 2 SCB Isolation Valves	NS-AQ	D	II	Yes	UFA	ANSI/ASME B31.1[6] RG 1.29[25]
~~30KLA24 AA001/ 003~~	~~ESF Filter Bypass Isolation Dampers~~	~~S~~	~~N/A~~	~~I~~	~~Yes~~	~~UFA~~	~~ASME AG-1[14], ASME N510~~
~~30KLA24 AA002~~	~~ESF Filter Bypass Fire Damper~~	~~S~~	~~N/A~~	~~I~~	~~Yes~~	~~UFA~~	~~NFPA 90A[18], NFPA 80[20]~~

- RG 1.29 Regulatory Position C.1 for Seismic Category I or C for Seismic Category II and NSC
- RG 1.189 Regulatory Position C.1.7
- RG 1.155 Regulatory Position C.3.5
- 10 CFR 50.46a Regulatory Position (b)
- RG 1.7 Regulatory Position C.2
- RG 1.143 Regulatory Position C.7
- RG 1.140 Regulatory Position C.1
- RG 1.21 Regulatory Position C.4
- NUREG-0737 Appendix B
- Staff Requirements Manual to SECY-93-087 Section II Q
- RG 1.45, Regulatory Position C 2.4
- RG 1.89 Regulatory Position C.1
- RG 1.97 Regulatory Position C
- NEI 12-06, Revision 0, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Nuclear Energy Institute, August 2012.

*26. [ACI 349/349R-01 refers to "Code Requirements for Nuclear Safety-Related Concrete Structures," 2001.]**

*NRC Staff approval is required prior to implementing a change in this information marked in this table; see FSAR Introduction.

Next File

3.3 Wind, Hurricane and Tornado Loadings

Seismic Category I structures are designed to withstand the effects of wind, hurricane, and tornado loadings. A combined license (COL) applicant that references the U.S. EPR design certification will determine site-specific wind, hurricane, and tornado characteristics and compare these to the standard plant criteria. If the site-specific wind, hurricane, and tornado characteristics are not bounded by the site parameters, postulated for the certified design, then the COL applicant will evaluate the design for site-specific wind, hurricane, and tornado events and demonstrate that these loadings will not adversely affect the ability of safety-related structures to perform their safety functions during or after such events.

Hurricane and tornado wind loading requirements for the Fire Protection Building and Storage Tanks are identified in Section 9.5.1.

3.3.1 Wind Loadings

The U.S. EPR wind pressure loads are determined in conformance with ASCE/SEI Standard 7-05, "Minimum Design Loads for Buildings and Other Structures" (Reference 1). A COL applicant that references the U.S. EPR design certification will demonstrate that failure of site-specific structures or components not included in the U.S. EPR standard plant design, and not designed for wind loads, will not affect the ability of other structures to perform their intended safety functions.

3.3.1.1 Design Wind Velocity

The design basic wind speed is a 3-second gust speed at 33 feet above ground. The basic wind speed (V) is 145 mph in open terrain, exposure category C associated with a 50-year mean recurrence interval. The velocity pressure is increased by an importance factor of 1.15 to obtain a 100-year mean recurrence interval for the design of safety-related and quality-related structures.

3.3.1.2 Determination of Applied Wind Forces

Wind velocity is converted into an effective pressure to be applied to surfaces of structures in conformance with Reference 1.

Effective wind design velocity pressure (q_z) on structural elements is calculated in conformance with Reference 1, Equation 6-15, as follows:

$$q_z = 0.00256\, K_z\, K_{zt}\, K_d\, V^2\, I \ (lb/ft^2),$$

Where:

q_z = velocity pressure in pounds per square foot at height "z".

3.4 Water Level (Flood) Design

In accordance with GDC 2 and RG 1.29, the Seismic Category I structures, systems, and components (SSC) identified in Table 3.2.2-1 can withstand the effects of flooding due to natural phenomena or onsite equipment failures, without losing the capability to perform their safety-related functions. A description of these structures is provided in Section 3.8. The U.S. EPR design meets the requirements of GDC 4 because safety-related SSC accommodate the effects of discharged fluid resulting from the high- and moderate-energy line breaks postulated in Sections 3.6.1 and 3.6.2. The criteria in RG 1.59 and ANSI/ANS-2.8-1992 "Determining Design Basis Flooding at Power Reactor Sites" (Reference 1) are used to establish the probable maximum flood (PMF), probable maximum precipitation (PMP), seiche, and other hydrologic considerations. The flood protection measures for Seismic Category I SSC are designed in accordance with RG 1.102. Section 2.4 provides further information on hydrologic engineering. Section 2.5 provides information on safe shutdown earthquake ground motion. Section 3.8 provides information on the design of Seismic Category I structures. The risk assessment for external and internal flooding is provided in the U.S. EPR probabilistic risk assessment addressed in Chapter 19.

Flood design requirements for the Fire Protection Building and Storage Tanks are identified in Section 9.5.1.

3.4.1 Internal Flood Protection

The U.S. EPR includes measures for protecting safety-related SSC against the effects of internal flooding from postulated flooding sources. These measures also protect safety-related SSC from flooding from non-safety-related SSC that are not required to be protected from either internal or external flooding. Because of these measures, a failure of components due to an internal flooding event will not prevent safe shutdown of the plant or mitigation of the flooding event. The nuclear island general arrangement drawings in Section 3.8 are a useful reference for the following description of protective measures for internal flooding.

The principal protective measure for Seismic Category I buildings is physical separation of the redundant safe shutdown systems and components. The safeguard buildings (SB), emergency power generating buildings (EPGB), and essential service water pump buildings (ESWPB) are Seismic Category I buildings designed with complete divisional separation of the four divisions of safety systems and are therefore consistent with an N+2 safety concept. With four divisions, one division can be down for maintenance and one can fail to operate due to an event such as internal flooding, while the remaining two divisions are available and sufficient to perform the necessary safety functions. The fuel building (FB) is designed with complete separation into two divisions below elevation +0 feet 0 inches such that in the event of an internal flood, the flood is restricted to one division of the FB while the other division is available and

integrity of the component. If a missile is generated in any of the redundant trains of a safety-related fluid system that is a Seismic Category I system and is capable of being powered from both onsite and offsite sources, a single active failure is not assumed in the remaining or associated supporting trains.

In the event that a missile is generated simultaneously with a single active failure, evaluations are performed to confirm that missile protection requirements are satisfied. Assessments are made of the missile size, energy, and potential path. Potentially impacted components associated with systems that are required to attain safe shutdown are analyzed to identify any at-risk items that may be within the postulated path and impact zone of the missile. Evaluations are performed to assess the loss of potentially impacted components, concurrent with a single active failure. These evaluations consider redundancy provided for safe shutdown equipment to determine if loss of the component due to missile impact and single active failure is acceptable. If this requirement is satisfied, no further protection from the missile is necessary.

Section 3.7.3 describes design of the non-seismic SSC which, if they fail, could potentially create seismic-generated missiles that could affect safety-related SSC. Section 9.1.5 describes evaluation of overhead lifting devices which, if they fail, could cause heavy-load drop impact events. Chapter 7 describes SSC required for safe shutdown of the U.S. EPR. Section 3.2 describes the quality classifications of SSC. Section 1.2 provides general arrangements and identification of U.S. EPR structures. U.S. EPR structures that house safe shutdown systems and components and require missile protection are identified in Section 3.5.2.

High wind generated missile requirements for the Fire Protection Building and Fire Water Storage Tanks are identified in Section 9.5.1.

The following sections provide the bases for the selection of missiles and protection requirements for internal and external missiles.

3.5.1 Missile Selection and Description

The U.S. EPR design is based upon consideration of the following potential missile generating sources:

- Internally generated missiles (outside containment) (Section 3.5.1.1).
- Internally generated missiles (inside containment) (Section 3.5.1.2).
- Turbine missiles (Section 3.5.1.3).
- Missiles generated by extreme winds (Section 3.5.1.4).
- Site proximity missiles (except aircraft) (Section 3.5.1.5).

Therefore, there is no potential for indirect interaction between the RWB and the NI structures.

Potential interaction between the RWB and EPGB is precluded by separation and by design and site selection and foundation design criteria for the RWB. The RWB is embedded a significant distance below grade and has a clear height above grade of +52.5 ft, while the clearance between the RWB and EPGB is at least 53 ft (see Figure 3B-1). Therefore, the separation between the two is only a small distance less than the height above grade of the RWB. Failure of the RWB in such a manner as to strike the EPGB is not considered credible due to the separation distance and because of the seismic design for 1/2 SSE loading described above. In addition, site selection and foundation design criteria for the U.S. EPR standard plant ensure that the RWB is founded on competent soils, while the embedded section below grade provides additional stabilization against rotation.

~~**[[Fire Protection Storage Tanks and Buildings]]**~~

~~[[The Fire Protection Storage Tanks and Buildings are classified as Conventional Seismic Structures.]] RG 1.189 requires that a water supply be provided for manual firefighting in areas containing equipment for safe plant shutdown in the event of a SSE. [[The fire protection storage tanks and building are designed to provide system pressure integrity under SSE loading conditions. Seismic load combinations are developed in accordance with the requirements of ASCE 7-10.]]~~

~~The Fire Protection Storage Tanks and Buildings are site-specific structures. A COL applicant that references the U.S. EPR design certification will provide the seismic design basis for the sources of fire protection water supply for safe plant shutdown in the event of a SSE.~~

3.7.2.9 Effects of Parameter Variations on Floor Response Spectra

Uncertainties in seismic modeling, due to such items as uncertainties in material properties, mass properties, concrete cracking under normal loading, and structural and soil modeling techniques can affect the accuracy of floor response spectra calculated using any of the approaches for seismic analysis presented in Section 3.7.2.1. To compensate for the effect of these uncertainties, the ISRS for U.S. EPR Seismic Category I structures are broadened by ±15 percent. These broadened ISRS are used in the subsequent design of structural elements of those structures, including flexible floors and walls.

3.7.2.10 Use of Constant Vertical Static Factors

Vertical seismic loads are generated from the SSI analysis for use in the seismic design of U.S. EPR Seismic Category I structures and Seismic Category II structures.

Table 3.10-1—List of Seismically and Dynamically Qualified Mechanical and Electrical Equipment
Sheet 164 of 201

Name Tag (Equipment Description)	Tag Number	Local Area KKS ID	EQ Environment (Note 1)	Radiation Environment Zone (Note 2)	EQ Designated Function (Note 3)	Safety Class (Note 4)	EQ Program Designation (Note 5)
KLA 2 Tr 1 HEPA Filter	30KLA21AT002	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
KLA 2 Tr 1 Iodine Filter	30KLA21AT003	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
KLA 2 Tr 1 Post Filter	30KLA21AT004	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
KLA 2 Tr 1 Moisture Separator	30KLA21AT005	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
KLA Purge Filtr Tr 2 Control Damper	30KLA22AA001	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
KLA Purge Filtr Tr 2 Man Ch Damper	30KLA22AA003	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
KLA 2 Tr 2 Damper	30KLA22AA004	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
KLA 2 Tr 2 Damper	30KLA22AA007	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
Elec Air Heater KLA 2 Tr 2 Filt	30KLA22AH005	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
KLA 2 Tr 2 Fan	30KLA22AN001	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
KLA 2 Tr 2 Prefilter	30KLA22AT001	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
KLA 2 Tr 2 HEPA Filter	30KLA22AT002	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
KLA 2 Tr 2 Iodine Filter	30KLA22AT003	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
KLA 2 Tr 2 Post Filter	30KLA22AT004	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
KLA 2 Tr 2 Moisture Separator	30KLA22AT005	30UFA	M	H	SI	S C/NM	Y (3) Y (5)
~~KLA 2 ESF Filter Bypass Isolation Damper~~	~~30KLA24AA001~~	~~30UFA~~	~~M~~	~~H~~	~~SI~~	~~S C/NM~~	~~Y (3) Y (5)~~
~~KLA 2 ESF Filter Bypass Fire Damper~~	~~30KLA24AA002~~	~~30UFA~~	~~M~~	~~H~~	~~SI~~	~~S C/NM~~	~~Y (3) Y (5)~~
~~KLA 2 ESF Filter Bypass Isolation Damper~~	~~30KLA24AA003~~	~~30UFA~~	~~M~~	~~H~~	~~SI~~	~~S C/NM~~	~~Y (3) Y (5)~~
KLA Plen Sup Motor Bal Damper	30KLA30AA001	30UFA	M	H	SII	NS-AQ C/NM	Y (3) Y (5)
KLA 3 Cont Iso Valv 32 ft FB	30KLA30AA002	30UFA	M	H	ES PAM SI	S C/NM	Y (3) Y (5)
KLA 3 Cont Iso Solen Glob Valv 1	30KLA30AA002A	30UFA	M	H	ES SI	S C/NM	Y (3) Y (5)
KLA 3 Cont Iso Valv 32 ft RB	30KLA30AA003	30UJA	H	H	ES PAM SI	S C/NM	Y (4) Y (5)
KLA 3 Cont Iso Son Glob Valv 2	30KLA30AA003A	30UJA	H	H	ES SI	S C/NM	Y (4) Y (5)
Motor Control Damper 1 to FB KLL	30KLA30AA004	30UFA	M	H	SII	NS-AQ C/NM	Y (3) Y (5)
Op Fl Control Damper Sup	30KLA30AA006	30UJA	H	H	SII	NS-AQ C/NM	Y (4) Y (5)
Op Fl Motorized Control Damper Sup	30KLA30AA007	30UJA	H	H	SII	NS-AQ C/NM	Y (4) Y (5)
Motor Control Damper 2 to FB KLL	30KLA30AA008	30UFA	M	H	SII	NS-AQ C/NM	Y (3) Y (5)
KLA 3 Plen Sup Fire Damper	30KLA30AA013	30UFA	M	H	SII	NS-AQ C/NM	Y (3) Y (5)
Fire Damper Plen Sup to FB KLL	30KLA30AA014	30UFA	M	H	SII	NS-AQ C/NM	Y (3) Y (5)
KLA 4 Cont Iso Damp 32 ft RB	30KLA40AA001	30UJA	H	H	ES PAM SI	S C/NM	Y (4) Y (5)
KLA 4 Cont Iso Solen Glob Val 32 ft RB	30KLA40AA001A	30UJA	H	H	ES SI	S C/NM	Y (4) Y (5)
KLA 4 Cont Iso Damp 32 ft FB	30KLA40AA002	30UFA	M	H	ES PAM SI	S C/NM	Y (3) Y (5)
KLA 4 Cont Iso Solen Glob Val 32 ft FB	30KLA40AA002A	30UFA	M	H	ES SI	S C/NM	Y (3) Y (5)
KLA 4 Sup Louver Damper 1	30KLA40AA003	30UJA	H	H	SII	NS-AQ C/NM	Y (4) Y (5)

