AP1000 CONTAINMENT VESSEL EXTERNAL PRESSURE ANALYSIS AND DESIGN

NRC REVIEW PACKAGE

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1.0 BACKGROUND

DCD 6.2.1.1.4, External Pressure Analysis, describes the requirement for operator action to mitigate the consequences of an event causing a vacuum to be developed inside containment. Evaluations have been performed that indicates a pressure reduction will be realized inside containment following low ambient temperature (-40 F) coincident with a loss of AC power. DCD 6.2.1.1.4 credits opening of the 16" vent and purge lines to mitigate the pressure reduction prior to reaching the containment shell design external pressure (0.9 psig).

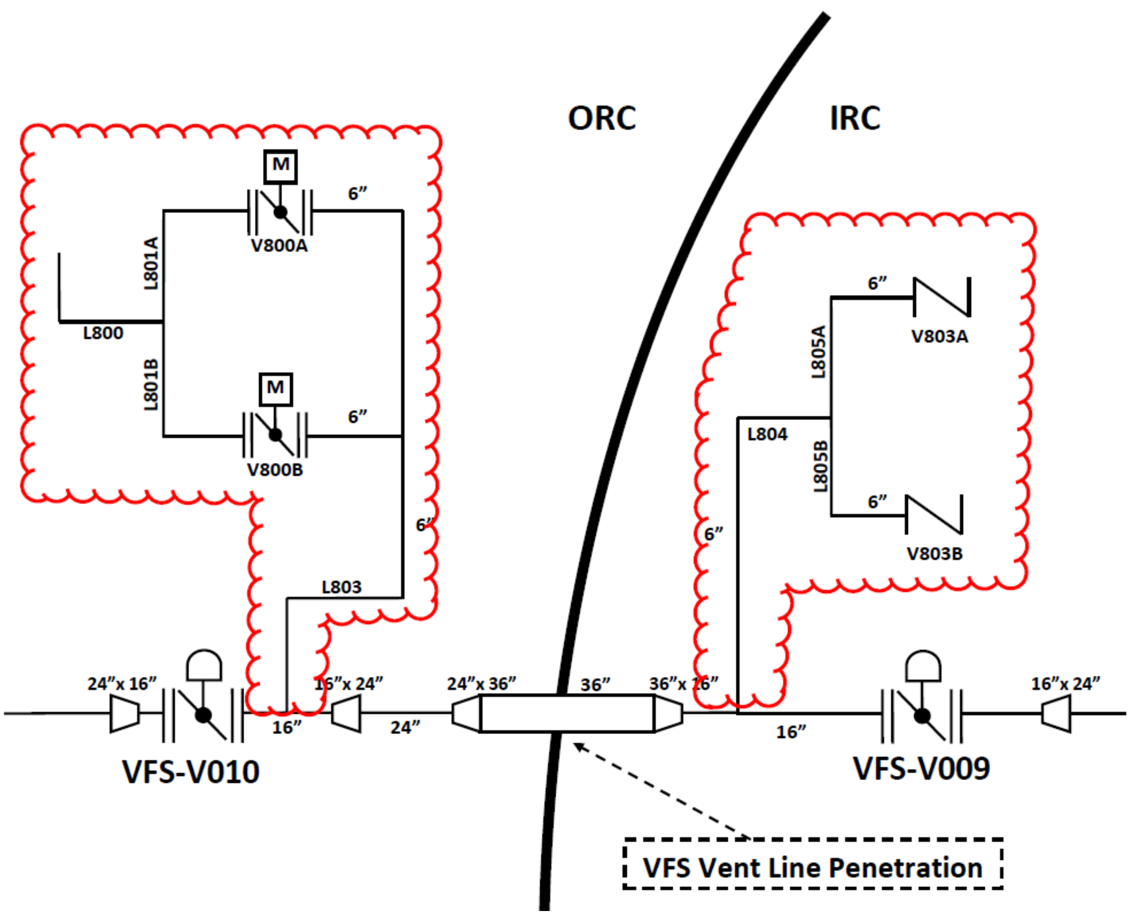
The DCD is misleading in that it states that the vent and purge valves are powered from the 1E batteries. The valves are not powered from the 1E batteries. The valves are air operated valves such that loss of AC or pneumatic supply will cause the valves to close on spring force. Without AC power or pneumatic supply, the valves cannot be reopened.

2.0 PROPOSED CHANGES

The proposed vacuum relief system consists of two vacuum relief lines sized to prevent differential pressure between containment and the shield building from exceeding the design value of 1.5 psid.
Each relief line consists of a check valve inside containment (V803A/B) and motor operated butterfly valve (V800A/B) outside of containment. Each butterfly valve operator is powered from separate IE DC battery sources. The check valves are balanced to open at 0.5 psi differential but will not open until the butterfly valves open.

The proposed change adds a Vacuum Relief System to the existing Containment Air Filtration System (VFS) vent line penetration as seen in the sketch below. The vent line was selected to provide enough flow area as well as the fact that in normal Purge and Vent operation the vent line will be under a slight negative pressure (vacuum system check valves will tend to close) and not short cycle the normal containment air flow when the Purge/Vent system is in operation.

FIGURE 1: PROPOSED VACUUM RELIEF SYSTEM SKETCH



Section 3.0 provides a detailed description of each DCD change required to implement this proposed design change.

Attachments 1-36 provide the actual DCD markups necessary to implement this proposed change.

3.0 PROPOSED DCD CHANGES AND JUSTIFICATION TABLE

Att.	DCD	Title	Reason for Change
Tier 1			
1	Table 2.2.1-1	Containment System	Valves VFS-V800A/B and VFS-V803A/B have been added to the Containment System equipment table. The valves are indicated with active functions to Transfer Closed and Transfer Open.
2	Figure 2.2.1-1	Containment System	The proposed vacuum relief system has been added to the Containment System figure on the vent line penetration (Penetration #32). In addition the piping upstream of VFS-V009.
3	Table 2.2.1-2	Containment System Piping	Line numbers L800, L801A/B, L803, L804, and L805A/B have been added to the Containment System safety related line number list.
4	Text 2.7.6	Containment Air Filtration System	The proposed Vacuum Relief System safety function was added to the Containment Air Filtration System Safety Function description.
5	Table 2.7.6-2	Inspections, Tests, Analyses, and Associated Criteria (ITAAC) Table for the VFS	The proposed Vacuum Relief System safety function was added to the Containment Air Filtration System ITAAC Table description.
Tier 2			
6	Table 3.2-3	AP1000 Classification of Mechnical and Fluid Systems, Components, and Equipment	Valves VFS-V800A/B and VFS-V803A/B have been added to the table as Class B, Seismic Category I, and ASME Section III Class 2 Construction Code.
7	Table 3.7.3-1	Seismic Cateogry I Equipment Outside Containment by Room Number	The VFS vacuum relief motor operated valves (VFS-V800A/B) are Seismic Category I and will be located outside containment in the VAS Equipment Room (Room # 12651).
8	Text 3.8.2.1.1	General	The CV Design External Pressure is defined as 1.5 psid based upon the actuation point of the containment vacuum relief system
9	Text 3.8.2.4.1.1	Axisymmetric Shell Analyses	Transient analysis no longer determines the design external pressure of the CV, therefore this section is revised to remove references to analysis that defined external pressure.
10	Table 3.8.2-1	Load Combinations and Service Limits for Containment Vessel	The CV load combinations table is updated based upon the new single design external pressure.
11	Table 3.9-12	List of ASME Class 1, 2, and 3 Active Valves	Valves VFS-V800A/B and VFS-V803A/B have been added to the Active Valve List since they have an active ESF function.
12	Table 3.9-16	Valve Inservice Test Requirements	Valves VFS-V800A/B and VFS-V803A/B have been added to the Inservice Testing Requirements Table. Valves VFS-V800A/B are categorized as A, with Active Safety Missions. Valves V800A/B will be full stroke exercised, remote position indication tested and receive a leakage rate test. Valves VFS-V803A/B are categorized as AC with Active Safety Missions. Valves V803A/B will be full stroke exercised and receive a leakage rate test. All of the requirements of the ASME OM Code have been addressed.

3.0 PROPOSED DCD CHANGES AND JUSTIFICATION TABLE (CONTINUED)

13	Table 3.11-1	Environmentally Qualified Electrical and Mechnical Equipment	Valves VFS-V800A/B and their respective motors and limit switches have been added to the table with the ESF/PAMS functions and required Operating Times. Valves VFS-V803A/B have been added to the table with and ESF Function and required Operating Times.
14	Table 3I.6-2	List of Potential High Frequency Sensitive AP1000 Safety-Related Electrical and Electro-Mechnical Equipment	The motor operators for valves VFS-V800A/B have been added to the table as potential high frequency sensitive safety related components.
15	Table 3I.6-3	List of AP1000 Safety-Related Electrical and Mechanical Equipment Not High Frequency Sensitive	Valves VFS-V800A/B and VFS-V803A/B have been added to the table as not potential high frequency sensitive safety related components.
16	Table 6.2.3-1	Containment Mechnical Penetrations and Isolation Valves	Since the proposed vacuum relief system valves are included as part of the containment air filtration vent line, valves VFS-V800A/B and VFS-V803A/B have been added to the table with the following actuation signals: Closes on Containment Isolation, High Radiation, High-2 Containment Pressure and Opens on Low-2 Containment Pressure.
17	Text 6.2.1.1.4/ Figure 6.2.1.1.-11/ Table 6.2.1.1-9	External Pressure Analysis	This text defines the containment pressure transient that forms the basis for sizing the vacuum relief system. Previously, this text had been incorrect as it credited IE batteries to open the containment ventilation purge isolation valves to mitigate a low containment pressure event. The text has been changed to reflect the revised analysis inputs, assumptions and containment pressure transient response. Using the results of this analysis, the vacuum relief system was sized to mitigate containment internal pressure from dropping below -1.5 psig.
			Figure 6.2.1.1-11 has been revised to reflect the new containment pressure transient analysis.
			New table 6.2.1.1-9 was added to list key parameters and assumptions used in the transient analysis.
18	Figure 7.2-1 (Sheet 13 of 20)	AP1000 Functional Diagram Containment and Other Protection	This figure has been updated to identify the signals for actuating the containment vacuum relief isolation valves. The following signals will OPEN the Containment Isolation Relief valves: a 2oo4 "Low-2 Containment Pressure", or one of two manual actuation controls. The following signals will CLOSE the Containment Isolation Relief valves: Safeguards (S) Actuation signal, High-1 Containment Radiation signal, or one-of-two manual actuation controls.

19	Table 7.3-1	Engineered Safety Features Actuation Signals	This table lists the actuation signals for safety related features. The containment vacuum relief system has been added to this table. Item 27 of this table lists the Containment Vacuum Relief signals. These signals are Low-2 Containment Pressure or Manual Initiation. No permissives or interlocks are required for any of these signals.
20	Text 7.3.1	Engineered Safety Features Description	This text has been updated to include Section 6.2 as a section that analyzes design basis events. The particular DCD paragraph is 6.2.1.1.4. DCD Chapter 15 contains the analyses of design basis events. Section 6.2 contains the analyses of the Containment only.
21	Text 7.3.1.2.25	Containment Vacuum Relief	DCD Section 7.3 describes the Engineered Safety Features. These features include "...providing containment integrity." The text of paragraph 7.3.1.2.25 describes the containment vacuum relief isolation actuation signal. It also gives a brief explanation of the high radiation, the high 2 containment pressure, and the manual initiation signals. This section has been added to explain the additions to Table 7.3-1.
22	Text 7.3.1.5.5	Design Basis: Engineered Safety Features for Malfunctions, Accidents, Natural Phenomena, or Credible Events	This text has been updated to include Section 6.2 as a section that analyzes design basis events. The particular DCD paragraph is 6.2.1.1.4. DCD Chapter 15 contains the analyses of design basis events. Section 6.2 contains the analyses of the Containment only.
23	Table 7.3-3	System-Level Manual Input to the Engineered Safety Features Actuation System	The manual Containment Vacuum Relief Actuation Signals have been added to this table. Two PMS Divisions are used: A and C. The use of two separate divisions provides reliability against a single channel failure.
24	Table 7.5-1	Post-Accident Monitoring System	The proposed containment vacuum relief motor operated valves have been included in the Post-Accident Monitoring System table with Open/Closed status requirements. The variable is considered D2. The valves are located outside containment (Mild Environment) and are seismically qualified. In addition as the table indicated each valve will have remote position switches and be supplied with 1E power.
25	Text 9.4.7.1.1	Containment Air Filtration System Safety Design Basis	A functional description of the proposed vacuum relief system and the safety related basis of the proposed vacuum relief system has been added to the Containment Air Filtration System Safety Design Basis description.

3.0 PROPOSED DCD CHANGES AND JUSTIFICATION TABLE (CONTINUED)

26	Text 9.4.7.2.1	Containment Air Filtration System General Description	A general description of the proposed vacuum relief system has been added to the Containment Air Filtration System General Description.
27	Text 9.4.7.2.2	Containment Air Filtration System Component Description	A description of the valve types and locations for the proposed vacuum relief system. Motor operated butterfly valves outside containment and self actuated swing check valves inside containment have been added to the Containment Air Filtration System Safety Evaluation.
28	Text 9.4.7.3	Containment Air Filtration System Safety Evaluation	A description of the proposed vacuum relief system piping and valves has been added to the Containment Air Filtration System Safety Evaluation to describe the independent/redundant vacuum relief lines. A statement was also added describing that the independent and redundant lines share a common containment penetration.
29	Figure 9.4.7-1	Containment Air Filtration System Piping and Instrumentation Diagram	This DCD figure has been revised to include the proposed vacuum relief system.
30	Table 9A-2	Safe Shutdown Components	The motor operated valves (VFS-V800A/B) included in the proposed vacuum relief system are located in Fire Area/Fire Zone 1200 AF 01. Valve VFS-V800A is powered from Division A and valve VFS-V800B is powered from Division C.
31	Tech Spec 3.3.2	ESFAS Actuation Instrumentation	The addition of a vacuum relief subsystem provides design basis protection during a containment overcooling condition to protect the containment vessel integrity. Therefore, a TS is required to identify the OPERABILITY requirements for the accident mitigation functions for this subsystem. Since this system is automatically actuated, TS 3.3.2 requires identifying the actuation signals and their set points.
32	Tech Spec B 3.3.2	ESFAS Actuation Instrumentation	Bases are required for each TS.
33	Tech Spec B 3.6.4	Containment Pressure Bases	In resolving an inconsistency between the VFS design in DCD Chapter 9 and the overcooling transient response in DCD Section 6.2.1.1.4, a vacuum relief system was required to be added to provide the mitigation capability described in DCD 6.2.1.1.4.
34	Tech Spec 3.6.10	Vacuum Relief Valves	The addition of a vacuum relief subsystem provides design basis protection during a containment overcooling condition to protect the containment vessel integrity. Therefore, a TS is required to identify the OPERABILITY requirements for the accident mitigation functions for this subsystem.
35	Tech Spec B 3.6.10	Vacuum Relief Valves Bases	Bases are required for each TS.
36	Table 18.12.2-1	Minimum Inventory of Fixed Position Controls Displays, and Alerts	The addition of the vacuum relief actuation to the remote shutdown work station is required since vacuum relief may be necessary at any operating condition.

4.0 NECESSARY DCD CHANGES

ATTACHMENT 1

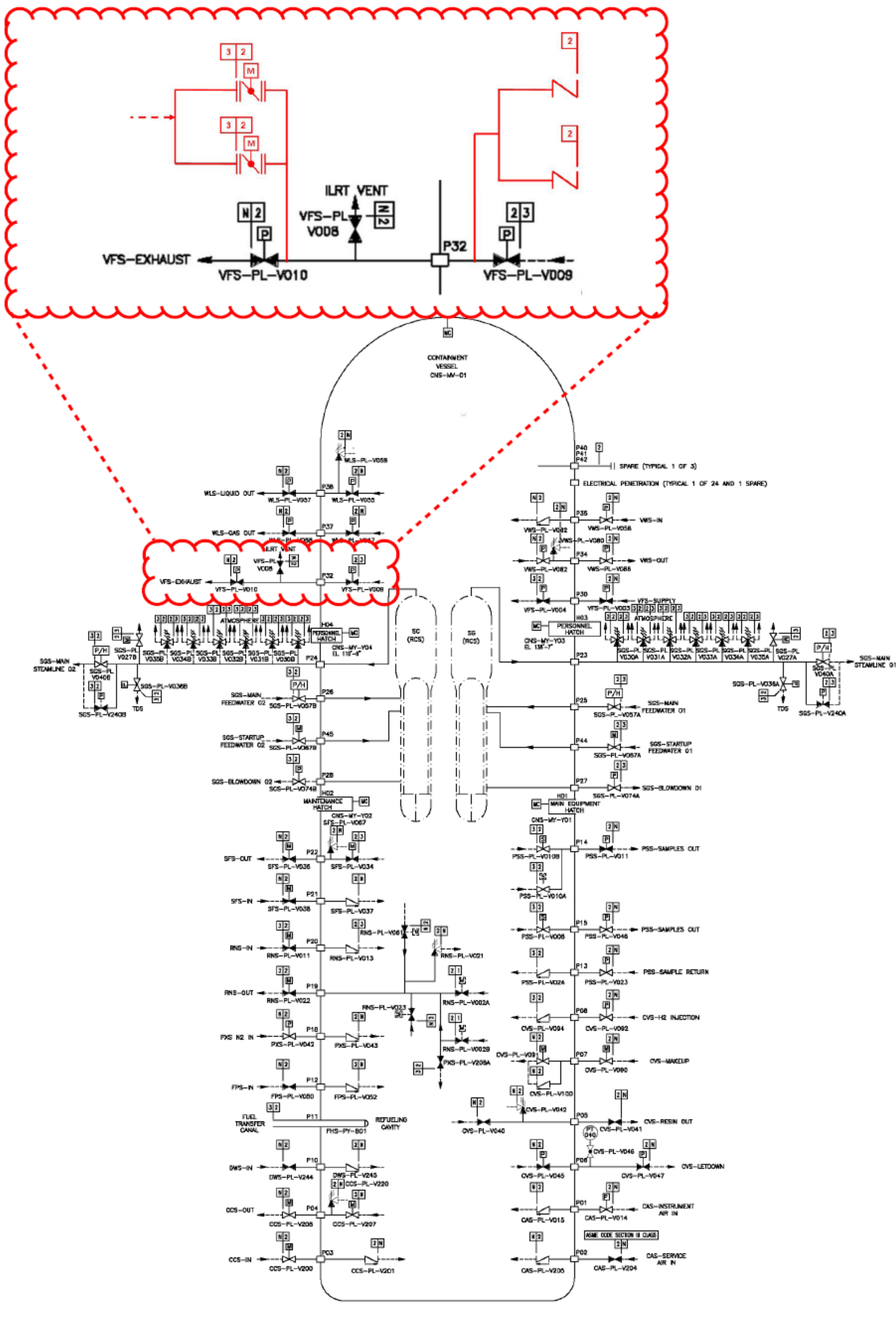
Tier 1 Table 2.2.1-1	Containment System

Table 2.2.1-1 (cont.)