Table 3.11-1—List of Environmentally Qualified Electrical/I&C Equipment
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Name Tag (Equipment Description)	Tag Number	Local Area KKS ID	EQ Environment (Note 1)	Radiation Environment Zone (Note 2)	EQ Designated Function (Note 3)	Safety Class (Note 4)	EQ Program Designation (Note 5)
33BTD01 Battery	33BTD01GR001	33UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
33BTP01 Battery Charger	33BTP01GR001	33UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
33BTP02 Battery Charger	33BTP02GR001	33UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
33BUC 250 VDC Bus (Switchboard)	33BUC00GW001	33UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
33BUF 250 VDC Switchboard	33BUF00GW001	33UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
33BUW51 DC/DC Converter	33BUW51GR001	33UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
33BUW53 DC/DC Converter	33BUW53GR001	33UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
33BUW56 DC/DC Converter	33BUW56GR001	33UBP	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BGA01 120 V Panelboard	34BGA01GW001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BGA02 Panelboard	34BGA02GW001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BGT01 480 V to 120 V Transformer	34BGT01GW001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BGT02 480 V to 120 V Transformer	34BGT02GW001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BRA 480 V Bus (MCC)	34BRA00GW001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BRD 480 V MCC	34BRD00GW001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BRU01 Inverter	34BRU01GU001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BRW70 AC/DC Converter	34BRW70GR001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BRW72 AC/DC Converter	34BRW72GR001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BRW76 AC/DC Converter	34BRW76GR001	34UBP	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BTD01 Battery	34BTD01GR001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BTP01 Battery Charger	34BTP01GR001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BTP02 Battery Charger	34BTP02GR001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BUC 250 VDC Bus (Switchboard)	34BUC00GW001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BUF 250 VDC Switchboard	34BUF00GW001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BUW71 DC/DC Converter	34BUW71GR001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BUW73 DC/DC Converter	34BUW73GR001	34UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
34BUW76 DC/DC Converter	34BUW76GR001	34UBP	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
Emergency Power Supply (EPSS)							
~~30BFT02 6.9 kV to 480 V (XFMR)~~	~~30BFT02GTO~~	~~32UJK~~	~~M~~	~~M~~	~~SI~~	~~NS AQ EMC~~	~~Y (5) Y (6)~~
31BDA 6.9 kV Bus (Switchgear)	31BDA01GS0	31UJK	M	M	RT ES PAM SI	S 1E EMC	Y (5) Y (6)
31BDB 6.9 kV Bus (Switchgear)	31BDB01GS0	31UJK	M	M	RT ES SI	S 1E EMC	Y (5) Y (6)
31BDC 6.9 kV Bus (Switchgear)	31BDC01GS0	31UJK	M	M	RT ES SI	S 1E EMC	Y (5) Y (6)
31BDD 6.9 kV Bus (Switchgear)	31BDD01GS0	31UQB	M	M	SI	S 1E EMC	Y (5) Y (6)
31BMB 480 V Bus (Load Center)	31BMB01GS0	31UJK	M	M	RT ES SI	S 1E EMC	Y (5) Y (6)
31BMC 480 V Bus (Load Center)	31BMC01GS0	31UJK	M	M	RT ES SI	S 1E EMC	Y (5) Y (6)

Detection and monitoring of SIS leakage within the Reactor Building (RB) is provided by the reactor coolant pressure boundary (RCPB) leakage detection systems described in Section 5.2.5. Leakage from the SIS in the SBs is detected and monitored by operating procedures and programs. Each SB has sump level indication to detect SIS/RHRS leakage.

The postulated accident sequences and analyses, including equipment actuation and response times, and design requirements for SIS delivery lag times, are described in Section 15.6.5.

6.3.2.2.2 System Components

Accumulators

Each accumulator is an austenitic stainless steel tank with a total volume of approximately 1950 ft^3 and is filled with approximately 1250–1400 ft^3 (approximately 10,000 gallons) of borated water and approximately 550–700 ft^3 of pressurized nitrogen. Nominal operating pressure is approximately 665 psig. The accumulators are designed so that the nitrogen pressure after their injection is lower than the LHSI discharge pressure. Thus, they do not inject nitrogen into the RCS prior to commencement of LHSI injection, even in the unlikely event of the loss of MHSI pumps. The relevant accumulator design and performance data are presented in Table 6.3-1.

Pumps

The LHSI and MHSI pumps are horizontally mounted, centrifugal pumps with single mechanical seals. Their motors are water cooled by the CCWS, with the exception of the LHSI pumps for Trains 1 and 4, which are cooled by the SCWS. Nominal flowrate for the LHSI pump is approximately 2200 gpm at 480 ft of total developed head (TDH), and for the MHSI pump it is approximately 600 gpm at 2260 ft of TDH. The relevant LHSI and MHSI pump design and performance data are presented in Tables 6.3-2 and 6.3-3, respectively.

The primary coolant injection pump is a horizontally mounted, centrifugal pump with mechanical seals. The pump motor is rated for high temperature. Nominal flowrate for the pump is approximately 330 gpm at ~~150~~857 ft of total developed head (TDH).

Heat Exchangers

The LHSI HXs are U-tube type, horizontally mounted, with reactor coolant flow through the austenitic stainless steel tubes and CCWS flow through the ferritic shell side. The relevant HX design and performance data are presented in Table 6.3-4—LHSI Heat Exchanger Design and Operating Parameters. Conservative fouling factors are incorporated into the performance evaluation of the LHSI HXs.

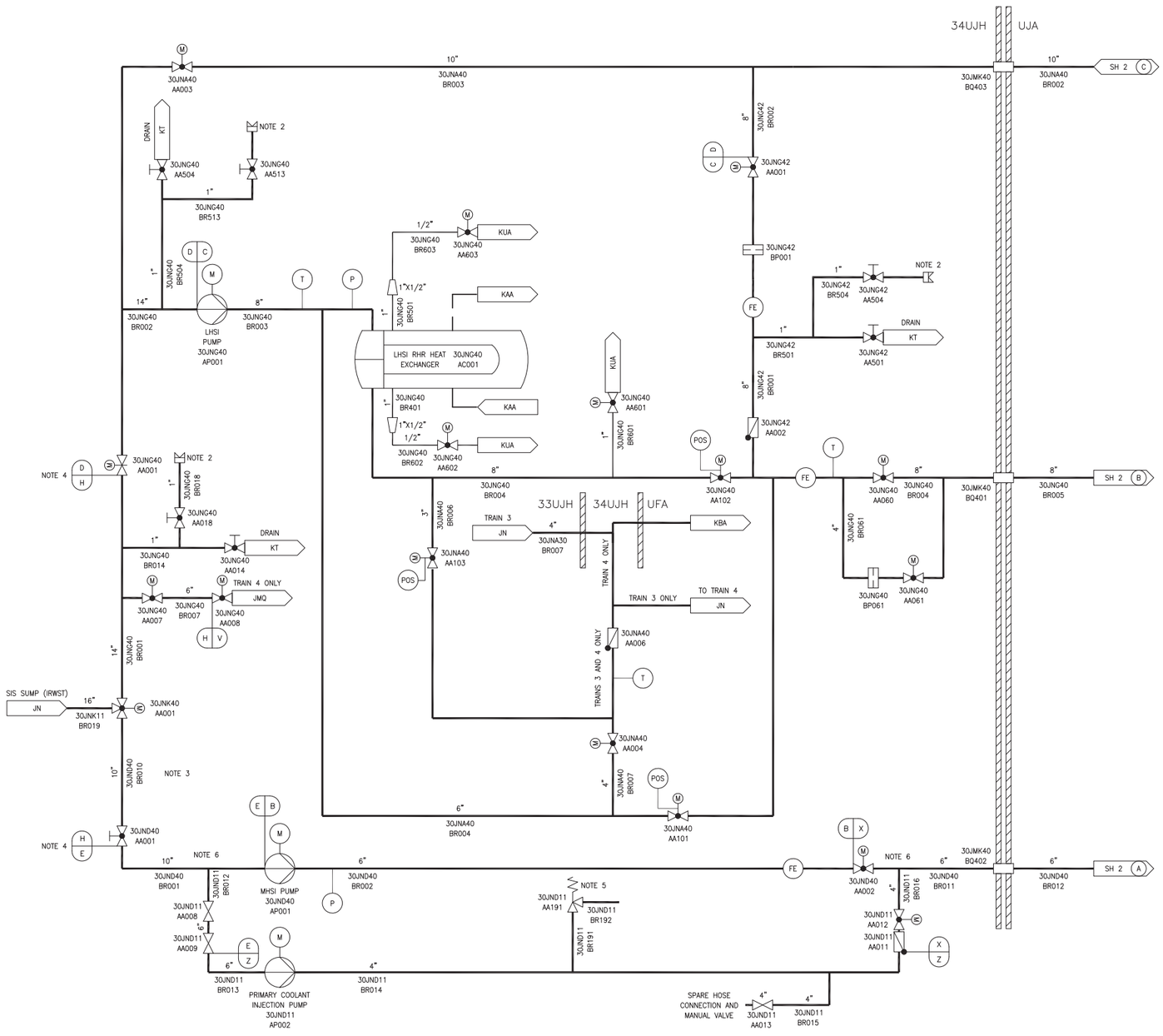
18. GL 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors," U.S. Nuclear Regulatory Commission, September 2004.

19. ANP-10293P, Revision 4, "U.S. EPR Design Features to Address GSI-191," AREVA NP Inc., November 2011.

20. NRC SECY Paper, "Use of Containment Accident Pressure in Analyzing Emergency Core Cooling System and Containment Heat Removal System Pump Performance in Postulated Accidents," SECY-11-0014, January 31, 2011.

21. ANP-10329, Revision 1~~0~~, "U.S. EPR Mitigation Strategies for an Extended Loss of AC Power Event Technical Report," AREVA ~~NP~~ Inc., November 2014~~May 2013~~.

Figure 6.3-2—Safety Injection / Residual Heat Removal System Train (Typical)
Sheet 1 of 2



JMQ – SEVERE ACCIDENT HEAT REMOVAL SYSTEM
JN – SAFETY INJECTION AND RESIDUAL HEAT REMOVAL SYSTEM
JNA – RESIDUAL HEAT REMOVAL SYSTEM
JND – MEDIUM HEAD SAFETY INJECTION SYSTEM
JNG – LOW HEAD SAFETY INJECTION SYSTEM
JNK – IN–CONTAINMENT REFUELING WATER STORAGE TANK SYSTEM
KAA – COMPONENT COOLING WATER SYSTEM SUPPLY TRAIN
KBA – VOLUME CONTROL SYSTEM
KT – NUCLEAR ISLAND DRAIN AND VENT SYSTEM
KUA – NUCLEAR SAMPLING SYSTEM– ACTIVE LIQUID SAMPLES

UJA – REACTOR BUILDING
33UJH – SAFEGUARD BUILDING MECHANICAL, DIVISION 3
34UJH – SAFEGUARD BUILDING MECHANICAL, DIVISION 4
UFA – FUEL BUILDING

NOTES:
1. TRAIN 4 SHOWN: REPRESENTATIVE OF TRAINS 1, 2 AND 3 WITH EXCEPTIONS AS NOTED.
2. CONNECTION FOR CONTAINMENT ISOLATION LEAK TIGHTNESS TEST.
3. 30JND40 BR010 APPLIES TO TRAIN 4 ONLY. FOR TRAINS 1, 2 AND 3, 30JND10/20/30 BR001 EXTENDS TO THE 3–WAY VALVE.
4. DESIGN AREA H ENDS AT THE INLET TO THE 3–WAY VALVE AND CONTINUES AS DESIGN AREA E FOR TRAINS 1, 2 AND 3.
5. DISCHARGE TO VISIBLE LOCATION.
6. 30JND11 APPLIES ONLY TO TRAIN 1.

Z	D	600	300	III
X	B	1525	340	I
V	B	175	320	I
H	B	75	320	I
E	B	75	300	I
D	B	930	360	I
C	B	1160	360	I
B	B	1525	300	I
DESIGN AREA	SSC QUALITY GROUP	DESIGN PRESSURE PSIG	DESIGN TEMPERATURE °F	SSC SEISMIC CLASS

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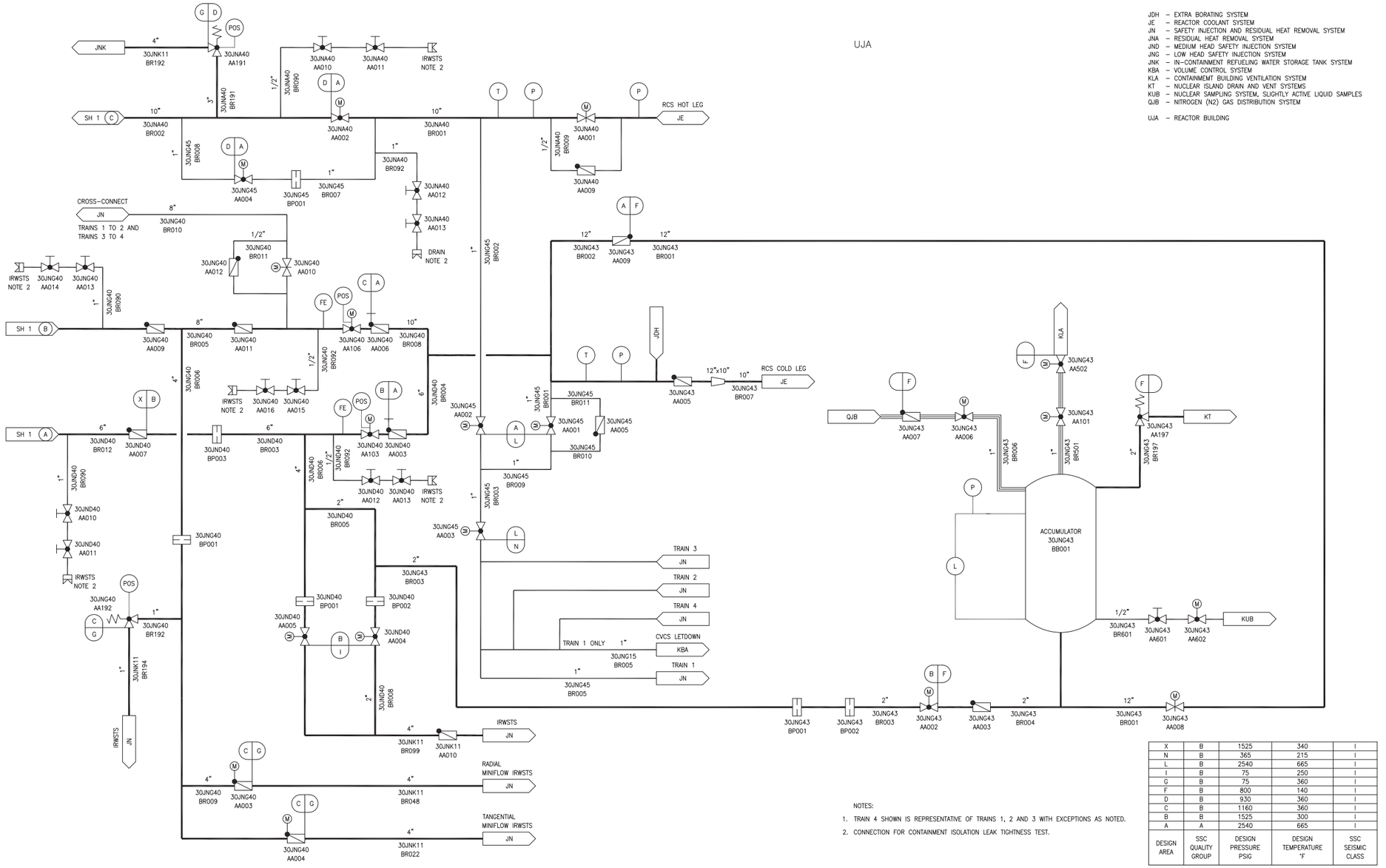
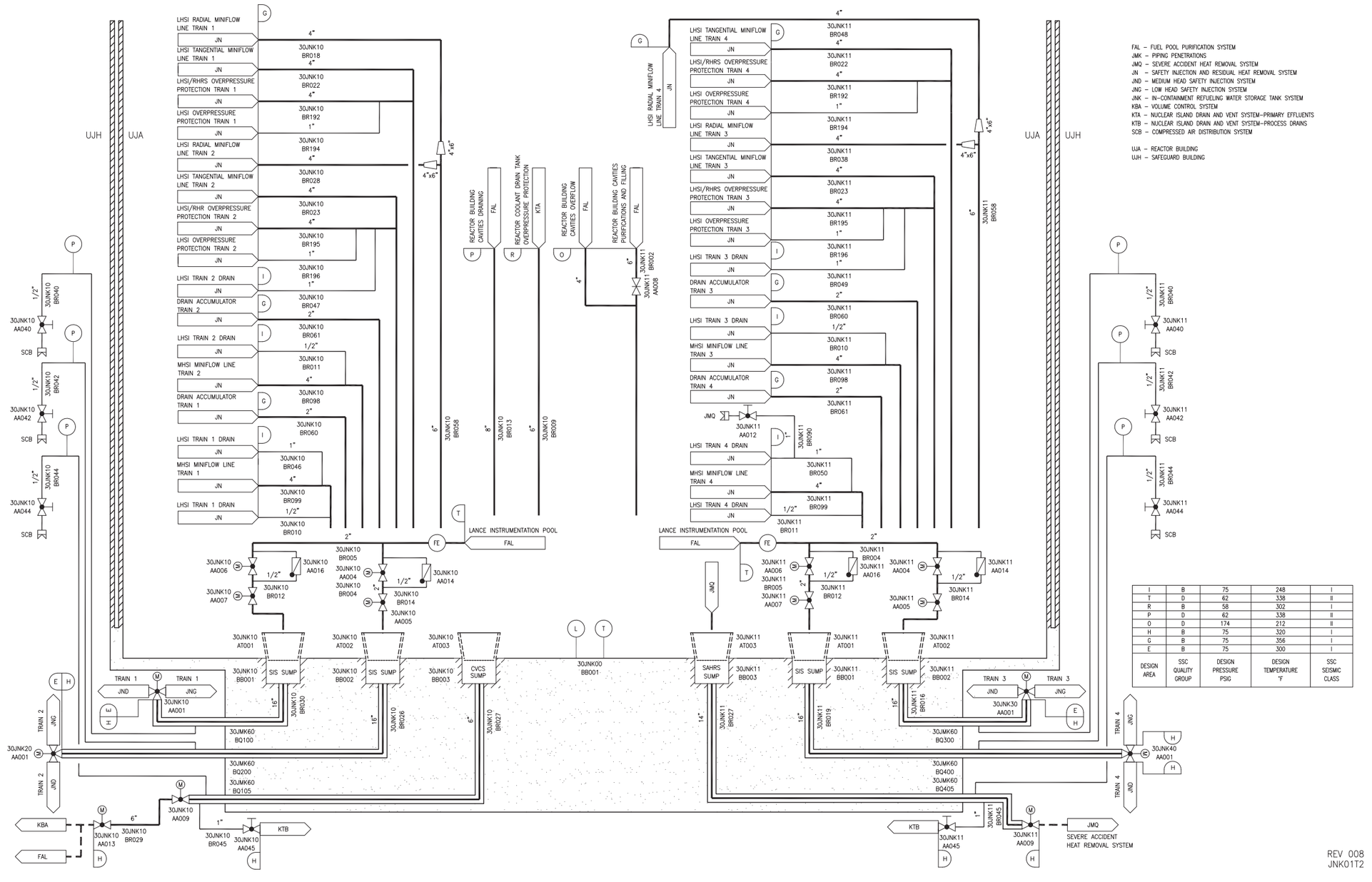
Figure 6.3-2—Safety Injection / Residual Heat Removal System Train (Typical)
Sheet 2 of 2



X	B	1525	340	I
N	B	365	215	I
L	B	2540	665	I
I	B	75	250	I
G	B	75	360	I
F	B	800	140	I
D	B	930	360	I
C	B	1160	360	I
B	B	1525	300	I
A	A	2540	665	I
DESIGN AREA	SSC QUALITY GROUP	DESIGN PRESSURE PSIG	DESIGN TEMPERATURE °F	SSC SEISMIC CLASS

Figure 6.3-3—IRWST Layout



Next File

45. Letter, Sandra Sloan (AREVA NP Inc.) to Document Control Desk (NRC), "Request for Alternatives to IEEE Std 603-1991 to Satisfy 10 CFR 50.55a(h)(3) Requirements - U.S. EPR Design Certification," May 24, 2011.

46. [*ANP-10315P, Revision 2, "U.S. EPR Protection System Surveillance Testing and Teleperm XS Self-Monitoring Technical Report," May 2013.*]*

47. NEI 12-06, Revision 0. "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Nuclear Energy Institute, August 2012.

48. ANP-10329 Revision 1~~0~~, "U.S. EPR Mitigation Strategies for an Extended Loss of AC Power Event Technical Report," AREVA Inc., November 2014~~May 2013~~.

Generation of the P12 permissive signal is described in Section 7.2.1.3.7.

Normally, the operator fully opens the isolation valves when RCS pressure exceeds accumulator pressure. Regardless, when RCS pressure increases above the P12 permissive threshold, the PS provides automatic signals to open the accumulator isolation valves. Once the isolation valves are verified to be in the fully open position, control power is removed from the valves to prevent inadvertent closure. During a normal decrease in pressure, power is restored to the valves at a point in time determined by the operating procedures. Then, after RCS pressure decreases below the P12 permissive threshold, the operator is prompted to manually validate the P12 permissive, which allows the isolation valves to be closed before RCS pressure is reduced below the accumulator pressure in Mode 4.

A pressure region exists below the P12 permissive pressure threshold where the accumulators are required to be available but Plant Technical Specifications allow an accumulator isolation valve to be closed for a short period of time. To accommodate operation in this pressure region, an automatic 'open' signal is sent to the accumulator isolation valves when an SIS actuation occurs. The SIS actuation function is described in Section 7.3.1.2.1.

~~When the RCS is depressurized upon entry into Mode 5, the accumulators are depressurized or maintained at a low pressure so they can be used as an RCS makeup source in response to an extended loss of AC power (ELAP) event. To respond to an ELAP event, the accumulator isolation valves are partially opened and repositioned as necessary to throttle makeup water to the RCS.~~

Two redundant ALUs within a division send the automatic opening signal through a "functional OR" logic to the isolation valve of the corresponding accumulator (i.e., PS Division 1 opens the isolation valve related to the Train 1 accumulator). This arrangement precludes a single actuator logic unit (ALU) failure from preventing the opening of a valve. Any other single failure which could prevent opening of a valve, such as failure of a PACS module or of the valve itself, is detected immediately by failure of the valve to open. Corrective actions can then be taken before continued increase in pressure.

The operational status of the PS on a divisional basis is provided to the operator. Indications and alarms are provided to the operator regarding the state of the P12 permissive signal. Additionally, the following indications are provided to the operator to verify correct operation of the interlock:

- Pressure and level of each accumulator.
- Percent open or closed position of each accumulator isolation valve.

8.3.1.1.6 Station Blackout Diesel Generators

Two station blackout diesel generators (SBODG) are provided for station blackout (SBO) conditions and are described in Section 8.4.

8.3.1.1.7 Extended Loss of AC Power Diesel Generator

The U.S. EPR design includes a diesel generator for use during Phase 2 of an extended loss of AC power (ELAP) event as described in Reference 43. The ELAP diesel generator can power Division 1, 2, and 4 equipment via EPSS 6.9 kV Buses 31BDB and 34BDB (refer to Figure 8.3-2). The alternate feed is utilized to power 6.9 kV bus 32BDA. The unit is sized to power only a minimum set of Division 1, 2, and 4 equipment as described in Reference 43~~The U.S. EPR design includes a 480 Vac diesel generator for use during Phase 2 of an extended loss of AC power (ELAP) event as described in Reference 43. Using manual transfer switches, this ELAP diesel generator can power Division 1 and 2 equipment via EPSS 480V Buses 31BMB and 32BMB (refer to Figure 8.3-2). The unit is sized to power only a minimum set of Division 1 and 2 equipment as described in Reference 43~~.

8.3.1.1.8 Electrical Equipment Layout

The electrical distribution system components distribute power to safety-related and non-safety-related loads in the Reactor Building (RB), Safeguards Buildings (SB), EPGBs, Essential Service Water Pump Buildings (ESWPB), Turbine Island (TI), Fuel Building (FB), Nuclear Auxiliary Building (NAB), Access Building (ACB), Circulating Water Pump Building (CWPB) and Radioactive Waste Processing Building (RWB).

The MSU and the auxiliary transformers are installed outdoors in the transformer yard near the Turbine Building.

EPSS 6.9 kV switchgear, 480 Vac load centers, MCCs and distribution transformers, are located in Seismic Category I Buildings electrical switchgear rooms. The electrical equipment is located in the SB, ESWPB or EPGB associated with its division.

The majority of NPSS 13.8 kV switchgear, 480 Vac load centers, MCCs and distribution transformers are located in the TI switchgear building. The NPSS 13.8 kV switchgear; 31BDE, 32BDE, 33BDE, and 34BDE, that provide power to the RCPs are located in their respective SB as well as the 480 Vac load center and MCCs that support non-safety-related equipment in the NI.

The onsite AC distribution switchgear, load center and MCC locations are provided in Table 8.3-2 and Table 8.3-3 for the EPSS and NPSS components respectively. General arrangement drawings showing locations of Class 1E equipment are located in Section 3.8.4.

34. IEEE Std 1313.2-1999(R2005), "IEEE Guide for the Application of Insulation Coordination," Institute of Electrical and Electronics Engineers, 1999.

35. IEEE 519-1992, "IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems," Institute of Electrical and Electronics Engineers, 1992.

36. IEEE Std 80-2000, "IEEE Guide for Safety in AC Substation Grounding," Institute of Electrical and Electronics Engineers, 2000.

37. IEEE Std 484-2002, "IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications," Institute of Electrical and Electronics Engineers, 2003.

38. IEEE Std 535-1986, "IEEE Standard for Qualification of Class 1E Lead Storage Batteries for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 1986.

39. IEEE Std 450-2002, "IEEE Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Applications," Institute of Electrical and Electronics Engineers, 2003.

40. IEEE Std 603-1991, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 1991.

41. IEEE Std 946-2004, "IEEE Recommended Practice for the design of DC Auxiliary Power Systems for Generating Stations," Institute of Electrical and Electronics Engineers, 2005.

42. IEEE Std 485-1997, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications," Institute of Electrical and Electronics Engineers, 1997.

43. ANP-10329, Revision 1~~0~~, "U.S. EPR Mitigation Strategies for an Extended Loss of AC Power Event Technical Report," AREVA ~~NP~~ Inc., November 2014~~May 2013~~.