Equipment Name	Tag No.	ASME Code Section III	Seismic Cat. I	Remotely Operated Valve	Class 1E/ Qual. for Harsh Envir.	Safety-Related Display	Control PMS/DAS	Active Function	Loss of Motive Power Position
Integrated Leak Rate Testing Vent Discharge Containment Isolation Valve – ORC	VFS-PL-V008	Yes	Yes	No	-/-	No	-/-	None	-
Containment Purge Discharge Containment Isolation Valve – IRC	VFS-PL-V009	Yes	Yes	Yes	Yes/Yes	Yes (Valve Position)	Yes/Yes	Transfer Closed	Closed
Containment Purge Discharge Containment Isolation Valve – ORC	VFS-PL-V010	Yes	Yes	Yes	Yes/No	Yes (Valve Position)	Yes/Yes	Transfer Closed	Closed
Vacuum Relief Containment Isolation A - ORC	VFS-PL-V800A	Yes	Yes	Yes	Yes/No	Yes (Valve Position)	Yes/No	Transfer Closed/ Transfer Open	As Is
Vacuum Relief Containment Isolation B - ORC	VFS-PL-V800B	Yes	Yes	Yes	Yes/No	Yes (Valve Position)	Yes/No	Transfer Closed/ Transfer Open	As Is
Vacuum Relief Containment Isolation Check Valve A - IRC	VFS-PL-V803A	Yes	Yes	No	-/-	No	-/-	Transfer Closed/ Transfer Open	-
Vacuum Relief Containment Isolation Check Valve B - IRC	VFS-PL-V803B	Yes	Yes	No	-/-	No	-/-	Transfer Closed/ Transfer Open	-

ATTACHMENT 2

Tier 1 Figure 2.2.1-1	Containment System

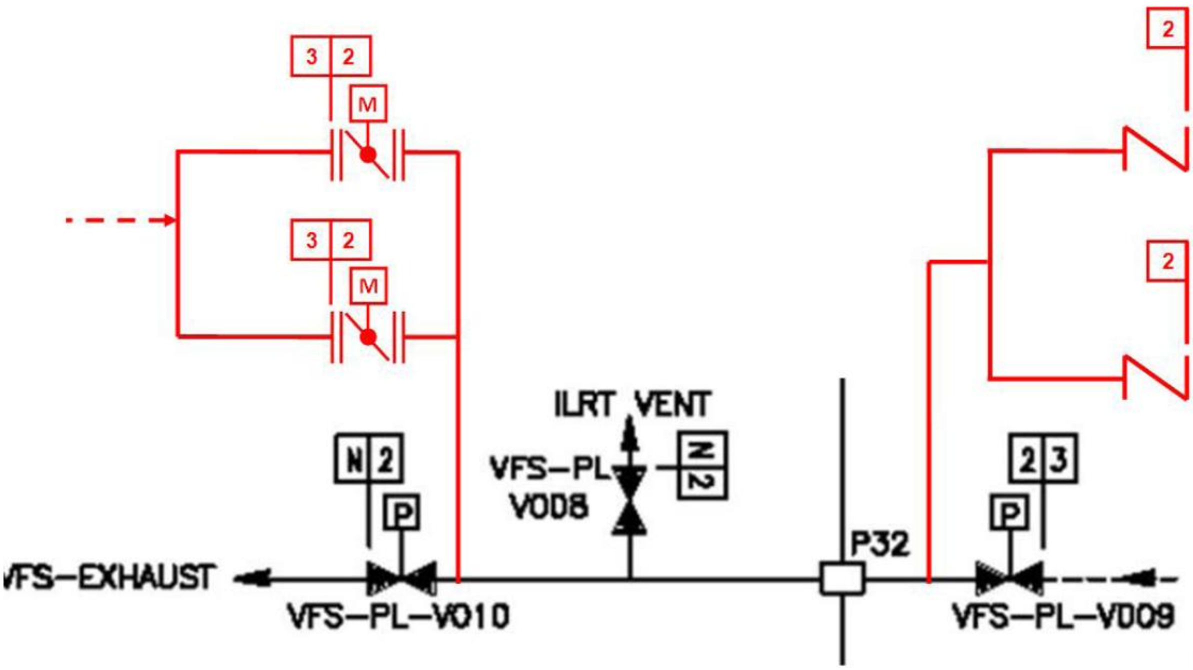


NOTE: PENETRATION CONNECTIONS; TEST, DRAIN OR VENT ARE NOT WITHIN THE SCOPE OF THIS FIGURE.

ATTACHMENT 2 (CONTINUED)

Tier 1 Figure 2.2.1-1	Containment System

DCD Tier 1 Figure 2.2.1-1 Markup



ATTACHMENT 3

Tier 1 Table 2.2.1-2	Containment System Piping

TABLE 2.2.1-2		
Line Name	**Line Number**	**ASME Code Section III**
Instrument Air In	CAS-PL-L015	Yes
Service Air In	CAS-PL-L204	Yes
Component Cooling Water Supply to Containment	CCS-PL-L201	Yes
Component Cooling Water Outlet from Containment	CCS-PL-L207	Yes
Demineralized Water In	DWS-PL-L245, L230	Yes
Fire Protection Supply to Containment	FPS-PL-L107	Yes
Spent Fuel Pool Cooling Discharge	SFS-PL-L017	Yes
Spent Fuel Pool Cooling Suction from Containment	SFS-PL-L038	Yes
Containment Purge Inlet to Containment	VFS-PL-L104, L105, L106	Yes
Containment Purge Discharge from Containment	VFS-PL-L203, L204, L205, L800, L801A/B, L803, L804, L805A/B	Yes
Fan Cooler Supply Line to Containment	VWS-PL-L032	Yes
Fan Cooler Return Line from Containment	VWS-PL-L055	Yes
RCDT Gas Out	WLS-PL-L022	Yes
Waste Sump Out	WLS-PL-L073	Yes

ATTACHMENT 4

Tier 1 Section Text 2.7.6	Containment Air Filtration System Design Description

2.7.6 Containment Air Filtration System
Design Description

The containment air filtration system (VFS) provides intermittent flow of outdoor air to purge and filter the containment atmosphere of airborne radioactivity during normal plant operation, and continuous flow during hot or cold plant shutdown conditions to reduce airborne radioactivity levels for personnel access. The VFS can also provide filtered exhaust for the radiologically controlled area ventilation system (VAS) during abnormal conditions.

The VFS is as shown in Figure 2.7.6-1 and the component locations of the VFS are as shown in Table 2.7.6-3.

1. The functional arrangement of the VFS is as described in the Design Description of this Section 2.7.6.

2. The VFS provides the safety-related functions of preserving containment integrity by isolation of the VFS lines penetrating containment and providing vacuum relief for the containment vessel.

3. The VFS provides the intermittent flow of outdoor air to purge the containment atmosphere during normal plant operation, and continuous flow during hot or cold plant shutdown conditions.

4. Controls exist in the main control room (MCR) to cause the components identified in Table 2.7.6-1 to perform the listed function.

5. Displays of the parameters in Table 2.7.6-1 can be retrieved in the MCR.

ATTACHMENT 5

Tier 1 Table 2.7.6-2	Containment Air Filtration System ITAAC

TABLE 2.7.6-2		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
1. The functional arrangement of the VFS is as described in the Design Description of this Section 2.7.6.	Inspection of the as-built system will be performed.	The as-built VFS conforms with the functional arrangement described in the Design Description of this Section 2.7.6.
2. The VFS provides the safety-related functions of preserving containment integrity by isolation of the VFS lines penetrating containment and providing vacuum relief for the containment vessel.	See Tier 1 Material, Table 2.2.1-3, items 1 and 7.	See Tier 1 Material, Table 2.2.1-3, items 1 and 7.
3. The VFS provides the intermittent flow of outdoor air to purge the containment atmosphere during normal plant operation, and continuous flow during hot or cold plant shutdown conditions.	i) Testing will be performed to confirm that containment supply AHU fan A when operated with containment exhaust fan A provides a flow of outdoor air.	i) The flow rate measured at each fan is greater than or equal to 3,600 scfm.
	ii) Testing will be performed to confirm that containment supply AHU fan B when operated with containment exhaust fan B provides a flow of outdoor air.	ii) The flow rate measured at each fan is greater than or equal to 3,600 scfm.
	iii) Inspection will be conducted of the containment purge discharge line (VFS-L204) penetrating the containment.	iii) The nominal line size is $\geq$ 36 in.
4. Controls exist in the MCR to cause the components identified in Table 2.7.6-1 to perform the listed function.	Testing will be performed on the components in Table 2.7.6-1 using controls in the MCR.	Controls in the MCR operate to cause the components listed in Table 2.7.6-1 to perform the listed functions.
5. Displays of the parameters identified in Table 2.7.6-1 can be retrieved in the MCR.	Inspection will be performed for retrievability of the parameters in the MCR.	The displays identified in Table 2.7.6-1 can be retrieved in the MCR.