Table 8.3-1—Onsite AC Power System Component Data Nominal Values
Sheet 1 of 4

	Component	Nominal Ratings
1.	MSUs (30BAT01, 30BAT02, 30BAT03, 30BAT04)	26 kV-(site-specific), single phase, 60 Hz 2100MVA (700MVA each phase) Cooling Class ODAF Temperature Rise 65°C
2.	EATs (30BDT01, 30BDT02)	(site-specific)-6.9 kV-6.9 kV, three phase, 60 Hz Rated Power 25/33.3/41.5 MVA Cooling Class ONAN/ONAF/ONAF Temperature Rise 65°C
3.	NATs (30BBT01, 30BBT02)	(site-specific)-13.8 kV-13.8 kV, three phase, 60 Hz Rated Power 140/186.2/232.4 MVA Cooling Class ONAN/ONAF/ONAF Temperature Rise 65°C
4.	NPSS 13.8 kV Switchgear	Rated Maximum Voltage, 15 kV Maximum Bus Bracing Current, 164 kA rms
	Feeder Circuit Breaker	Maximum Rated Interrupting Current, 63 kA Maximum Rated Closing and Latching Current 164 kA (peak value)
	31BBA, 32BBA, 33BBA, 34BBA	Maximum Continuous Current, 3000 A
	31BBC, 32BBC, 33BBC, 34BBC 31BBD, 32BBD, 33BBD, 34BBD 31BDE, 32BDE, 33BDE, 34BDE	Maximum Continuous Current, 1200 A
5.	EPSS and NPSS 6.9 kV Switchgear	Rated Maximum Voltage, 8.25 kV Maximum Bus Bracing Current, 104 kA rms
	Feeder Circuit Breaker	Maximum Rated Interrupting Current 40 kA rms Maximum Rated Closing and Latching Current 104 kA (peak value)
	31BBH, 32BBH, 33BBH, 34BBH	Maximum Continuous Current, 2000 A
	31BDA, 32BDA, 33BDA, 34BDA 31BDB, 32BDB, 33BDB, 34BDB 31BDD, 32BDD, 33BDD, 34BDD 31BDC, 34BDC, 33BBG, 34BBG 30BBH	Maximum Continuous Current, 1200 A

Table 8.3-3—Normal Power Supply System Switchgear and Load Center Numbering and Nominal Voltage

Nominal Voltage Level	Train	Bus/Load Center
13.8 kV Switchgear	1	31BBA (4) 31BBC (1), 31BDE (1), 31BBD (5)
13.8 kV Switchgear	2	32BBA (4) 32BBC (1), 32BDE (1), 32BBD (5)
13.8 kV Switchgear	3	33BBA (4) 33BBC (1), 33BDE (1), 33BBD (5)
13.8 kV Switchgear	4	34BBA (4) 34BBC (1), 34BDE (1), 34BBD (5)
6.9 kV Switchgear	N/A	30BBH (6)
6.9 kV Switchgear	1	31BBH (4)
6.9 kV Switchgear	2	32BBH (4)
6.9 kV Switchgear	3	33BBH (4), 33BBG (4)
6.9 kV Switchgear	4	34BBH (4), 34BBG (4)
480V Load Center	1	31BFA (4), 31BFB (4), 31BFC (4), 31BFD (1), 31BFX (4), 31BFE (3) [[31BFG (5), 31BFF (5)]]
480V Load Center	2	32BFA (4), 32BFB (4), 32BFC (4), 32BFD (1), 32BFX (4), 32BFE (3) [[32BFG (5), 32BFF (5)]]
480V Load Center	3	33BFA (4), 33BFD (1), [[33BFG (5), 33BFF (5)]]
480V Load Center	4	34BFA (4), 34BFD (1), 34BFE (3) [[34BFG (5), 34BFF (5)]]

Notes:

1. Equipment located in the Safeguards Buildings.
2. Deleted.
3. Equipment located in the Radioactive Waste Processing Building.
4. Equipment located in the TI Switchgear Building.
5. Equipment located in the Cooling Tower Area.
6. Equipment located in the Fire Protection Building (USG) and supplied by ELAP DG.

Figure 8.3-2—Emergency Power Supply System Single Line Drawing
Sheet 2 of 3

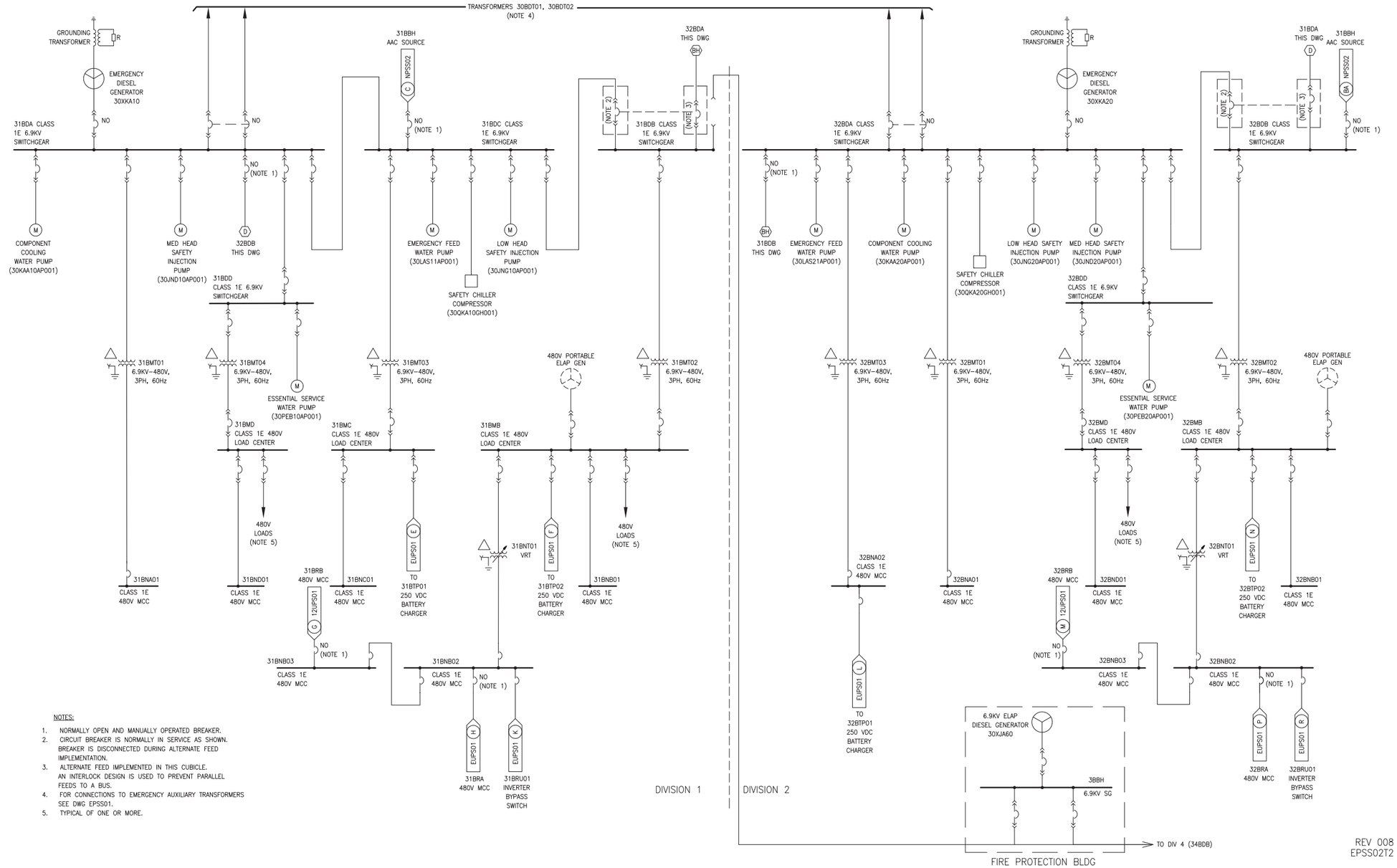
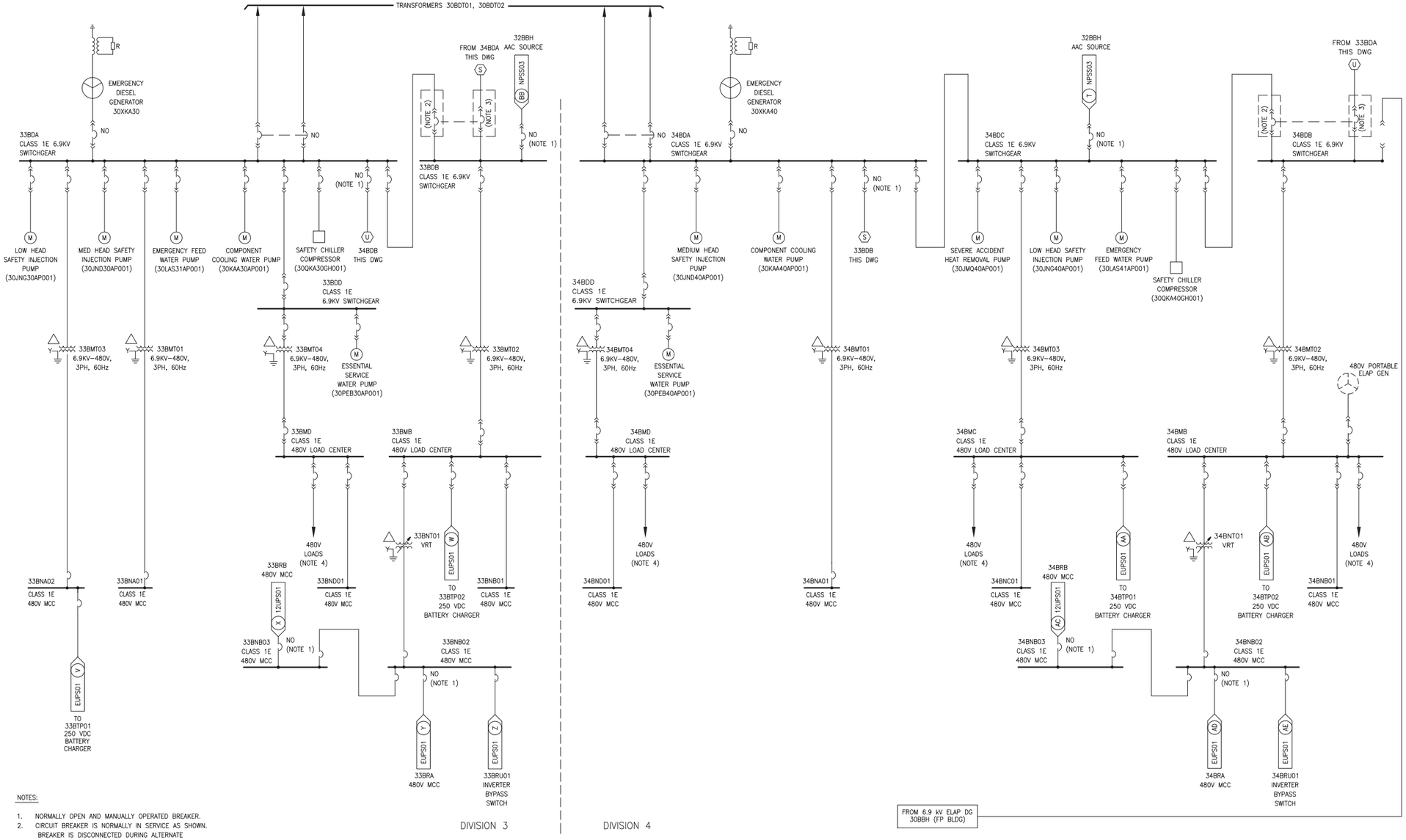


Figure 8.3-2—Emergency Power Supply System Single Line Drawing
Sheet 3 of 3



NOTES:

1. NORMALLY OPEN AND MANUALLY OPERATED BREAKER.
2. CIRCUIT BREAKER IS NORMALLY IN SERVICE AS SHOWN. BREAKER IS DISCONNECTED DURING ALTERNATE FEED IMPLEMENTATION.
3. ALTERNATE FEED IMPLEMENTED IN THIS CUBICLE. AN INTERLOCK DESIGN IS USED TO PREVENT PARALLEL FEEDS TO A BUS.
4. TYPICAL OF ONE OR MORE.

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Figure 9.2.2-4—Component Cooling Water System Dedicated CCWS Trains

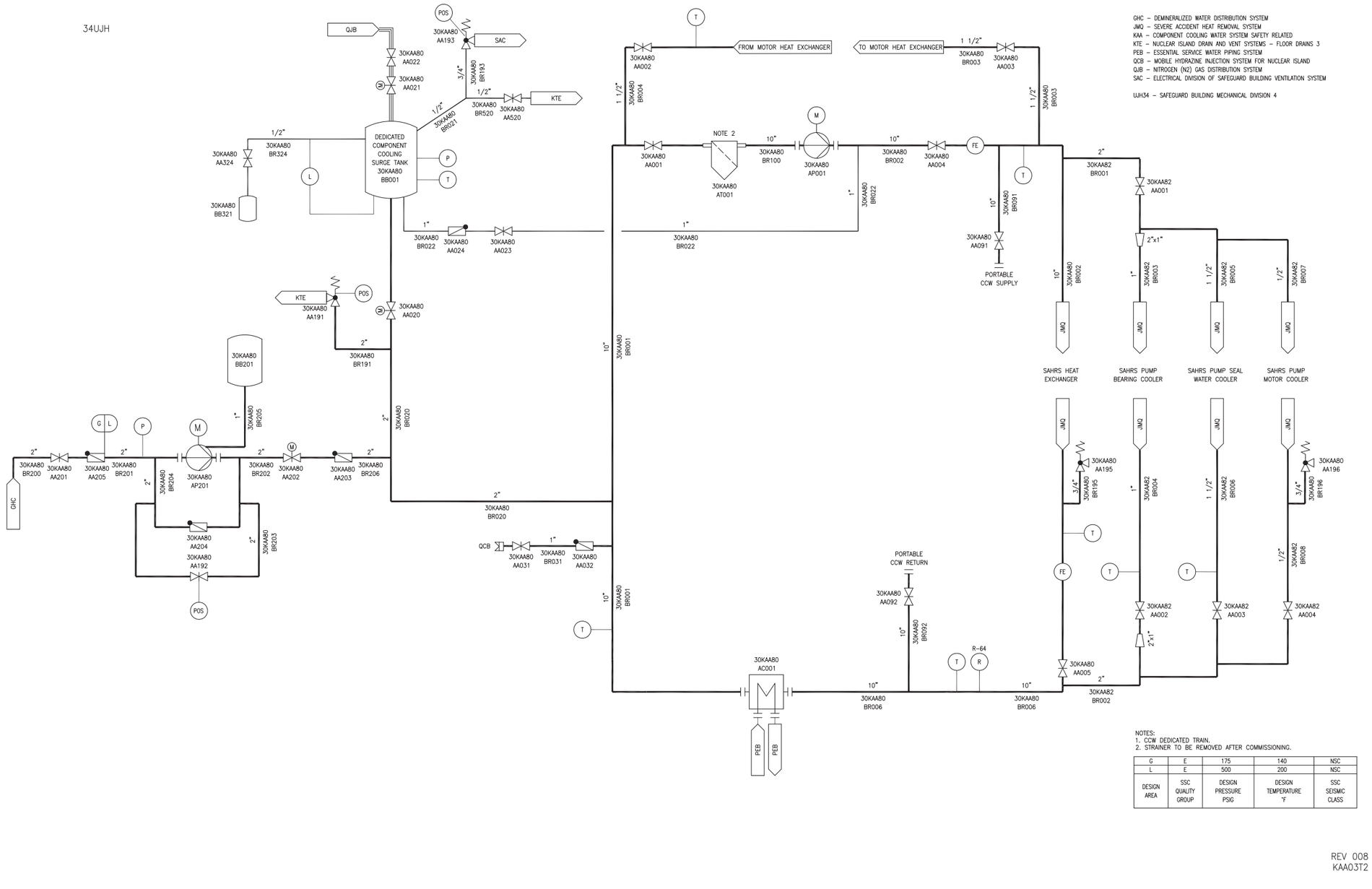

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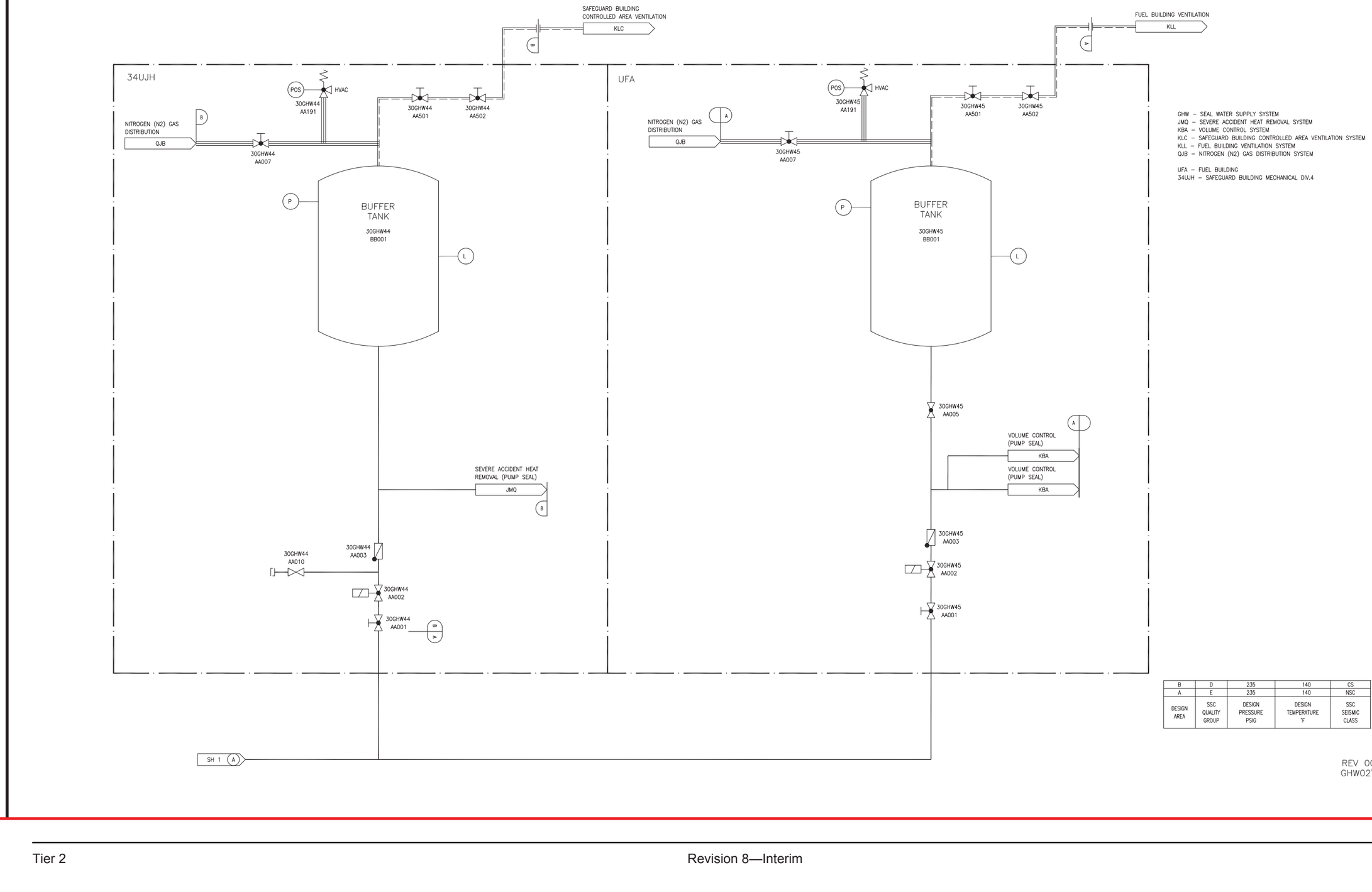
Figure 9.2.7-1—Seal Water Supply System
Sheet 2 of 3



The CBVS performs the following safety-related system functions:

- Maintain the component cooling water system's (CCWS) capability to perform its safety related functions by maintaining the integrity of the CCWS's pressure boundary at the two systems' interface. This is a secondary function.

The CBVS performs the following non-safety-related system functions:

- Controls and maintains a negative pressure in the Containment Building when the CBVS purge subsystem is operating.
- Maintains the following ambient conditions in the accessible areas (service compartments) for personnel accessibility and equipment operability during normal operation:
  - A minimum temperature of 59°F.
  - A maximum temperature of 86°F.
  - 30 percent to 70 percent humidity.
- Maintains the following ambient conditions in the non-accessible areas (equipment compartments) for protection and safe operation of the equipment:
  - A minimum temperature of 59°F.
  - A maximum temperature of 122°F.
  - Humidity: Non-condensing.
  - Supports reactor coolant pressure boundary (RCPB) leakage detection.
- ~~Provides an unfiltered vent path from containment to the vent stack during an extended loss of AC power (ELAP) event.~~

9.4.7.2 System Description

9.4.7.2.1 General Description

The supply air for the containment building ventilation system is conditioned outside air that is filtered, cooled, or heated by the nuclear auxiliary building ventilation system (NABVS) as described in Section 9.4.3. The supply air is delivered to the Containment Building through the Fuel Building plenum. The supply air is then distributed through the CBVS supply duct network if the containment purge subsystem is operating.

The CBVS is composed of the following separate subsystems:

- Containment purge subsystem.

Section 11.5.3.1.4 and Table 11.5-1, Monitor R-9). The full flow purge exhaust subsystem directs the containment exhaust air through the NABVS exhaust filtration train (refer to Section 9.4.3).

The dampers downstream of the supply plenum regulate pressure inside the Containment Building. The equipment compartment exhaust dampers regulate differential pressure between the service and equipment compartments when the low flow purge subsystem is operating.

The containment purge subsystems provide automatic isolation of containment atmosphere by quick closure of containment isolation valves and closure of the air supply in front of the hatch.

The containment purge subsystem is designed in accordance with ASME AG-1 (Reference 1) and RG 1.52 for atmospheric cleanup.

~~The low flow purge exhaust duct provides a vent path from the containment to the vent stack through a bypass vent path around the ESF filters and fans for use during an ELAP event.~~

Internal Filtration Subsystem

The internal filtration subsystem (See Figure 9.4.7-3—Containment Building Internal Filtration Subsystem) limits the release of radioactive material by reducing radioactive iodine contamination inside the equipment compartment with air circulation and filtration during normal plant operation. The internal filtration subsystem contains one filtration train which consists of an electric heater, prefilter, HEPA filter, carbon adsorber, and post filter; with two redundant fans downstream of the filtration train. The air is drawn from the equipment compartments, filtered, and returned to the equipment compartments.

Radiation monitors are located upstream of the filtration trains for monitoring the radiation in the equipment compartments prior to filtration (refer to Section 11.5.3.1.5 and Table 11.5-1, Monitor R-10).

The system is designed in accordance with ASME AG-1 (Reference 1) and RG 1.140 (Reference 14).

Containment Building Cooling Subsystem

The containment building cooling subsystem (See Figure 9.4.7-4—Containment Building Cooling Subsystem) provides cool air into a stainless steel sheet metal circular header located above the residual heat removal-safety injection room, and into the reactor pit cooling fan plenum. The containment building cooling subsystem provides cool air to the reactor coolant pumps, steam generators, chemical volume control

system (CVCS), control rod drive mechanism system (CRDMS), and vent and drain system. There are two trains of two main fans and four cooling coils located in the equipment compartments. The cooling coils receive cold water from the operational chilled water system (OCWS).

Two trains of two reactor pit cooling fans located in the equipment compartments supply cool air to the reactor pit area. These fans are used to ventilate the reactor pit during normal and station blackout (SBO) conditions. The reactor pit is cooled by air from a plenum between the main fans and the reactor pit cooling fans. The supply air subsystem to the reactor pit is composed of a 16 duct layout around the main coolant piping.

The exhaust from these areas is recycled through the cooling coils located in the equipment compartments.

The system is designed in accordance with ASME AG-1 (Reference 1).

Service Compartments Cooling Subsystem

The service compartment cooling subsystem (See Figure 9.4.7-5—Containment Building Service Compartments Cooling Subsystem) contains 12 recirculating cooling units. Each air cooling unit is equipped with a cooling coil connected to the OCWS. The recirculation cooling units provide ventilation and cooling for the service compartments. The service compartments include safety injection system valve rooms, steam generator blowdown system tank and heat exchanger rooms, instrument measuring cabinets and table rooms, and containment dome and annular space.

The system is designed in accordance with ASME AG-1 (Reference 1).

9.4.7.2.2 Component Description

The major components of the CBVS are listed in the following paragraphs, along with the applicable code and standards. Table 3.2.2-1 provides the seismic design and other design classifications for components in the CBVS.

Ductwork and Accessories

The supply and exhaust air ducts are structurally designed for fan shutoff pressures. The ductwork is designed, tested and constructed in accordance with ASME AG-1 (Reference 1).

~~The low-flow purge exhaust duct from the CI valves through the filter bypass duct and to the vent stack is designed for a pressure of 35 psig and a temperature of 280°F.~~

Fans

The supply and exhaust fans are centrifugal or vane-axial designed with electric motor drivers. Fan performance is rated in accordance with ANSI/AMCA 210 (Reference 4), AMCA 211 (Reference 5), and ANSI/AMCA 300 (Reference 6).

Isolation Dampers

Manual dampers are adjusted during initial plant startup testing to establish accurate air flow balance between rooms. The motor-operated isolation dampers will fail as-is in case of power loss. The performance and testing requirements of the dampers will be conducted in accordance with ASME AG-1 (Reference 1).

Fire Dampers

Fire dampers are installed where ductwork penetrates a fire barrier. Fire damper design meets the requirements of NFPA 80 (Reference 7) and NFPA 90A (Reference 17) and the damper fire rating is commensurate with the fire rating of the barrier penetrated. Fire dampers are equipped with fusible links for automatic closure when the temperature reaches a predetermined setpoint.

Fire damper 30KLA20AA 014 which passes through the 3 hour fire barrier wall between rooms 30UFA24 053 and 30UFA24 095 is a combination fire and smoke damper paired with the temperature override option. This configuration allows normal closure of the damper assembly at 165°F and the ability to override the 165°F closure command and remain open provided the temperature does not exceed 350°F. ~~A combination fire and smoke damper is required in the containment vent path. The damper has a temperature override option. This allows normal closure of the damper assembly at 165°F and the ability to override the 165°F closure command and remain open provided the temperature does not exceed 350°F.~~

Recirculation Cooling Units

The recirculation cooling units consist of a fan section, a water cooling section, and a moisture separator. The housing is constructed of heavy gauge steel. The fan is driven by an electric motor. The cooling coils are finned coil type and are connected to the operational chilled water system. The cooling coils are designed in accordance with ASME AG-1 (Reference 1 and Reference 18). The moisture separator collects condensate which is directed to drain system.

9.4.7.2.3 System Operation

Normal Plant Operation

The containment low flow purge subsystem can operate during normal operation. The containment building negative pressure is maintained by controlling the supply air

Small-Break Loss-of-Coolant Accident and Loss-of-Coolant Accident

In the event of a small-break loss-of-coolant accident (SBLOCA) or loss-of-coolant accident (LOCA), containment isolation valves automatically close after receipt of the containment isolation signal. These valves are designed to perform their isolation function under LOCA conditions and will close within five seconds after receipt of a containment isolation signal from the PACS module.

~~*ELAP*~~

~~In the event of a loss of all AC power, the low flow purge exhaust duct may be used to vent the containment. Compressed air is provided to the CI valves to allow them to open. A bypass duct around the ESF filters and fans is used to direct the containment air to the vent stack.~~

9.4.7.3 Safety Evaluation

The CBVS maintains proper temperatures in the Containment Building during normal operations and shutdown conditions. Sufficient redundancy is included for proper operation of the system when one active component is out of service. The CBVS is an engineered safety feature and the safety-related functions are closure of the CBVS containment isolation valves (CIV) and filtration of the low flow purge prior to closure of the CIVs during a postulated rod ejection accident.

The CBVS low flow purge removes radioactive materials via two 100 percent iodine filtration trains prior to release to the plant vent stack. Each train operates independently. A failure in one train will not prevent the remaining train from providing the required engineered safety feature function.

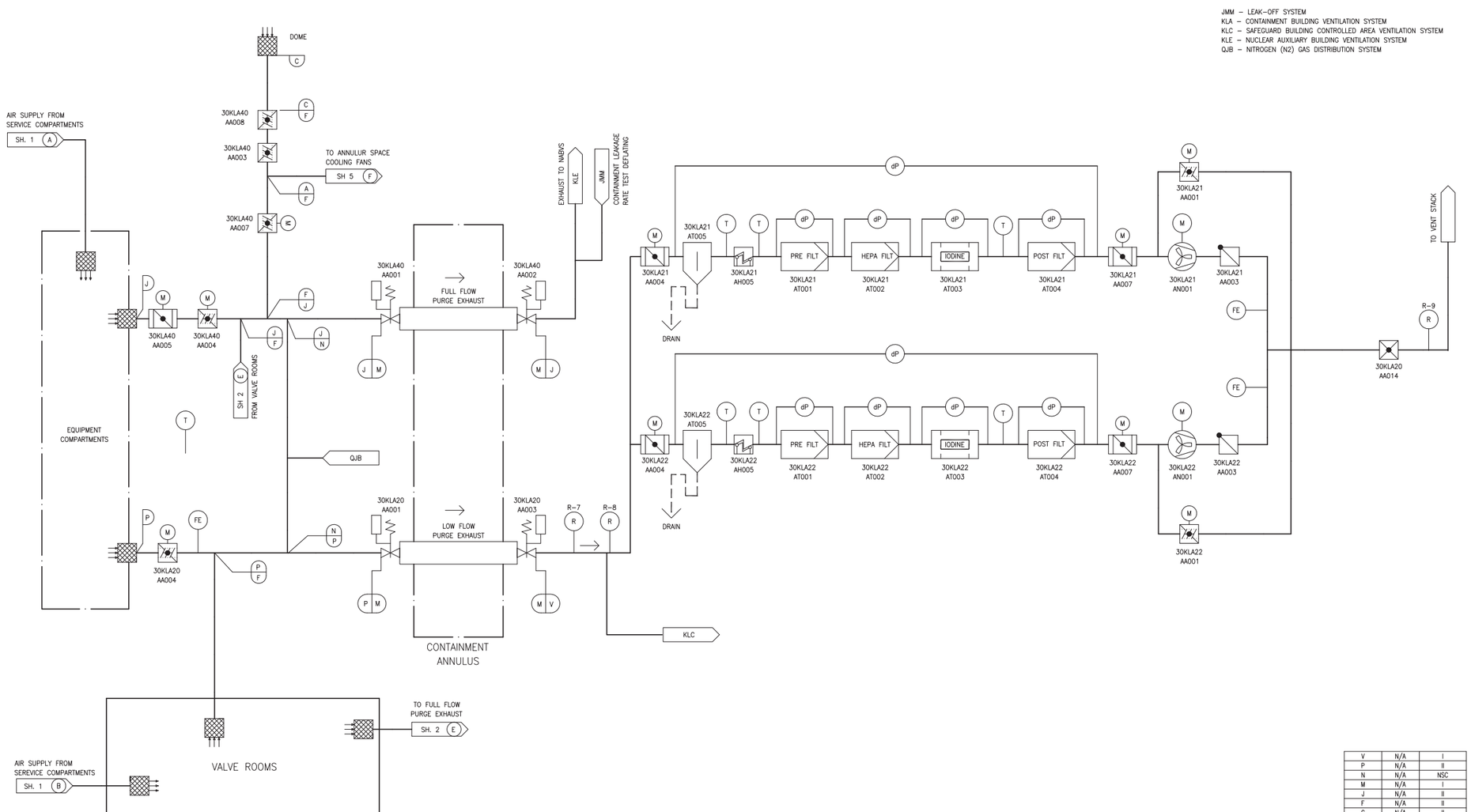
The containment purge subsystem supply and exhaust penetrations through the containment annulus are equipped with two normally open isolation valves, each connected to separate control trains. A failure in one train will not prevent the remaining isolation valve from providing the required capability. The valves automatically close within five seconds after receipt of a containment isolation signal from the PACS module. The isolation valves and containment penetrations are the only portions of the CBVS that are safety related.