ATTACHMENT 6

Table 3.2-3	AP1000 Classification of Mechanical and Fluid Systems, Components, and Equipment

Table 3.2-3 (Sheet 58 of 65)

AP1000 CLASSIFICATION OF MECHANICAL AND FLUID SYSTEMS, COMPONENTS, AND EQUIPMENT

Tag Number	**Description**	**AP1000 Class**	**Seismic Category**	**Principal Construction Code**	**Comments**
Containment Air Filtration System (Continued)					
VFS-PL-V008	Containment Isolation Test Connection	B	I	ASME III-2	
VFS-PL-V009	Containment Purge Discharge Containment Isolation Valve	B	I	ASME III-2	
VFS-PL-V010	Containment Purge Discharge Containment Isolation Valve	B	I	ASME III-2	
VFS-PL-V012	Containment Isolation Test Connection	B	I	ASME III-2	
VFS-PL-V015	Containment Isolation Test Connection	B	I	ASME III-2	
VFS-PL-V800A	Vacuum Relief Containment Isolation A - ORC	B	I	ASME III-2	
VFS-PL-V800B	Vacuum Relief Containment Isolation B - ORC	B	I	ASME III-2	
VFS-PL-V803A	Vacuum Relief Containment Isolation Check Valve A - IRC	B	I	ASME III-2	
VFS-PL-V803B	Vacuum Relief Containment Isolation Check Valve B - IRC	B	I	ASME III-2	
n/a	Valves Providing VFS AP1000 Equipment Class D Function	D	NS	ANSI 16.34	
n/a	Dampers in lines isolating radioactive contamination	R	NS	ASME-509	
n/a	Shutoff, Isolation, and Balancing Dampers	L	NS	ANSI/AMCA-500	
n/a	Fire Dampers	Note 3	NS	UL-555	
n/a	Supply Air Handling Units	L	NS	Manufacturer Std.	
n/a	Air Exhaust Filtration Units	R	NS	ASME AG-1, Note 4	
n/a	Fans, Ductwork	L or R	NS	SMACNA or ASME AG-1, Note 4	
Balance of system components are Class L and Class R					

ATTACHMENT 7

Table 3.7.3-1	Seismic Category I Equipment Outside Containment by Room Number

Table 3.7.3-1 (Sheet 3 of 3)

SEISMIC CATEGORY I EQUIPMENT OUTSIDE CONTAINMENT BY ROOM NUMBER

Room No.	Room Name	Equipment Description
12421	Non 1E equipment/penetration room	Divisional cabling
12422	Reactor trip switchgear II	Reactor trip switchgear
12423	Reactor trip switchgear I	Reactor trip switchgear
12452	VFS penetration room	VFS containment isolation valves, divisional cabling
12454	VFS/SFS/PSS penetration room	SFS/PSS/VFS containment isolation valves, RNS pressure boundary
12462	Cask washdown pit	SFS piping
12504	Upper MSIV compartment B	SGS CIVs, instrumentation and controls
12506	Upper MSIV compartment A	SGS CIVs, instrumentation and controls
12541	Upper annulus	PCS piping and cabling PCS air baffle
12553	Personnel access area	Personnel airlock (interlocks)
12555	Operating deck staging area/VES air storage	VES high pressure air bottles
12651	VAS Equipment Room	VFS containment isolation valves, VFS vacuum relief valves
12562	Fuel handling area	Spent fuel storage racks
12701	PCS valve room	PCS isolation valves/instrumentation
12703	PCS water storage tank	PCS piping, level and temperature instrumentation

ATTACHMENT 8

Text 3.8.2.1.1	General

3.8.2.1.1 General

This subsection describes the structural design of the steel containment vessel and its parts and appurtenances. The steel containment vessel is an integral part of the containment system whose function is described in Section 6.2. It serves both to limit releases in the event of an accident and to provide the safety-related ultimate heat sink.

The containment vessel is an ASME metal containment. The information contained in this subsection is based on the design specification and preliminary design and analyses of the vessel. Final detailed analyses will be documented in the ASME Design Report.

The containment arrangement is indicated in the general arrangement figures in Section 1.2. The portion of the vessel above elevation 132′-3″ is surrounded by the shield building but is exposed to ambient conditions as part of the passive cooling flow path. A flexible watertight and airtight seal is provided at elevation 132′-3″ between the containment vessel and the shield building. The portion of the vessel below elevation 132′-3″ is fully enclosed within the shield building.

Figure 3.8.2-1 shows the containment vessel outline, including the plate configuration and crane girder. It is a free-standing, cylindrical steel vessel with ellipsoidal upper and lower heads. [*The containment vessel has the following design characteristics:*

Diameter: 130 feet
Height: 215 feet 4 inches
Design Code: ASME III, Div. 1
Material: SA738, Grade B
Design Pressure: 59 psig
Design Temperature: 300°F
Design External Pressure: ~~2.9~~1.5 psid

The wall thickness in most of the cylinder is 1.75 inches. The wall thickness of the lowest course of the cylindrical shell is increased to 1.875 inches to provide margin in the event of corrosion in the embedment transition region. The thickness of the heads is 1.625 inches.]* The heads are ellipsoidal with a major diameter of 130 feet and a height of 37 feet, 7.5 inches.

ATTACHMENT 9

Text 3.8.2.4.1.1	Axisymmetric Shell Analyses

3.8.2.4.1.1 Axisymmetric Shell Analyses

The containment vessel is modelled as an axisymmetric shell and analyzed using the ANSYS computer program. A model used for static analyses is shown in Figure 3.8.2-6.

Dynamic analyses of the axisymmetric model, which is similar to that shown in Figure 3.8.2-6, are performed to obtain frequencies and mode shapes. These are used to confirm the adequacy of the containment vessel stick model as described in subsection 3.7.2.3.2. Stress analyses are performed for each of the following loads:

Dead load
Internal pressure
Seismic
Polar crane wheel loads
Wind loads
Thermal loads

The seismic analysis performed envelope all soil conditions. The seismic analysis is discussed in Section 3.7. The torsional moments, which include the effects of the eccentric masses, are increased to account for accidental torsion and are evaluated in a separate calculation.

The results of these load cases are factored and combined in accordance with the load combinations identified in Table 3.8.2-1. These results are used to evaluate the general shell away from local penetrations and attachments, that is, for areas of the shell represented by the axisymmetric geometry. The results for the polar crane wheel loads are also used to establish local shell stiffnesses for inclusion in the containment vessel stick model described in subsection 3.7.2.3. The results of the analyses and evaluations are included in the containment vessel design report.

Design of the containment shell is primarily controlled by the internal pressure of 59 psig. The meridional and circumferential stresses for the internal pressure case are shown in Figure 3.8.2-5. The most highly stressed regions for this load case are the portions of the shell away from the hoop stiffeners and the knuckle region of the top head. In these regions the stress intensity is close to the allowable for the design condition.

Table 3.8.2-1 includes a second design load combination to address external pressure. For the design external pressure load combination a conservatively large magnitude of 1.5~~2.9~~ psi differential pressure is used. Design external pressure is defined as a value greater than the actuation point of the containment relief system, which is a part of the containment air filtration system (See DCD Section 9.4.7). Upon actuation, the external pressure transient is immediately controlled and the external pressure is relieved. This design external pressure is combined with a coincident -40°F outside air temperature which corresponds to a -18.5°F metal temperature for the CV shell not insulated from ambient conditions. The portions of the CV shell which are below the external stiffener are insulated from the cold outside air conditions and result in a metal temperature of 70°F. ~~This design external pressure is validated by assuming that the containment is operating at the maximum temperature, 120°F, with 100% relative humidity, and experiences a step change to the minimum operating temperature, 50°F. The assumptions used to validate the 2.9 psi differential pressure are discussed in Subsection 6.2.1.1.4. These assumptions are nonmechanistic because the outside air temperature conditions to result in an operating temperature of 50°F are inconsistent with an initial containment~~

Text 3.8.2.4.1.1	Axisymmetric Shell Analyses

atmosphere temperature of 120°F. The calculation of the differential pressure using this nonmechanistic approach results in a value of external pressure less than the 2.9 psid design external pressure. The design external pressure provides a bounding value for the design conditions. The load combination for the external pressure design condition includes deadweight, design external pressure, and reaction loads. Thermal loads are not included.

Several events are evaluated for the potential to result in an external pressure load. The credible limiting event for external pressure is the loss of all AC power. The external pressure used to evaluate the ASME Service Limits shall be 0.9 psid, combined with an outside air temperature of -40°F. This outside air temperature results in a metal temperature of -18.5°F for those portions of the vessel above E.L. 131'-9" and a metal temperature of 70°F below this elevation with a step change at the external stiffener.

Loss of ac power is evaluated using more realistic, mechanistic assumptions than for the design external pressure condition. The more credible determination of the external pressure for the loss of ac power results in a value smaller than the inadvertent actuation of the active containment cooling and considerably smaller than the design external pressure.

Inadvertent actuation of the containment fan coolers is another event that could result in external pressure at cold conditions, however, this event is not credible due to the fact that the containment fan coolers will be operational and cannot be inadvertently actuated. This event is evaluated at several initial ambient temperature conditions to determine the maximum differential pressure. The thermal load associated with this event is due to the thermal gradient in the containment shell from the portion protected by concrete mass to the portion exposed to the ambient external temperature condition.

For AP1000, the passive containment cooling system provides heat removal from the containment shell to the environment via natural circulation air flow during normal operation. Since the passive containment cooling system water is relatively warm (minimum of 40°F) compared to the outside air temperature, actuation of this system results in a less limiting external pressure and shell temperature. Inadvertent actuation of the containment spray is not credible since the AP1000 containment spray requires significant local operator action to align the system.

Design Eexternal pressure is used in load combinations that include thermal loads and are used to evaluate Service Level A and D stress limits. These external pressure conditions are included in the loading combinations in Table 3.8.2-1. The load combinations that include external pressures and thermal loads are evaluated for several cases of initiating event and external temperature to determine the limiting cases of external pressure and external temperature.

Major loads that induce compressive stresses in the containment vessel are internal and external pressure and crane and seismic loads. Each of these loads and the evaluation of the compressive stresses are discussed below.