The four main cooling coils enable the CCWS's capability to perform its safety related functions by maintaining the integrity of the pressure boundary of the CCWS's cooling supply and return lines. This is a secondary design function.

9.4.7.4 Inspection and Testing Requirements

The CBVS major components, such as dampers, motors, fans, filters, coils, heaters, and ducts are located to provide access for initial and periodic testing to verify their integrity.

Figure 9.4.7-2—Containment Building Low Flow and Full Flow Purge Exhaust Subsystem



V	N/A	I
P	N/A	II
N	N/A	NSC
M	N/A	I
J	N/A	II
F	N/A	II
C	N/A	II
A	N/A	NSC
DESIGN AREA	SSC QUALITY GROUP	SSC SEISMIC CLASS

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standpipe system in the Reactor Annulus. In addition, each of the control valves for the Reactor Annulus standpipe system has a 1 inch by-pass line which will keep the standpipe filled and pressurized.

The proper type of hose nozzle provided for each hose station is based on the fire hazards in the area. Combination spray or straight-stream nozzles are not used in plant areas where a straight stream could cause unacceptable damage or present an electrical hazard to firefighting personnel. UL listed electrically safe fixed fog nozzles are provided in areas where high-voltage shock hazards exist. All nozzles have full shutoff capability.

Fire hose meets the applicable criteria of NFPA 1961 (Reference 26) and is hydrostatically tested in accordance with the applicable guidance of NFPA 1962 (Reference 27).

Standpipe and hose systems in areas containing equipment required for safe plant shutdown following an SSE are designed to be functional following an SSE and capable of providing flow to at least two hose stations (approximately 75 gpm per hose stream). The standpipe and hose stations in these areas, the water supply and distribution piping, and the supports and valves, as a minimum, satisfy ASME B31.1 (Reference 32). This is accomplished by manually realigning valves to isolate non-seismically qualified portions of the FPS from the seismic portions of the system and manually starting the diesel fire pumps. Specific fire protection SSCs including diesel driven fire water pump, discharge piping, portable equipment, the fire protection building, and fire water storage tanks are relied upon to mitigate an extended loss of power event and are designed to meet the NEI 12-06 reasonable protection requirements.To comply with ~~this~~these requirements, portions of the fire protection water supply and water distribution system are designed to satisfy, as a minimum, the following requirements:

- The Fire Protection Building and Storage Tanks are designed for high wind loads computed using the requirements of ASCE 7-10 (Reference 46). The Fire Protection Building and Storage Tanks are designed against the effects of high wind missile spectra. The hurricane wind speed and missile spectra are defined in RG 1.221 for the site specific location. The tornado wind speed and missile spectra are defined per RG 1.76 for the site specific location.

- The Fire Protection Building and Storage Tanks are designed against the effects of local intense precipitation, flooding from nearby rivers, lakes, and reservoirs, high tides, seiche, hurricane and storm surge, and tsunami events by locating the structures using a dry site concept. The Fire Protection Building and Storage Tanks are to be located at least one foot above the maximum design basis flood level for the site.

- The Fire Protection Building and Storage Tanks are designed against the effects of avalanche, frost, ice cover, frazil ice, snow, and extreme low temperatures as applicable using the requirements of ASCE 7-10 (Reference 46) for the site specific

location and using a best estimate 1% exceedance low temperature value of (-10°F).

- The Fire Protection Building and Storage Tanks are designed against the effects of high temperatures as applicable using a best estimate 1% exceedance high temperature value of (100°F dry bulb / 77°F wet bulb coincident).

- ~~Seismic design of t~~The fire water storage tanks are designed to the site SSE using~~is in accordance with~~ AWWA D100-2005 (Reference 45), referenced by NFPA 22 (Reference 6), "Standard for Water Tanks for Private Fire Protection," (refer to RG 1.189) ~~ASCE 7-10 (Reference 46)~~.

- The fire pump house (Part of USG) is designed ~~in accordance with ASCE 7-10 (Reference 46),~~ with the seismic demand on the structure calculated for the site SSE with a limiting acceptance condition for the structure characterized as essentially elastic behavior with no damage (i.e., Limit State D) as specified in ASCE 43-05.

- The two diesel fire pump drivers and fuel tanks, including their attachments and supports, are designed for seismic loads in accordance with ASCE 43-05. The limiting acceptable deformation, displacement or stress for the equipment support structures is characterized by Limit State C of the standard. Seismic demand on the SSC being evaluated is based on the SSE for the site. The diesel pumps are design to be started manually following an SSE utilizing the pump batteries. Isolation valves which isolate the diesel fire pumps from the motor driven fire pump are designed to remain functional so that the cross connections to the motor driven pump can be manually closed after an SSE.

- Seismic design of the battery racks and anchors is in accordance with ASCE 43-05. The limiting acceptable deformation, displacement or stress for the battery support structures, including the anchorage, is characterized by Limit State C of the standard. Seismic demand on the SSC being evaluated is based on the SSE for the site.

- The portion of the underground fire main which supplies fire protection water to the seismically qualified standpipe and hose system is designed to remain functional following an SSE. Isolation valves between seismically qualified portions of the underground fire main and non-seismically qualified portions must remain functional following an SSE so that they can be manually closed.

- The portion of the inside fire water distribution system which supplies fire protection water to the seismically qualified standpipe and hose system is designed to remain functional following an SSE. Isolation valves between seismically qualified portions of the inside fire water distribution system and non-seismically qualified portions must remain functional following an SSE so that they can be manually closed.

Failure or rupture of standpipe and hose systems will not significantly impair the safety capability of SSC important to safety.

5.2.2 Table 14.3-2 Item 2-14.

5.3 Verify that safety-related components meet electrical independence requirements and redundancy requirements.

14.2.12.3.5 Containment Isolation Valves Leakage Rate (Test #028)

1.0 OBJECTIVE

1.1 To verify that the measured leakage through each containment penetration isolation valve when summed with the total of other Type B and C LRTs is within the limits as required by the Technical Specifications and 10 CFR 50, Appendix J.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested have been completed.

2.2 Temporary pressurization equipment is installed and instrumentation is calibrated.

3.0 TEST METHOD

3.1 Close the individual CIVs by the means provided for normal operation of each individual valve. The valves must be stroked to the closed position by the normal means to perform a valid leakage test.

3.2 Perform 10 CFR 50 Appendix J, Type C test, by local pressurization of each penetration.

4.0 DATA REQUIRED

4.1 Individual penetration leak data.

5.0 ACCEPTANCE CRITERIA

5.1 Verify leak rates, when summed with the total of other Type B and C LRTs, do not exceed the allowable limits as required by the Technical Specifications and 10 CFR 50, Appendix J.

5.2 The CIVs operate as designed (refer to Sections 3.1.5, 3.8.1, and 6.2.6).

14.2.12.3.6 Containment Integrated Leak Rate and Structural Integrity Tests (Test #029)

1.0 OBJECTIVE

1.1 To perform the structural integrity test (SIT) and integrated leak rate test (ILRT) for the containment.

1.2 To verify that the integrated leak rate from the containment does not exceed the maximum allowable leakage rate.

1.3 ~~To verify that the various purge paths can control the containment depressurization.~~

2.0 PREREQUISITES

2.1 Containment penetration local leak rate testing has been completed.

2.2 All systems inside containment which have CIVs identified are vented and drained as required by Section 6.2.6.1.

2.3 Leakage rate determination instrumentation is available, calibrated, and is operating satisfactorily prior to performing the following test.

2.4 Containment inspection completed as required by the Technical Specifications and 10 CFR 50, Appendix J.

2.5 Systems required for the test are available, including station air and other miscellaneous systems.

2.6 Instrumentation to measure containment building movement is installed and calibrated and is operating satisfactorily prior to performing the following test.

2.7 Containment ventilation system fans are capable of running for air circulation. Note that it is necessary to create air circulation to eliminate local temperature variations that would bias the test results.

2.8 ~~The containment purge paths are available for containment depressurization.~~

3.0 TEST METHOD

3.1 Close individual CIVs by the means provided for normal operation of the valves as required by 10 CFR 50, Appendix J.

3.2 Remove power from the hydrogen mixing damper solenoids.

3.3 Verify that the hydrogen mixing dampers are open prior to beginning the containment pressurization.

Note: There should be at least one opening (door or foil) into each confined area but the test should also consider adequate air mixing (to prevent local hot spots) in areas that are not instrumented during the test.

3.4 A suitable number of the following components have been placed in the open position:

3.4.1 Convection and rupture lower door frames.

3.4.2 Pressure relieving doors.

3.4.3 Radiation doors.

3.5 Increase the internal pressure in the containment building from atmospheric pressure to a minimum of 115 percent of design pressure in at least four approximately equal increments and depressurized in the same increments.

3.6 Record data at each pressure level, during pressurization and depressurization, an evaluation of the deflections shall be made to

determine if the response deviates significantly from the expected response.

3.7 Perform a visual inspection of the containment hatches, penetrations, and flanged joints.

3.8 Determine the containment leak rate at calculated peak accident pressure and at one-half calculated peak accident pressure.

3.9 Verify leakage by reference vessel method, absolute pressure method, or both.

3.10 Verify the test accuracy by supplementary means.

3.11 ~~Verify that the containment can be depressurized.~~

3.11.1 ~~Initially using the deflation line, verify that the control valve adequately controls the depressurization.~~

3.11.2 ~~Terminate the deflation and verify that the system responds as desired.~~

3.11.3 ~~When containment pressure has been depressurized to approximately 35 psig, place the normal low flow purge valve into service and verify that the system adequately controls the depressurization.~~

3.11.4 ~~Terminate the deflation and verify that the system responds as desired.~~

3.11.5 ~~When containment pressure has been depressurized to approximately 30 psig, place the ELAP bypass small purge path into service and verify that the system adequately controls the depressurization.~~

3.11.6 ~~Terminate the deflation and verify that the system responds as desired.~~

4.0 DATA REQUIRED

4.1 Structural integrity data.

4.1.1 The readings of instrumentation to measure containment building movement shall be recorded at selected pressure levels.

4.1.2 Displacements shall be measured at several points along locations spaced evenly around the containment. The locations shall include the following:

- Springline.
- Top of dome (the top of the concrete).
- Locations with varying stiffness characteristics such as major penetrations.
- Radial and vertical defections of the containment wall adjacent to the equipment hatch opening shall be measured at twelve points around the hatch penetration. The twelve points shall be three locations each at the

three, six, nine and twelve o'clock positions around the penetration.

4.2 Integrated leak rate data.

4.2.1 Containment temperature, pressure, and humidity.

4.2.2 Reference vessel temperature and pressure.

4.2.3 Atmospheric pressure and temperature.

4.2.4 Known leakage air flow.

4.3 Record the following data in the equipment space and the service area.

4.3.1 Differential pressure data.

4.3.2 Temperature data in the equipment space.

4.3.3 Temperature data in the service area.

5.0 ACCEPTANCE CRITERIA

5.1 SIT results are satisfactory, in accordance with ASME Code, Article CC-6000 (Reference 2) and RG 1.136, as detailed in Section 3.8.1.7.1.

5.2 Containment vessel shows no signs of structural degradation following the SIT as designed (refer to Section 3.8.1).

5.3 The ILRT results are satisfactory as specified in Section 6.2.6.

5.3.1 Table 14.3-1 Item 1-10.

5.3.2 Table 14.3-2 Item 2-2.

5.4 Containment meets design requirements (refer to Sections 3.1.5, 3.8.1, and 6.2.6).

5.5 ~~The various alignments that can be used to depressurize containment function as designed.~~

5.5.1 ~~Damage to flow path is not experienced.~~

14.2.12.3.7 Reactor Coolant System Hydrostatic (Test #030)

1.0 OBJECTIVE

1.1 To verify the integrity of the RCS pressure boundary and associated Safety Class I piping.

2.0 PREREQUISITES

2.1 The RCS is filled, vented, and above the minimum required temperature. Note that it is necessary to heat the RCS by running the RCPs so that the system shall remain above the minimum temperature during the soak period and the subsequent examination period.

2.2 All RCPs are functional.

2.3 A high head pump (1.25 times the RCS design pressure) is available for the hydrostatic test.

includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.8.1 Range.

5.8.2 Response time.

5.8.3 Sensitivity.

14.2.12.6.3 Primary to Secondary Heat Transfer~~Feed and Bleed~~ (ELAP) (Test #053)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the fire water distribution system (FWDS) feed to EFW (primary to secondary heat transfer~~secondary feed and bleed~~) system following an ELAP event.