- Internal pressure causes compressive stresses in the knuckle region of the top head and in the equipment hatch covers. The evaluation methods are similar to those discussed in subsection 3.8.2.4.2 for the ultimate capacity.

ATTACHMENT 10

Table 3.8.2-1	Load Combinations and Service Limits for Containment Vessel

Table 3.8.2-1

LOAD COMBINATIONS AND SERVICE LIMITS FOR CONTAINMENT VESSEL

Load Description		**Load Combination and Service Limit**											
		Con	**Test**	**Des.**	**Des.**	**A**	**A**	**A**	**C**	**D**	**C**	**D**	
Dead	D	x	x	x	x	x	x	x	x	x	x	x	
Live	L	x	x	x	x	x	x	x	x	x	x	x	
Wind(56)	W	x						x					
Safe shutdown earthquake	E_s								x	x		x	
Tornado	W_t										x		
Test pressure	P_t		x										
Test temperature	T_t		x										
Operating pressure	P_o							x			x		
Design pressure	P_d			x			x		x			x	
Design External pressure	P_e				x	x				x			
~~External pressure(3)~~	~~P_e~~					~~x~~				~~x~~			
Normal reaction	R_o				x	x		x		x	x		
Normal thermal(45)	T_o				x	x		(34)		x	(34)		
Accident thermal reactions	R_a			x			x		x			x	
Accident thermal	T_a			x			x		x			x	
Accident pipe reactions	Y_r											x	
Jet impingement	Y_j											x	
Pipe impact	Y_m											x	

ATTACHMENT 10 (CONTINUED)

Table 3.8.2-1	Load Combinations and Service Limits for Containment Vessel

Notes:

1. Service limit levels are per ASME-NE.
2. Where any load reduces the effects of other loads, that load is to be taken as zero, unless it can be demonstrated that the load is always present or occurs simultaneously with the other loads.

~~3. External pressure based on evaluation of credible initiating events in cold weather or inadvertent PCS actuation.~~

3~~4~~. Temperature of vessel is 70°F.

4~~5~~. Temperature distribution for normal operation in cold weather ~~credible initiating event in cold weather or inadvertent PCS actuation. Evaluation of load combination cases including external pressure and thermal combine the coincident external pressure with thermal load for same temperature~~.

5~~6~~. Wind load for the construction load combination is based on a 70 mph wind. Wind load for the Service Level A load combination is analyzed as a reduction in external pressure.

ATTACHMENT 11

Table 3.9-12	List of ASME Class 1, 2, and 3 Active Valves

Table 3.9-12 (Sheet 7 of 7)

LIST OF ASME CLASS 1, 2, AND 3 ACTIVE VALVES

Valve No.	**Description**	**Function[(a)]**
Containment Air Filtration System		
VFS-PL-V003	Containment Purge Inlet Containment Isolation Valve	2
VFS-PL-V004	Containment Purge Inlet Containment Isolation Valve	2
VFS-PL-V009	Containment Purge Discharge Containment Isolation Valve	2
VFS-PL-V010	Containment Purge Discharge Containment Isolation Valve	2
VFS-PL-V800A	Vacuum Relief Containment Isolation A ORC	2
VFS-PL-V800B	Vacuum Relief Containment Isolation B ORC	2
VFS-PL-V803A	Vacuum Relief Containment Isolation Check Valve A IRC	2
VFS-PL-V803B	Vacuum Relief Containment Isolation Check Valve B IRC	2
Central Chilled Water System		
VWS-PL-V058	Fan Coolers Supply Containment Isolation	2
VWS-PL-V062	Fan Coolers Supply Containment Isolation Check Valve	2
VWS-PL-V080	Containment Isolation Thermal Relief Valve	2
VWS-PL-V082	Fan Coolers Return Containment Isolation	2
VWS-PL-V086	Fan Coolers Return Containment Isolation	2
Liquid Radwaste System		
WLS-PL-V055	Sump Containment Isolation IRC	2
WLS-PL-V057	Sump Containment Isolation ORC	2
WLS-PL-V058	Containment Isolation Relief Valve	2
WLS-PL-V067	Reactor Coolant Drain Tank Gas Containment Isolation IRC	2
WLS-PL-V068	Reactor Coolant Drain Tank Gas Containment Isolation ORC	2
WLS-PL-V071A	Chemical and Volume Control System Compartment to Sump	3
WLS-PL-V071B	Passive Core Cooling System A Compartment to Sump	3
WLS-PL-V071C	Passive Core Cooling System B Compartment to Sump	3
WLS-PL-V072A	Chemical and Volume Control System Compartment to Sump	3
WLS-PL-V072B	Passive Core Cooling System A Compartment to Sump	3
WLS-PL-V072C	Passive Core Cooling System B Compartment to Sump	3

ATTACHMENT 12

Table 3.9-16	Valve Inservice Test Requirements

Valve Tag Number	Description[1]	Size (in)	Normal Position	Safety Position	Fail Position	Valve/Actuator Type	Safety-Related Missions	Safety Functions[2]	ASME Class/ IST Category	Inservice Testing Type and Frequency	IST Notes
VFS-PL-V010	Containment Purge Discharge Containment Isolation Valve					Remote AO Butterfly	Maintain Close Transfer Close	Active-to-Failed Containment Isolation Safety Seat Leakage Remote Position	Class 2 Category A	Remote Position Indication, Exercise/2 Years Containment Isolation Leak Test Exercise Full Stroke/Quarterly Operability Test	27, 31
VFS-PL-V800A	Vacuum Relief Containment Isolation A - ORC	24	Closed	Closed Open	N/A	Remote MO Butterfly	Maintain Close Transfer Close Maintain Open Transfer Open	Active Containment Isolation Safety Seat Leakage Remote Position	Class 2 Category A	Remote Position Indication, Exercise/2 Years Containment Isolation Leak Test Exercise Full Stroke/Quarterly Operability Test	27, 31
VFS-PL-V800B	Vacuum Relief Containment Isolation B - ORC	24	Closed	Closed Open	N/A	Remote MO Butterfly	Maintain Close Transfer Close Maintain Open Transfer Open	Active Containment Isolation Safery Seat Leakage Remote Position	Class 2 Category A	Remote Position Indication, Exercise/2 Years Containment Isolation Leak Test Exercise Full Stroke/Quarterly Operability Test	27, 31
VFS-PL-V803A	Vacuum Relief Containment Isolation Check Valve A - IRC	24	Closed	Closed	N/A	Check	Maintain Close Transfer Close Transfer Open	Active Containment Isolation Safety Seat Leakage	Class 2 CategoryAC	Containment Isolation Leak Test Exercise Full Stroke/Refueling Shutdown	39
VFS-PL-V803B	Vacuum Relief Containment Isolation Check Valve B - IRC	24	Closed	Closed	N/A	Check	Maintain Close Transfer Close Transfer Open	Active Containment Isolation Safety Seat Leakage	Class 2 Category AC	Containment Isolation Leak Test Exercise Full Stroke/Refueling Shutdown	39
VWS-PL-V058	Fan Coolers Supply Containment Isolation					Remote AO Butterfly	Maintain Close Transfer Close	Active-to-Failed Containment Isolation Safety Seat Leakage Remote Position	Class 2 Category A	Remote Position Indication, Exercise/2 Years Containment Isolation Leak Test Exercise Full Stroke/Quarterly Operability Test	27, 28, 31
VWS-PL-V062	Fan Coolers Supply Containment Isolation					Check	Maintain Close Transfer Close	Active Containment Isolation Safety Seat Leakage	Class 2 Category AC	Containment Isolation Leak Test Check Exercise/Quarterly	27, 28
VWS-PL-V080	Fan Coolers Return Containment Isolation Thermal Relief Valve					Relief	Maintain Close Transfer Close Transfer Open	Active Containment Leakage Safety Seat Leakage	AC	Containment Isolation Leak Test/2 Years	27

ATTACHMENT 12 (CONTINUED)

Table 3.9-16	Valve Inservice Test Requirements

23. Thermal relief check valves in the normal residual heat removal suction line (RNS-V003A/B) and the Chemical and Volume Control System makeup line (CVS-V100) are located inside containment. To exercise test these valves, entry to the containment is required and temporary connections made to gas supplies. Because of the radiation exposure and effort required, this test is not conducted during power operation or during cold shutdowns. Exercise testing is performed during refueling shutdowns.

24. Normal residual heat removal system reactor coolant isolation check valves (RNS-V015A/B, V017A/B) are not exercise tested quarterly. During normal power operation these valves isolate the high pressure RCS from the low pressure RNS. Opening during normal operation would require a pressure greater than the RCS normal pressure, which is not available. It would also subject the RCS connection to undesirable transients. These valves will be exercised during cold shutdowns.

25. This note applies to the main feedwater control valves (SGS-V250A/B), moisture separator reheater 2nd stage steam isolation valve (MSS-V015A/B), turbine control valves (MTS-V002A/B, V004A/B). The valves are not quarterly stroke tested since full stroke testing would result in a plant transient during power operation. Normal feedwater and turbine control operation provides a partial stroke confirmation of valve operability. The valves will be full stroke and failsafe tested during cold shutdowns.

26. This note applies to containment compartment drain line check valves (SFS-V071, SFS-V072, WLS-V071A/B/C, WLS-V072A/B/C). These check valves are located inside containment and require temporary connections for exercise testing. Because of the radiation exposure and effort required, these valves are not exercised during power operation or during cold shutdowns. The valves will be exercised during refuelings.

27. Containment isolation valves leakage test frequency will be conducted in accordance with the "Primary Containment Leakage Rate Test Program" in accordance with 10 CFR 50 Appendix J. Refer to SSAR subsection 6.2.5.

28. This note applies to the chilled water system containment isolation valves (VWS-V058, V062, V082 and V086). Closing any of these valves stops the water flow to the containment fan coolers. This water flow may be necessary to maintain the containment air temperature within Technical Specification limits. As a result, quarterly exercise testing will be deferred to refueling shutdowns when plant operating conditions and site climatic conditions would cause the containment air temperature to exceed this limit during testing.

29. Exercise testing of the turbine bypass control valves (MSS-V001, V002, V003, V004, V005 and V006) will result in an undesirable temperature transient on the turbine, condenser and other portions of the turbine bypass due to the actuation of bypass flow. Therefore, quarterly exercise testing will not be performed. Exercise and failsafe testing will be performed during cold shutdowns.

30. Deleted.

31 These valves are subject to operability testing per the requirements of 10 CFR 50.55a. See subsection 3.9.6.2.2 for the factors to be considered in the evaluation of operability testing and subsection 3.9.8.4 for the Combined License information item. The test frequency is the longer of every 3 refueling cycles or 5 years until sufficient data exists to determine a longer test frequency is appropriate in accordance with Generic Letter 96-05. Some of the valves will be tested the first time after a shorter period to provide for trending information. The specified frequency for operability testing is a maximum of once every 10 years provided there is sufficient experience to justify the longer interval.

32. These valves are subject to leak testing to support the nonsafety-related classification of the CVS purification subsystem inside containment. These valves are not included in the PIV integrity Technical Specification 3.4.15. The leakage through valves CVS-V001, CVS-V002, and CVS-V080 will be tested separately with a leakage limit of 1.5 gpm for each valve. The leakage through valves CVS-V069, V081, V082, V084, and V085 will be tested at the same time as a group with a leakage limit of 1 gpm for the group. The leak tests will be performed at reduced RCS pressures. The observed leakage at lower pressures can be assumed to be the leakage at the maximum pressure as long as the valve leakage is verified to diminish with increasing pressure differential. Verification that the valves have the characteristic of decreasing leakage with pressure may be provided with two tests at different test pressures. The test requirements including the minimum test pressure and the difference between the test pressures will be defined by the Combined License applicant in the inservice test program as discussed in subsection 3.9.8.

33. This note applies to valve FHS-V001. This valve closes one end of the fuel transfer tube. The fuel transfer tube is normally closed by a flange except during refuelings. This valve has an active safety function to close when the fuel transfer tube flange is removed and normal shutdown cooling is lost. Closing this valve, along with other actions, provides containment closure which allows long term core cooling to be provided by the PXS. As a result this valve is only required to be operable during refueling operations.

34. This note applies to the moisture separator reheater 2nd stage steam isolation valve (MSS-V015A/B), turbine control valves (MTS-V002A/B, V004A/B), main turbine stop valves (MTS-V001A/B, V003A/B), the turbine bypass control valves (MSS-V001, V002, V003, V004, V005, V006). These valves are not ASME Code Class 1, 2, or 3, and the ASME 1ST Category is indicated based on the valve functions listed. These valves are relied on in the safety analyses for those cases in which the rupture of the main steam or feedwater piping inside containment is the postulated initiating event. These valves are credited in single failure analysis to mitigate the event.

35. This note applies to the turbine stop valves (MTS-V001A/B, V003A/B). The valves are not quarterly stroke tested since full stroke testing would result in a plant transient during power operation. The valves will be full stroke and failsafe tested during cold shutdowns. See Note 34 above.

36. In each of the four turbine inlet lines, there is a turbine stop valve and turbine control valve. Only one of the valves in each of the four lines is required by Technical Specification 3.7.2 to be operable.

37. This note applies to inside containment isolation valves CAS-V205, DWS-V245, and FPS-V052. It is not practical to exercise these valves during power operation or cold shutdowns since the valves are located inside containment and are locked closed. These valves are exercised during refueling conditions when system and plant conditions allow entry into containment

38. The exercise stroke test for the VES pressure regulating valves will consist of a pressure drop test across the valve using the downstream test connection. This method ensures adequate testing of the valves.

39. This note applies to the vacuum relief containment isolation check valves VFS-V803A and VFS-V803B. It is not practical to exercise these valves during normal power operation or during cold shutdown since the valves are located inside containment and require temporary test equipment for exercising. The valves will be full stroke exercised during refueling outages when containment entry is possible.

Table 3.11-1	Environmentally Qualified Electrical and Mechanical Equipment

Table 3.11-1 (Sheet 30 of 50)

ENVIRONMENTALLY QUALIFIED ELECTRICAL AND MECHANICAL EQUIPMENT

Description	**AP1000 Tag No.**	**Envir. Zone (Note 2)**	**Function (Note 1)**	**Operating Time Required (Note 5)**	**Qualification Program (Note 6)**
Air Tank Relief A	VES-PL-V040A	7	ESF	2 wks	M
Air Tank Relief B	VES-PL-V040B	7	ESF	2 wks	M
Air Tank Relief A	VES-PL-V041A	7	ESF	2 wks	M
Air Tank Relief B	VES-PL-V041B	7	ESF	2 wks	M
Main Air Flow Path Isolation Valve	VES-PL-V044	3	ESF	2 wks	M
Containment Purge Inlet Isolation Limit Switch Solenoid Valve	VFS-PL-V003 VFS-PL-V003-L VFS-PL-V003-S1	7 7 7	ESF PAMS ESF	5 min 2 wks 5 min	M S E E
Containment Purge Inlet Isolation Limit Switch Solenoid Valve	VFS-PL-V004 VFS-PL-V004-L VFS-PL-V004-S1	1 1 1	ESF PAMS ESF	5 min 1 yr 5 min	M * E * E *
Containment Purge Discharge Isolation Limit Switch Solenoid Valve	VFS-PL-V009 VFS-PL-V009-L VFS-PL-V009-S1	1 1 1	ESF PAMS ESF	5 min 1 yr 5 min	M * E * E *
Containment Purge Discharge Isolation Limit Switch Solenoid Valve	VFS-PL-V010 VFS-PL-V010-L VFS-PL-V010-S1	6 6 6	ESF PAMS ESF	5 min 2 wks 5 min	M S ** E ** E **
Vacuum Relief Containment Isolation Valve A - ORC Limit Switch Motor Operator	VFS-PL-V800A VFS-PL-V800A-L VFS-PL-V800A-M	7 7 7	ESF PAMS ESF	5 min 2 wks 5 min	M E E
Vacuum Relief Containment Isolation Valve B - ORC Limit Switch Motor Operator	VFS-PL-V800B VFS-PL-V800B-L VFS-PL-V800B-M	7 7 7	ESF PAMS ESF	5 min 2 wks 5 min	M E E
Vacuum Relief Containment Isolation Check Valve A - IRC	VFS-PL-V803A	1	ESF	5 min	M*
Vacuum Relief Containment Isolation Check Valve B - IRC	VFS-PL-V803B	1	ESF	5 min	M*
Fan Cooler Supply Isolation Limit Switch Solenoid Valve	VWS-PL-V058 VWS-PL-V058-L VWS-PL-V058-S	2 2 2	ESF PAMS ESF	5 min 2 wks 5 min	M S E E

ATTACHMENT 14

Table 3I.6-2	List of Potential High Frequency Sensitive AP1000 Safety-Related Electrical and Electro-Mechanical Equipment

Table 3I.6-2 (Sheet 26 of 28)

LIST OF POTENTIAL HIGH FREQUENCY SENSITIVE AP1000 SAFETY-RELATED ELECTRICAL AND ELECTRO-MECHANICAL EQUIPMENT

Description	**AP1000 Tag Number**
Containment Purge Discharge Isolation	
Limit Switch	VFS-PL-V009-L
Solenoid Valve	VFS-PL-V009-S1
Containment Purge Discharge Isolation	
Limit Switch	VFS-PL-V010-L
Solenoid Valve	VFS-PL-V010-S1
Vacuum Relief Containment Isolation Valve A - ORC	
Limit Switch	VFS-PL-V800A-L
Motor Operator	VFS-PL-V800A-M
Vacuum Relief Containment Isolation Valve B - ORC	
Limit Switch	VFS-PL-V800B-L
Motor Operator	VFS-PL-V800B-M
Fan Cooler Supply Isolation	
Limit Switch	VWS-PL-V058-L
Solenoid Valve	VWS-PL-V058-S
Fan Cooler Return Isolation	
Limit Switch	VWS-PL-V082-L
Solenoid Valve	VWS-PL-V082-S
Fan Cooler Return Isolation	
Limit Switch	VWS-PL-V086-L
Solenoid Valve	VWS-PL-V086-S
Sump Containment Isolation IRC	
Limit Switch	WLS-PL-V055-L
Solenoid Valve	WLS-PL-V055-S1

ATTACHMENT 15

Table 3I.6-3	List of AP1000 Safety-Related Electrical and Mechanical Equipment Not High Frequency Sensitive

Table 3I.6-3 (Sheet 11 of 32)