1.2 To demonstrate electrical independence and redundancy of power supplies to the following:

1.2.1 Diesel driven fire pumps.

1.2.2 MSRT controllers (Trains 1& 2 or Trains 3 & 4) powered from the 2 hour batteries.

2.0 PREREQUISITES

2.1 Construction activities on the FWDS to EFW (primary to secondary heat transfer~~secondary feed and bleed~~) piping (from FWDS header to EFW cross connect discharge header) have been completed.

2.2 FWDS header feed to EFW (primary to secondary heat transfer~~secondary feed and bleed~~) instrumentation has been calibrated and is functional for performance of the following test.

2.3 Special test instrumentation available and calibrated per applicable procedures.

2.4 The following instrumentation downstream of the diesel driven fire water pump is functional:

2.4.1 EFW flow (all divisions).

2.4.2 Steam generator level (all divisions).

2.4.3 Steam generator pressure (all divisions).

2.5 The MSRT valves are available for MSRT operation, where necessary.

2.6 Appropriate AC and DC power sources are available.

2.7 The following fluid systems have been cleaned to steam generator cleanliness requirements and filled with secondary grade water:

2.7.1 Fire water storage tanks.

2.7.2 Diesel driven fire pumps.

2.7.3 FWDS header.

2.7.4 Piping from FWDS header to EFW cross connect discharge header.

2.8 The steam generators (all divisions) are available for receiving flow from the EFW cross connect discharge header.

3.0 TEST METHOD

3.1 Verify pump performance characteristics (e.g., head versus flow, diesel motor RPM) for the diesel driven fire pumps.

3.1.1 $NPSH_a \geq NPSH_R$.

3.1.2 Discharge head.

3.1.3 Flow corresponding to head at each point.

3.1.4 Starting time (motor start time and time to reach flow).

3.1.5 Connections to diesel tank to allow fuel and lube oil refill by mobile means are available and meet connection standards.

3.2 Verify MOV performance (torque switch settings, limit switch settings, opening thrust, etc.) requirements for each MOV.

3.3 Verify manual and check valve operation for all valves.

3.4 Demonstrate that each MSRT division can be operated from its 2 hour battery supply.

3.5 Demonstrate that each diesel driven fire pump starts automatically in response to each appropriate signal.

3.6 Verify that the FWDS feed to EFW (primary to secondary heat transfer~~secondary feed and bleed~~) supplies water to the SG at the rated flow and design conditions.

3.7 Verify alarms, interlocks, indicating instruments, and status lights are functional.

3.8 Verify system baseline performance during hot functional testing (HFT) with SGs pressurized at the design pressure for secondary side feed and bleed cooling injection.

3.9 Check electrical independence and redundancy of power supplies for described functions by selectively removing power and determining loss of function.

3.10 Verify that diesel driven fire pump starts/stops, valve realignments, of the cross-connects occur without introducing water hammer.

Note: It is not necessary to actually connect the portable pump.

3.11 Verify that the two connections for attaching a portable self-powered pump are functional and meet the established standard connection requirements.

4.0 DATA REQUIRED

4.1 Record flows as required to each steam generator and throttle valve position.

4.2 Record alarm, interlocks, and control setpoints.

4.3 Record FWDS header feed to EFW (primary to secondary heat transfer~~secondary feed and bleed~~) normal operating parameters.

4.4 Record pump head versus flow and operating data for single and parallel diesel driven fire pump operation.

4.4.1 Fuel oil consumption.

4.4.2 Lube oil consumption.

4.4.3 Delivered flow.

4.4.4 Delivered head.

4.4.5 Pump speed (rpm).

4.4.6 Available NPSH.

4.5 System operating parameters during hot functional testing (HFT).

4.6 Record pressure transients for system evolutions such as valve closure and pump starts and stops.

4.7 Signal levels necessary to initiate alarm actuation.

4.8 Tank and steam generator levels as a function of time during the test.

5.0 ACCEPTANCE CRITERIA

5.1 The FWDS feed to EFW (primary to secondary heat transfer~~secondary feed and bleed~~) operates as described in Section 19.2.8.

5.1.1 Verify pump performance characteristics for the diesel driven fire pumps meet design requirements.

5.1.2 Verify that each SG division control meets design requirements.

5.1.3 Verify that each MSRT division controls as designed in response to each appropriate signal.

5.1.4 Verify that the system supplies water to the steam generators at the rated flow and design conditions.

5.1.5 Verify alarms, interlocks, indicating instruments, and status lights meet design requirements.

5.2 Verify that components meet electrical independence and redundancy requirements.

5.3 Verify that diesel driven fire pumps do not indicate evidence of water hammer when flow is initiated or terminated.

5.4 Verify that closing of the cross-connect valves during pump operation does not indicate evidence of water hammer.

14.2.12.6.8 Primary Coolant Injection Subsystem (ELAP) (Test #058)

1.0 OBJECTIVE

1.1 To functionally test the operation and performance of the primary coolant injection subsystem in conditions that are representative of actual plant conditions or close enough to allow data to be extrapolated to actual conditions following an ELAP event.

1.2 To observe the core cooling pump response to ~~the normal power supply and~~ the independent diesel generator power supply.

1.3 To observe operation of the flow paths through the cold leg safety injection piping to the reactor vessel, to determine if the system is properly installed and is functional.

1.4 To confirm full flow capability of the primary coolant injection subsystem with minimum and analyzed maximum backpressure.

1.5 To observe operation of the primary coolant injection isolation valves relative to the IRWST water level to validate pump NPSH.

1.6 To record data that is used to validate design basis assumptions or provide a baseline record of system performance for non-safety-related attributes.

1.7 To demonstrate electrical independence and redundancy of power supplies.

1.8 To demonstrate that the primary coolant injection system is capable of preventing pump run out over the range of RCS pressure that the pump is relied upon to provide core cooling.~~To demonstrate the ability of the safety injection accumulators to deliver core cooling makeup water and control the delivery rate by controlling accumulator pressure and accumulator isolation valve position.~~

2.0 PREREQUISITES

2.1 Construction activities on the primary coolant injection subsystem have either been completed or exceptions have been recorded and the impact on system performance has been determined.

2.2 Support systems and instrumentation required for operation of the primary coolant injection subsystem are complete and functional or the impact on system performance has been determined.

2.2.1 ~~Instrumentation includes all normal safety injection accumulator instrumentation and a wide range accumulator level indicator that can be sequenced with the other test instrumentation.~~

2.3 The IRWST is filled with sufficient primary makeup water to conduct testing on the primary coolant injection subsystem.

2.4 In the maximum backpressure test, the RCS is intact and one set of Primary Depressurization System (PDS) valves are open with the

simulated maximum analyzed backpressure.~~The safety injection accumulators have been filled and pressurized to support subsequent testing.~~

2.5 ~~The~~In the minimum backpressure test, the reactor vessel head and internals have been removed and the reactor vessel water level has been lowered below the vessel nozzles (simulates minimum backpressure "run out" conditions).

2.6 Test instrumentation to be used for pump performance has been installed and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

2.7 The primary coolant injection subsystem instrumentation is functional and calibrated and is operating satisfactorily prior to performing the following test.

3.0 TEST METHOD

3.1 Operate system valves while:

3.1.1 Observing each valve operation and position indication.

3.1.2 Measuring MOV valve performance data (e.g., thrust, opening and closing times, and ability to control injection flow).

3.2 Observe operation of power-operated valves upon loss of motive power.

3.3 Start the primary coolant injection pump and collect initial pump operating data:

3.3.1 The primary coolant injection pump shall be aligned to discharge to the depressurized RCS (vessel level maintained below the vessel nozzles).

3.3.2 The primary coolant injection isolation valve throttled and calibrated instrumentation installed to compare pump flow and discharge pressure to the pump manufacturer head-flow curve.

3.3.3 Perform critical (full flow) sections of the test using ~~the normal power supply to the bus and then using~~ the pre-staged ELAP diesel generator power source.

3.3.4 Collect valve data on valves that reposition to perform an accident mitigation function under maximum differential pressure conditions.

3.3.5 Measure suction supply (NPSH) to the primary coolant injection pump from the IRWST using the suction header under maximum flow conditions, minimum IRWST level, and minimum vessel level.

3.3.6 Compare the measured suction head to the primary coolant injection pump manufacturer NPSH requirements when corrected for IRWST minimum level attainable during

maximum IRWST fluid temperature. (Note: it is acceptable to correct available data if design conditions cannot be duplicated).

3.4 Check electrical independence and redundancy of power supplies for subsystem functions by selectively removing power and determining loss of function.

3.5 Test the primary coolant injection pump delivery rate to depressurized reactor coolant system as follows:~~Test the safety injection accumulator delivery rate to depressurized reactor coolant system as follows:~~

3.5.1 Verify that the primary coolant pump injects water to the RCS at greater than the required minimum flow.~~Establish the overpressure in one or more accumulators at 65 psig while maintaining the water level within the normal technical specification required level.~~

3.5.2 Verify that the primary coolant pump discharge throttle valve prevents excessive flow to a depressurized RCS.~~Open the accumulator isolation valve to 15% open and record accumulator parameters as a function of time until the conditions are stable.~~

- Verify that the discharge throttle valve provides relatively constant flow to a depressurized RCS such that long term operation is assured.

3.5.3 Verify that the primary coolant pump injects water to the RCS at greater than the required minimum flow when the RCS is pressurized to the maximum analyzed pressure for pump operation.~~Repeat the 65 psig test as necessary to resolve discrepancies and to verify that the process is repeatable. To produce the required design flow rate, throttle the accumulator isolation valve as necessary to maintain the flow rate within the design limits.~~

3.5.4 Verify that the primary coolant injection pump discharge throttle valve does not adversely impact operation when RCS pressure is at the upper range of primary coolant pump operation.~~Determine a safety injection accumulator isolation target valve position that is partially open that will provide significant system resistance.~~

3.5.5 Repeat the test as necessary to resolve discrepancies and to verify that the process is repeatable.~~Establish the overpressure in one or more accumulators at 50 psig while maintaining the water level within the normal technical specification required level.~~

3.5.6 ~~Open the accumulator isolation valve to the previously established target position and record accumulator parameters as a function of time until the conditions are stable. To produce the required design flow rate, throttle the~~

accumulator isolation valve as necessary to maintain the flow rate within the design limits.

3.5.7 Repeat the 50 psig test as necessary to resolve discrepancies and to verify that the process is repeatable.

3.5.8 Establish the overpressure in one or more accumulators at 40 psig while maintaining the water level within the normal technical specification required level.

3.5.9 Open the accumulator isolation valve to the previously established throttle position and record accumulator parameters as a function of time until the conditions are stable.

3.5.10 Repeat the 40 psig test as necessary to resolve discrepancies and to verify that the process is repeatable. To produce the required design flow rate, throttle as necessary to maintain the flow rate within the design limits.

3.5.11 Establish the overpressure in one or more accumulators at 30 psig while maintaining the water level within the normal technical specification required level.

3.5.12 Open the accumulator isolation valve to the previously established target position and record accumulator parameters as a function of time until the conditions are stable.

3.5.13 Repeat the 30 psig test as necessary to resolve discrepancies and to verify that the process is repeatable.

3.5.14 Establish a new target valve position and target accumulator pressure to produce the required design flow rate.

3.5.15 Establish the overpressure in one or more accumulators at the target pressure while maintaining the water level within the normal technical specification required level.

3.5.16 Open the accumulator isolation valve to the new target valve position and record accumulator parameters as a function of time until the conditions are stable.

3.5.17 Repeat the test as necessary to resolve discrepancies and to verify that the process is repeatable.

4.0 DATA REQUIRED

4.1 Valve position and position indication.

4.2 Position response of valves to loss of motive power.

4.3 Valve performance data, where required.

4.4 Primary coolant injection pump initial functional data including the following:

4.4.1 Pump head versus flow.

4.4.2 Pump suction pressure.

4.4.3 Pumped fluid temperature.

4.4.4 Reactor vessel level.

4.4.5 IRWST level.

4.4.6 ~~Normal power supply to the bus and then using the pre-staged~~ ELAP diesel generator power source.

4.5 Response of the primary coolant injection subsystem when powered by ~~normal power supply to the bus and then using~~ the pre-staged ELAP diesel generator power source:

4.5.1 Motor current.

4.5.2 Bus voltage.

4.5.3 Time from start signal to rated flow.

4.5.4 Flow delivered to the RCS.

4.6 ~~Safety Injection Accumulator performance data for each test pressure as a function of time.~~

4.6.1 ~~Accumulator pressure.~~

4.6.2 ~~Accumulator isolation valve position.~~

4.6.3 ~~Accumulator wide range level.~~

4.6.4 ~~Flow delivered to the RCS.~~

5.0 ACCEPTANCE CRITERIA

5.1 The primary coolant injection subsystem meets design requirements:

5.1.1 Verify that the alarms and interlocks function as designed.

5.1.2 Verify that the system controls function as designed.

5.1.3 Verify that the primary coolant injection pump flow and developed head meet design requirements.

5.1.4 Verify that the primary coolant injection pump NPSH meets design requirements.

5.1.5 Verify that valve performance meets design requirements.

5.1.6 Verify that the primary coolant injection flow rate meets minimum/maximum design limitations in the full analyzed RCS pressure range.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

5.3 Verify that the primary coolant injection subsystem does not indicate evidence of water hammer when flow is initiated or terminated.

5.4 ~~Verify that the Safety Injection Accumulator delivers makeup flow to the depressurized RCS in a predictable manner for multiple accumulator over pressure values and that the final overpressure and throttling settings meet the minimum acceptance standards for accumulator delivery.~~

1.2 To demonstrate electrical independence and redundancy of power supplies.

1.3 Demonstrate containment purge system response to protection system (PS) signals.

1.4 To verify that radiation monitors respond as designed to check sources.

1.5 To verify that radiation monitors initiate automatic control functions upon detecting high activity levels.

1.6 To verify that the response time from when radiation monitors detect a high radiation condition until each actuated component travels to the required position meets design requirements.

1.7 ~~Verify that the containment purge path can be realigned to the required ELAP event containment exhaust alignment during a simulated compressed air failure.~~

2.0 PREREQUISITES

2.1 Construction activities in the containment have been completed and acceptable levels of cleanliness established.

2.2 Construction activities on the containment purge systems have been completed.

2.3 Containment purge system instrumentation, including radiation monitors, has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the containment purge systems are complete and functional.

2.5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Demonstrate manual and automatic system controls.

3.2 Verify alarms, indicating instruments and status lights are functional.

3.3 Verify design air flows for high purge, low purge.

3.4 Perform HEPA filters and carbon adsorber efficiency tests.

3.5 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.6 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 9.4.7).

3.7 Simulate the following and observe isolation valve response:

3.7.1 CIAS.

3.7.2 High radiation actuation signal.

3.8 Verify that operation of containment purge system radiation monitors meets design requirements (refer to Table 11.5-1, Monitor R-7 through R-9).

3.9 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.10 Verify that the containment purge system functions as designed.

Note: Response time of actuated components is to be determined from a single test.

3.11 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Points R-7 through R-9) and external test equipment, as necessary:

3.11.1 Check the self-testing features of radiation monitors.

3.11.2 Record the response of radiation monitors to check sources.

3.11.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.11.4 Record alarm actuations at local and remote locations, as appropriate.

3.11.5 Initiate a high radiation signal to emergency push button to measure the response time for each actuated component from the time until the actuated component has traveled to the designated position.

3.12 Confirm that Automatic Control Function (refer to Table 11.5-1, Radiation Measuring Point R-9) initiate upon actuation of emergency push button.

3.13 Verify that sample points (refer to Table 11.5-1, Radiation Measuring Points R-7 through R-8) are capable of collecting representative samples.

3.14 ~~Verify that the normal filtered purge path can be isolated and the ELAP containment exhaust bypass path can be aligned to the plant vent stack.~~

3.15 ~~Verify that the ELAP containment purge can be aligned during a simulated failure of the compressed air system.~~

3.15.1 ~~Verify that the normal compressed air source has been isolated from the containment purge valves.~~

3.15.2 ~~Align the ELAP compressed air source to the containment low-flow purge valves.~~

3.15.3 ~~Verify that the ELAP compressed air source can realign the normal containment purge valves, as applicable.~~

3.15.4 ~~Verify that the ELAP power supply can realign the ELAP containment bypass path valves, as applicable.~~

to Table 11.5-1, Radiation Measuring Points R-7 through R-9). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.4.1 Range.

5.4.2 Response time.

5.4.3 Sensitivity.

5.5 Radiation monitoring instrumentation meets design requirements to monitor radiation (refer to Table 11.5-1, Radiation Measuring Point R-9).

5.5.1 The response time from actuation of the emergency push button until each actuated component has reached the required position meets the design requirement.

5.6 Radiation sample points (refer to Table 11.5-1, Radiation Measuring Points R-7 through R-8) are capable of collecting the required samples.

5.7 ~~The normal purge path can be isolated and the ELAP bypass containment exhaust path can be aligned as designed.~~

14.2.12.8.5 Annulus Ventilation System (Test #077)

1.0 OBJECTIVE

1.1 To demonstrate the capability of the annulus ventilation system (AVS) to produce and maintain a negative pressure in the annulus following a loss of coolant accident (LOCA).

1.2 To minimize the release of radioisotopes following a LOCA by filtering annulus air prior to discharge to the vent stack.

1.3 To demonstrate electrical independence and redundancy of power supplies.

1.4 To verify that radiation monitors respond as designed to check sources.

1.5 To verify that the radiation sample point provides a representative sample of the AVS.

2.0 PREREQUISITES

2.1 Construction activities on the containment wall and shield wall are complete with penetrations sealed in place.

2.2 Construction activities on the AVS have been completed.

2.3 AVS instrumentation, including radiation monitors, has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the AVS are complete and functional.

2.5 Test instrumentation is available and calibrated.

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 4 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
053	Primary to Secondary Heat Transfer~~Secondary Feed and Bleed~~ (ELAP)	FSAR		NRC Order EA-12-049
054	Fire Water Distribution System	FSAR	Appendix A, 1.n.(7)	
055	Spray Deluge System	FSAR	Appendix A, 1.n.(7)	
056	Sprinkler System	FSAR	Appendix A, 1.n.(7)	
057	Gaseous Fire Extinguishing System	FSAR	Appendix A, 1.n.(7)	
058	Primary Coolant Injection Subsystem (ELAP)	FSAR		NRC Order EA-12-049
059	Feedwater System	FSAR	Appendix A, 1.e.(9)	
060	Feedwater Heating System	FSAR	Appendix A, 1.e.(10)	
061	Main Steam – Turbine Bypass Systems	FSAR	Appendix A, 1.e.(2) & 5.t	
062	Main Steam Safety Valve	FSAR	Appendix A, 1.d.(1), 1.e.(4), & 5.t	
063	Main Steam Isolation Valves and MSIV Bypass Valves	FSAR	Appendix A, 1.d.(7), 1.e.(3), & 5.u	
064	Turbine Gland Sealing System	FSAR	Appendix A, 1.e.(5)	
065	Main Condenser and Main Condenser Evacuation System	FSAR	Appendix A, 1.e.(7)	
066	Condensate System	FSAR	Appendix A, 1.e.(8)	
067	Steam Generator Blowdown System	FSAR	Appendix A, 1.e.(1)	
068	Steam Turbine	FSAR	Appendix A, 1.e.(6) & 5.t	

16. NEI 05-01 (Rev A), "Severe Accident Mitigation Alternatives (SAMA) Analysis, Guidance Document," Nuclear Energy Institute, November 2005.

17. NUREG/BR-0184, "Regulatory Analysis Technical Evaluation Handbook," U.S, Nuclear Regulatory Commission, January 1997.

18. NEI 07-13, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs," Revision 8, April 2011.

19. Letter from D. Matthews, NRC to R. Ford, AREVA NP, "Approval of AREVA NP Inc. Safeguards Protection Program and Reviewing Official, and Transmittal of Beyond Design Basis, Large Commercial Aircraft Characteristics Specified by the Commission", December 21, 2007.

20. Deleted.

21. Achenbach, J.A., Miller, R.B., Srinivas, V., "Large-Scale Hydrogen Burn Equipment Experiments," EPRI NP-4354, Electric Power Research Institute, 1985.

22. NUREG/CR-5334, "Severe Accident Testing of Electrical Penetration Assemblies," SAND89-0327, November 1989.

23. ANP-10314, Revision 0, "The Operating Strategies for Severe Accidents Methodology for the U.S. EPR Technical Report," AREVA NP Inc., July 2010.

24. ANP-10317, Revision 3, "Design Requirements for the U.S. EPR Aircraft Hazard Protection Structures," AREVA NP Inc., July 2013.

25. ANP-10295P, Revision 4, "U.S. EPR Security Design Features Technical Report," AREVA NP Inc., April 2013.

26. ANP-10296, Revision 2, "U.S. EPR Design Features that Enhance Security," AREVA NP Inc., June 2013.

27. ANP-10329, Revision 1~~0~~, "U.S. EPR Mitigation Strategies for an Extended Loss of AC Power Event Technical Report," AREVA ~~NP~~ Inc., November 2014~~May 2013~~.

28. Regulatory Guide 1.126, "Containment Structural Integrity Evaluation for Internal Pressure Loadings Above Design Basis Pressure," August 2010.

29. Regulatory Guide 1.155, "Station Blackout," August 1988.

Table 19.2-6—COL Applicant Responsibilities for ELAP Event Mitigation
Sheet 1 of 3

ANP-10329 Section Number	COL Responsibility	
4.1.1	The COL applicant shall establish Phase 2 and 3 ELAP event mitigation strategies.	
4.1.4	The COL applicant shall provide reasonable protection for portable equipment utilized in ELAP event mitigation.	
4.1.5.1 Table 4-19~~0~~	The COL applicant shall provide three 480 Vac portable generators. The portable generator connected to Division 1 shall be at least 550 kW, the generators connected to Divisions 2 and 4 shall each be at least 350 kW ~~If one portable ELAP diesel generator is used to repower Divisions 1 and 2, the required output shall be at least 650 kW. If Divisions 1 and 2 are powered by separate portable generators, the required output for each shall be at least 350 kW. Output voltage shall be 480 Vac.~~	RAIs 563 598 624
~~4.1.5.2~~	~~The COL applicant shall evaluate the risk associated with a beyond design basis external event occurring during plant shutdown states when the steam generators are not available for heat removal and the reactor vessel head is not removed.~~	RAIs 563, 624
4.1.5.2.2~~1~~ Table 4-19~~0~~	The COL applicant shall provide a portable self-powered SG feed pump and hoses required to connect the portable pump to the fire water distribution system. The portable SG feed pump is capable of providing a minimum of 150 gpm to each of the four SGs (600 gpm total) with a maximum SG pressure of 100 psia.~~The Pump shall be sized for a flow rate of 660 gpm (330 gpm to each of two SGs). Required head increase across the pump shall be 483 ft at 660 gpm.~~	RAIs 563 623, 624
~~4.1.5.2.1~~ ~~Table 4-10~~	~~The COL applicant shall provide a portable self-powered RCS makeup pump, a portable source of borated water, and hoses required to connect the portable pump to the suction source and to the EBS discharge piping. The pump shall be sized for a flow rate of 50 gpm with a head increase across the pump of 1242 ft. The pump discharge pressure under these conditions shall be greater than 548.4 psia.~~	RAIs 563 624
4.1.5.3.~~1~~	The COL Applicant shall administratively control the Primary Coolant Injection Pump discharge MOV 30JND11 AA012 closed and de-energized while the plant is operated in Modes 1-4.	RAI 563
~~4.1.5.4.1~~ ~~Table 4-10~~	~~The COL applicant shall provide a portable air compressor or pressurized gas bottles to supply air to both low flow purge containment isolation valves. The portable air supply must be capable of supplying air at a pressure between 58.8 psig and 147 psig. A volume of 1.24 ft^3 is required to open both of the low flow purge containment isolation valves.~~	RAIs 563 598
~~4.1.5.4.2~~ ~~Table 4-10~~	~~The COL applicant shall provide a portable, self-powered pump and borated water supply for containment spray. The pump shall be sized for a flow rate of 700 gpm with a head increase across the pump of 447.4 ft. The pump discharge pressure under these conditions shall be greater than 209 psia.~~	RAIs 563 598, 623

Table 19.2-6—COL Applicant Responsibilities for ELAP Event Mitigation
Sheet 2 of 3

ANP-10329 Section Number	COL Responsibility
4.1.5.4.1 Table 4-19	The COL applicant shall provide a pressurized demineralized water source to the seal water supply system buffer tank for makeup to the SAHRS pump mechanical seal after 250 days. The demineralized water source must be greater than 102 psig and greater than 0.0001 gpm.
4.1.5.4.1 Table 4-19	The COL applicant shall provide portable cooling water at a nominal flow rate of 2218 gpm to the dedicated component cooling water piping to provide cooling to the SAHRS heat exchangers and to the SAHRS pump bearing, seal water, and motor coolers.
4.1.5.5 Table 4-19~~0~~	The COL applicant shall provide a portable, self-powered pump and water supply for spent fuel pool makeup. The pump shall be sized for a minimum flow rate of ~~500~~140 gpm with a discharge head of 130 ft.
4.1.5.7.3 Table 4-1~~0~~9	The COL applicant shall provide a portable cooler (air conditioner) to cool the Main Control Room to maintain MCR habitability. The portable cooler (air conditioner) shall be sized to provide a minimum of 32,000 BTUs/hr of cooling to MCR. The COL applicant shall provide portable ductwork to exhaust air from the portable cooler to Safeguard Building 3.
4.1.5.7.3 Table 4-19	The COL applicant shall provide a portable cooler (air conditioner) to cool Safeguard Building 4 switchgear room 4UJK18026 and maintain equipment functionality. The portable cooler (air conditioner) shall be sized to provide a minimum of 31,000 BTUs/hr of cooling to the switchgear room. The COL applicant shall provide portable ductwork to exhaust air from the portable cooler to north stairwell elevation + 27' (Room 4UJH01020).
4.1.5.7.3	The COL applicant shall provide a Fire Protection Building HVAC system to ventilate the Fire Protection Building during Phase 1, 2, and 3 ELAP event mitigation.

RAIs 563 598, 623

RAIs 563, 623

RAIs 563 598

Table 19.2-6—COL Applicant Responsibilities for ELAP Event Mitigation
Sheet 3 of 3

ANP-10329 Section Number	COL Responsibility	
Table 4-17 Table 4-18~~Table 4-8 and Table 4-9~~	The COL applicant shall provide a means of tank replenishment that is capable of filling the ELAP diesel generator fuel oil storage tank within 8 hours after start of the ELAP DG~~10 hours for events initiated in Modes 1 through 6~~.	RAIs 563 598, 624
	The COL applicant shall provide a means of fire water storage tank replenishment or alternate feed supply that is capable of being placed in service within 16 hours 53 minutes~~17 hours~~ for events initiated in Modes 1 through 5.	RAIs 563, 598
	~~The COL applicant shall provide a portable RCS makeup pump and borated water supply capable of being placed in service within 24 hours for events initiated in Modes 1 through 5.~~	RAIs 563 598 624
	The COL applicant shall provide a means of tank replenishment that is capable of filling the diesel driven fire water pump fuel oil storage tank within 3.5 days for events initiated in Modes 1 through 5 with steam generators available.	
	~~The COL applicant shall provide a portable containment spray pump capable of a containment spray flow of at least 88.2 lbm/sec and a borated water supply capable of being placed in service within 24 hours for events initiated in Modes 1 through 6.~~	
	The COL applicant shall provide portable generators within 2.9 hours for ELAP events initiated in Modes 1-5 with the steam generators available and within 1 hour in Modes 5 and 6 when steam generators are unavailable.~~The COL applicant shall provide a portable diesel generator within 2 hours for events initiated in Modes 1 through 6.~~	
	The COL applicant shall provide a portable cooler for the MCR within 7 hours for events initiated in Modes 1 through 6.	
	The COL applicant shall provide a portable cooler for SB 4 switchgear room 4UJK18026 within 16 hours and 40 minutes if the 480V portable generator is used to repower the SAHRS pump for events initiated in Modes 5 and 6 when SGs are unavailable or 36 hours for events initiated in Modes 1 through 5 with steam generators available.	RAI 563
	The COL applicant shall provide portable cooling water to the SAHRS heat exchangers and to the SAHRS pump bearing, seal water, and motor cooler within 16 hours and 40 minutes for events initiated in Modes 5 and 6 when steam generators are unavailable or 36 hours for events initiated in Modes 1 through 5 with steam generators available.	
	The COL applicant shall provide a pressurized demineralized water source for makeup to the SAHRS pump mechanical seal within 250 days for events initiated in Modes 1 through 6.	
	The COL applicant shall provide a means of supplying makeup water to the spent fuel pool within 15.5 hours~~22 hours~~ for events initiated in Modes 1 through 6.	RAIs 563, 598