LIST OF AP1000 SAFETY-RELATED ELECTRICAL AND MECHANICAL EQUIPMENT NOT HIGH FREQUENCY SENSITIVE

Description	**AP1000 Tag Number**	**Comment**
Air Tank Relief A	VES-PL-V040A	2
Air Tank Relief B	VES-PL-V040B	2
Air Tank Relief A	VES-PL-V041A	2
Air Tank Relief B	VES-PL-V041B	2
Main Air Flow Path Isolation Valve	VES-PL-V044	2
Containment Purge Inlet Isolation	VFS-PL-V003	2
Containment Purge Inlet Isolation	VFS-PL-V004	2
Containment Purge Discharge Isolation	VFS-PL-V009	2
Containment Purge Discharge Isolation	VFS-PL-V010	2
Vacuum Relief Containment Isolation Valve A - ORC	VFS-PL-V800A	2
Vacuum Relief Containment Isolation Valve B - ORC	VFS-PL-V800B	2
Vacuum Relief Containment Isolation Check Valve A - IRC	VFS-PL-V803A	2
Vacuum Relief Containment Isolation Check Valve B - IRC	VFS-PL-V803B	2
Fan Cooler Supply Isolation	VWS-PL-V058	2
Fan Cooler Supply Isolation	VWS-PL-V062	2
VWS Containment Isolation Relief	VWS-PL-V080	2
Fan Cooler Return Isolation	VWS-PL-V082	2
Fan Cooler Return Isolation	VWS-PL-V086	2
Sump Containment Isolation IRC	WLS-PL-V055	2
Sump Containment Isolation ORC	WLS-PL-V057	2
WLS Containment Isolation Relief	WLS-PL-V058	2
RCDT Gas Containment Isolation	WLS-PL-V067	2
RCDT Gas Containment Isolation	WLS-PL-V068	2
CVS To Sump	WLS-PL-V071 A	2

ATTACHMENT 16

Table 6.2.3-1	Containment Mechanical Penetrations and Isolation Valves

Table 6.2.3-1 (Sheet 3 of 4)

CONTAINMENT MECHANICAL PENETRATIONS AND ISOLATION VALVES

	Containment Penetration			Isolation Device					Test		
System	**Line**	**Flow**	**Closed Sys IRC**	**Valve/Hatch Identification**	**DCD Subsection**	**Position N-S-A**	**Signal**	**Closure Times**	**Type[1] & Note**	**Medium**	**Direction**
VFS	Cont. air filter supply	In	No	VFS-PL-V003 VFS-PL-V004	9.4.7	C-O-C C-O-C	T, HR,DAS T, HR,DAS	10 sec 10 sec	C,5	Air	Forward Forward
	Cont. air filter exhaust	Out	No	VFS-PL-V010 VFS-PL-V009 VFS-PL-V008 VFS-PL-V800A VFS-PL-V800B VFS-PL-V803A VFS-PL-V803B	9.4.7	C-O-C C-O-C C-C-C C-C-C C-C-C C-C-C C-C-C	T,HR,DAS T,HR,DAS N/A T, HR (Note 8) T, HR (Note 8) None None	10 sec 10 sec N/A std. std. N/A N/A	C,5	Air	Forward
VWS	Fan Coolers out	Out	No	VWS-PL-V086 VWS-PL-V082 VWS-PL-V080	9.2.7	O-O-C O-O-C C-C-C	T T None	std. std. N/A	C,3,4,5	Air	Forward
	Fan coolers in	In	No	VWS-PL-V058 VWS-PL-V062	9.2.7	O-O-C O-O-C	T N/A	std. std.	C,3,4,5	Air	Forward
WLS	Reactor coolant drain tank gas	Out	No	WLS-PL-V068 WLS-PL-V067	11.2	C-C-C C-C-C	T T	std. std.	C	Air	Forward
	Normal cont. sump	Out	No	WLS-PL-V057 WLS-PL-V055 WLS-PL-V058	11.2	C-C-C C-C-C C-C-C	T,DAS T,DAS None	std. std. N/A	C	Air	Forward
SPARE		N/A	No	P40	6.2.5	C-C-C	N/A	N/A	B	Air	Forward
SPARE		N/A	No	P41	6.2.5	C-C-C	N/A	N/A	B	Air	Forward
SPARE		N/A	No	P42	6.2.5	C-C-C	N/A	N/A	B	Air	Forward
CNS	Main equipment hatch	N/A	No	CNS-MY-Y01	6.2.5	C-C-C	None	N/A	B	Air	Forward
	Maintenance hatch	N/A	No	CNS-MY-Y02	6.2.5	C-C-C	None	N/A	B	Air	Forward
	Personnel hatch	N/A	No	CNS-MY-Y03	6.2.5	C-C-C	None	N/A	B	Air	Forward
	Personnel hatch	N/A	No	CNS-MY-Y04	6.2.5	C-C-C	None	N/A	B	Air	Forward

ATTACHMENT 16 (CONTINUED)

Table 6.2.3-1	Containment Mechanical Penetrations and Isolation Valves

Table 6.2.3-1 (Sheet 4 of 4)

CONTAINMENT MECHANICAL PENETRATIONS AND ISOLATION VALVES

Explanation of Heading and Acronyms for Table 6.2.3-1

System: Fluid system penetrating containment

Containment Penetration: These fields refer to the penetration itself

Line: Fluid system line

Flow: Direction of flow in or out of containment

Closed Sys IRC: Closed system inside containment as defined in DCD Section 6.2.3.1.1

Isolation Device: These fields refer to the isolation devices for a given penetration

Valve/Hatch ID: Identification number on P&ID or system figure

Subsection Containing Figure: Safety analysis report containing the system P&ID or figure

Position N-S-A: Device position for N (normal operation)
- S (shutdown)
- A (post-accident)

Signal: Device closure signal
- MS: Main steamline isolation
- LSL: Low steamline pressure
- MF: Main feedwater isolation
- LTC: Low T_{cold}
- PRHR: Passive residual heat removal actuation
- T: Containment isolation
- S: Safety injection signal
- HR: High containment radiation
- DAS: Diverse actuation system signal
- PL2: High 2 pressurizer level signal
- S+PL1: Safety injection signal plus high 1 pressurizer level
- SGL: High steam generator level

Closure Time:
Required valve closure stroke time
- std: Industry standard for valve type (≤ 60 seconds)
- N/A: Not Applicable

Test: These fields refer to the penetration testing requirements

Type: Required test type
- A: Integrated Leak Rate Test
- B: Local Leak Rate Test -- penetration
- C: Local Leak Rate Test -- fluid systems

Note: See notes below

Medium: Test fluid on valve seat

Direction: Pressurization direction
- Forward: High pressure on containment side
- Reverse: High pressure on outboard side

Notes:

1. Containment leak rate tests are designated Type A, B, or C according to 10CFR50, Appendix J.
2. The secondary side of the steam generator, including main steam, feedwater, startup feedwater, blowdown and sampling piping from the steam generators to the containment penetration, is considered an extension of the containment. These systems are not part of the reactor coolant pressure boundary and do not open directly to the containment atmosphere during post-accident conditions. During Type A tests, the secondary side of the steam generators is vented to the atmosphere outside containment to ensure that full test differential pressure is applied to this boundary.
3. The central chilled water system remains water-filled and operational during the Type A test in order to maintain stable containment atmospheric conditions.
4. The containment isolation valves for this penetration are open during the Type A test to facilitate testing. Their leak rates are measured separately.
5. The inboard valve flange is tested in the reverse direction.
6. These valves are not subject to a Type C test. Upstream side of RNS hot leg suction isolation valves is not vented during local leak rate test to retain double isolation of RCS at elevated pressure. Valve is flooded during post accident operation.
7. Refer to DCD Table 15.0-4b for PORV block valve closure time.
8. These valves also receive a signal to close on High 2 containment pressure and a signal to open on Low 2 containment pressure.

ATTACHMENT 17A

Section Text 6.2.1.1.4	External Pressure Analysis

6.2.1.1.4 External Pressure Analysis

Certain design basis events and credible inadvertent systems actuation have the potential to result in containment external pressure loads. Evaluations of these events show that a loss of all ac power sources during extreme cold ambient conditions has the potential for creating the worst-case external pressure load on the containment vessel. This event leads to a reduction in the internal containment heat loads from the reactor coolant system and other active components, thus resulting in a temperature reduction within the containment and an accompanying pressure reduction. Evaluations are performed to determine the maximum external pressure to which the containment may be subjected during a postulated loss of all ac power sources for the purpose of designing the containment vacuum relief system.

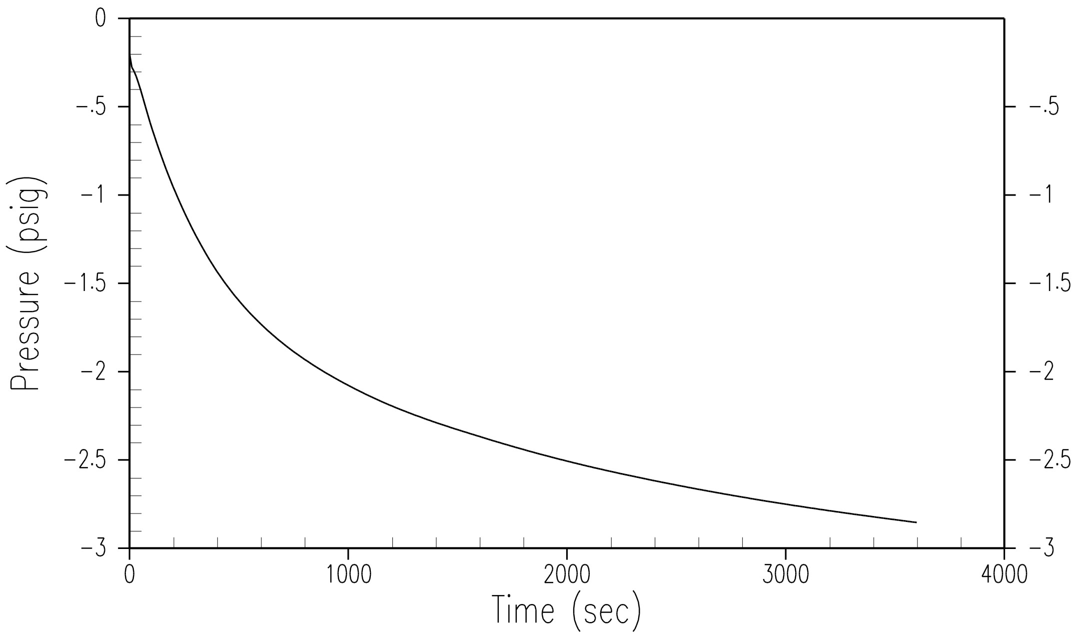
The evaluations are performed with the assumption of a -40 33°F ambient temperature with a steady 48 mph wind blowing to maximize cooling of the containment vessel no outside wind blowing to maximize the containment internal temperature and humidity. The initial internal containment temperature is in equilibrium conservatively assumed to be at 120°F, creating the largest possible temperature differential to maximize the heat removal rate through the containment vessel wall. A negative 0.2 psig initial containment pressure is used for this evaluation. Containment internal humidity is conservatively assumed to be at 100%.. A conservative maximum initial containment relative humidity of 100 percent is used. to produce the greatest reduction in containment pressure due to the loss of steam partial pressure by condensation. At transient initiation, the external wind is assumed to instantaneously accelerate to 48mph, and the external temperature is assumed to begin decreasing based on the form of a chopped cosine with minimum value of 13°F and periodicity of 24 hours. It is also conservatively assumed that no air leakage occurs into the containment during the transient. The key assumptions for heat transfer characteristics, containment initial conditions, and containment transient conditions are listed in Table 6.2.1.1-9.

Evaluations are performed using WGOTHIC with conservatively low estimates of the containment heat loads and conservatively high heat removal through the containment vessel consistent with the limiting assumptions stated above. Results of these evaluations are used to develop the maximum depressurization rate of containment for use in designing the active safety grade containment vacuum relief system. demonstrate that at one hour after the event the net external pressure is within the 2.9 psid design external pressure. Based on Tthe limiting case containment pressure transient is shown in Figure 6.2.1.1-11, the containment vacuum relief system is designed to ensure the containment vessel design external pressure of 1.5 psid will not be exceeded.

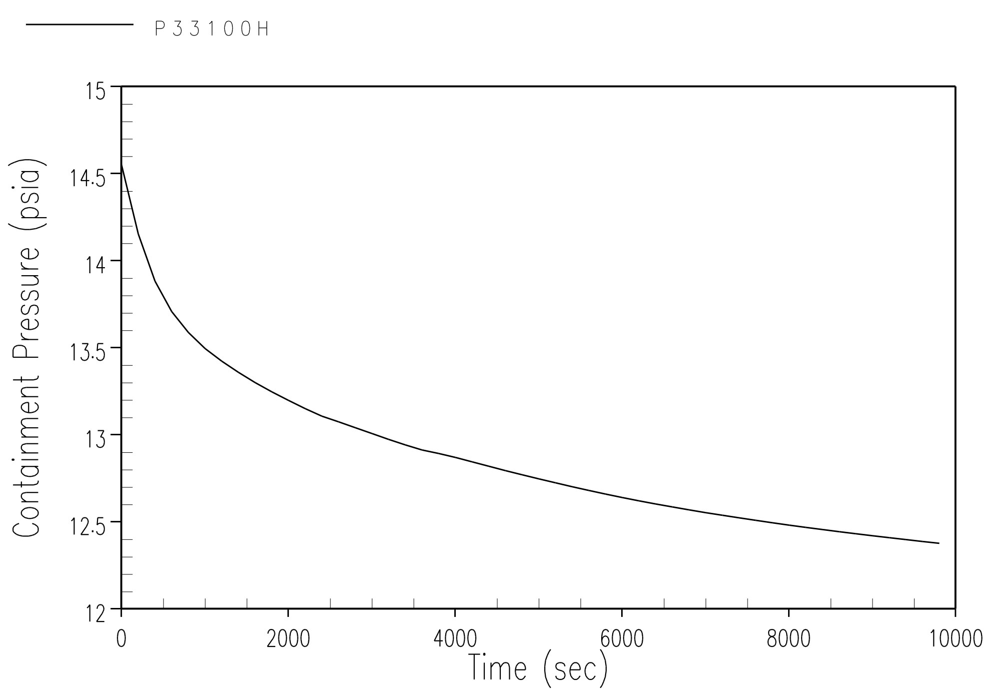
ATTACHMENT 17 B

Figure 6.2.1.1-11	External Pressure Analysis

DCD Figure 6.2.1.1-11 (Old)



DCD Figure 6.2.1.1-11 (New)



July 20, 2010

ATTACHMENT 17 C

Table 6.2.1.1-9	External Pressure Analysis

Table 6.2.1.1-9

Containment External Pressure Analysis Major Assumptions

Pre-Transient Conditions	
Parameter	Value
Containment External Temperature	33°F
Containment Wind Speed	Natural Convection
Containment Internal Temperature	120°F
Containment Initial Humidity	100%
IRWST Temperature	120°F
Containment Internal Pressure	14.5 psia
Containment Heat Rate	0 Decay Heat, Sensible Heat addition ~ 1/5 design heat rate at transient time t=0 sec.
Transient and Post-Transient Conditions	
Containment External Temperature	Chopped Cosine ramping to 13°F in 12 hours
Containment Wind Speed	Forced Convection at 24.8 ft/sec in the riser region
Containment Heat Rate	0 Decay Heat, Sensible Heat addition ~ 1/5 design heat rate at transient time t=0 sec.

ATTACHMENT 18

Figure 7.2-1	AP1000 Functional Diagram Containment and Other Protection

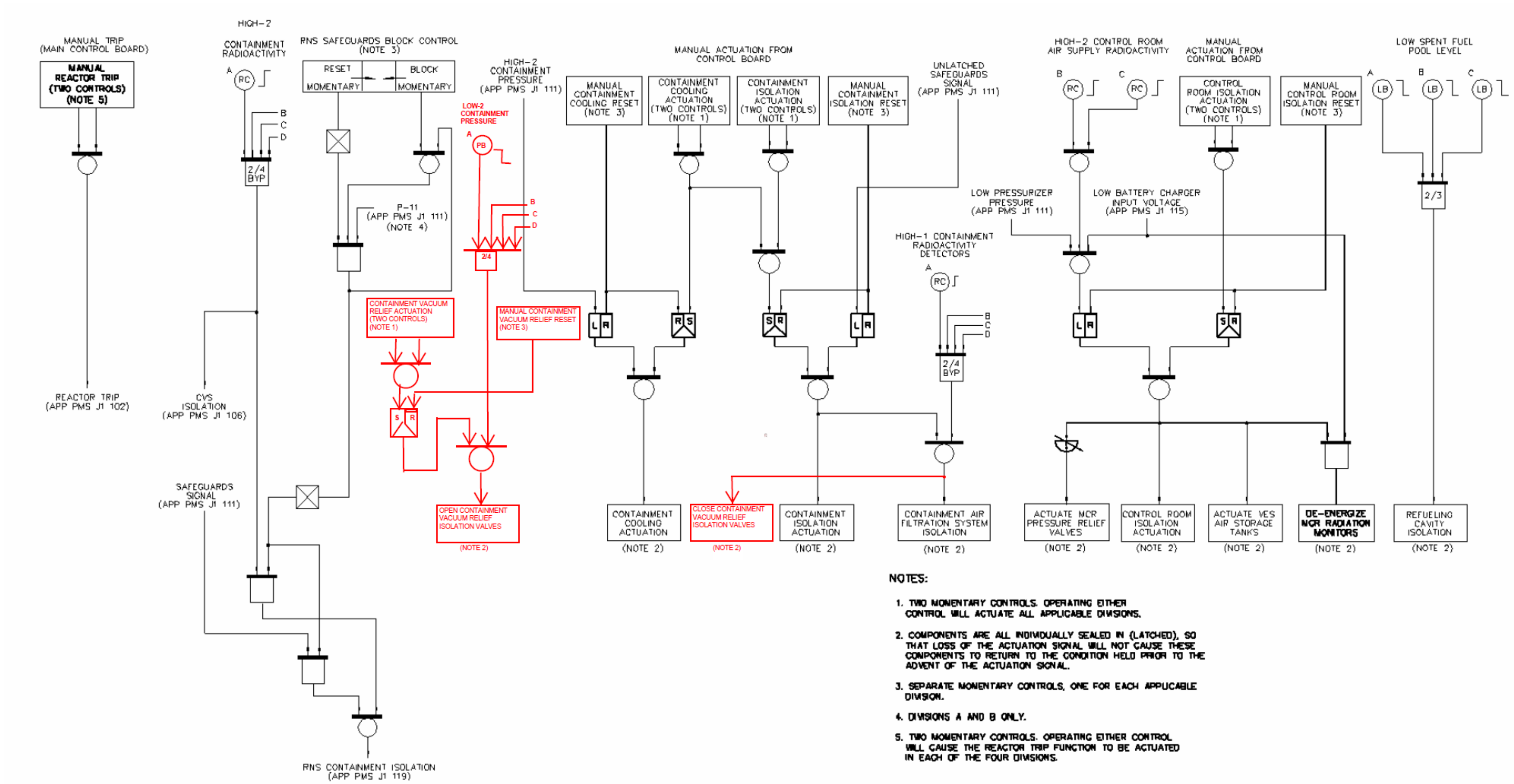


Figure 7.2-1 (Sheet 13 of 20)

Functional Diagram
Containment and Other Protection

ATTACHMENT 18 (CONTINUED)

Figure 7.2-1	AP1000 Functional Diagram Containment and Other Protection

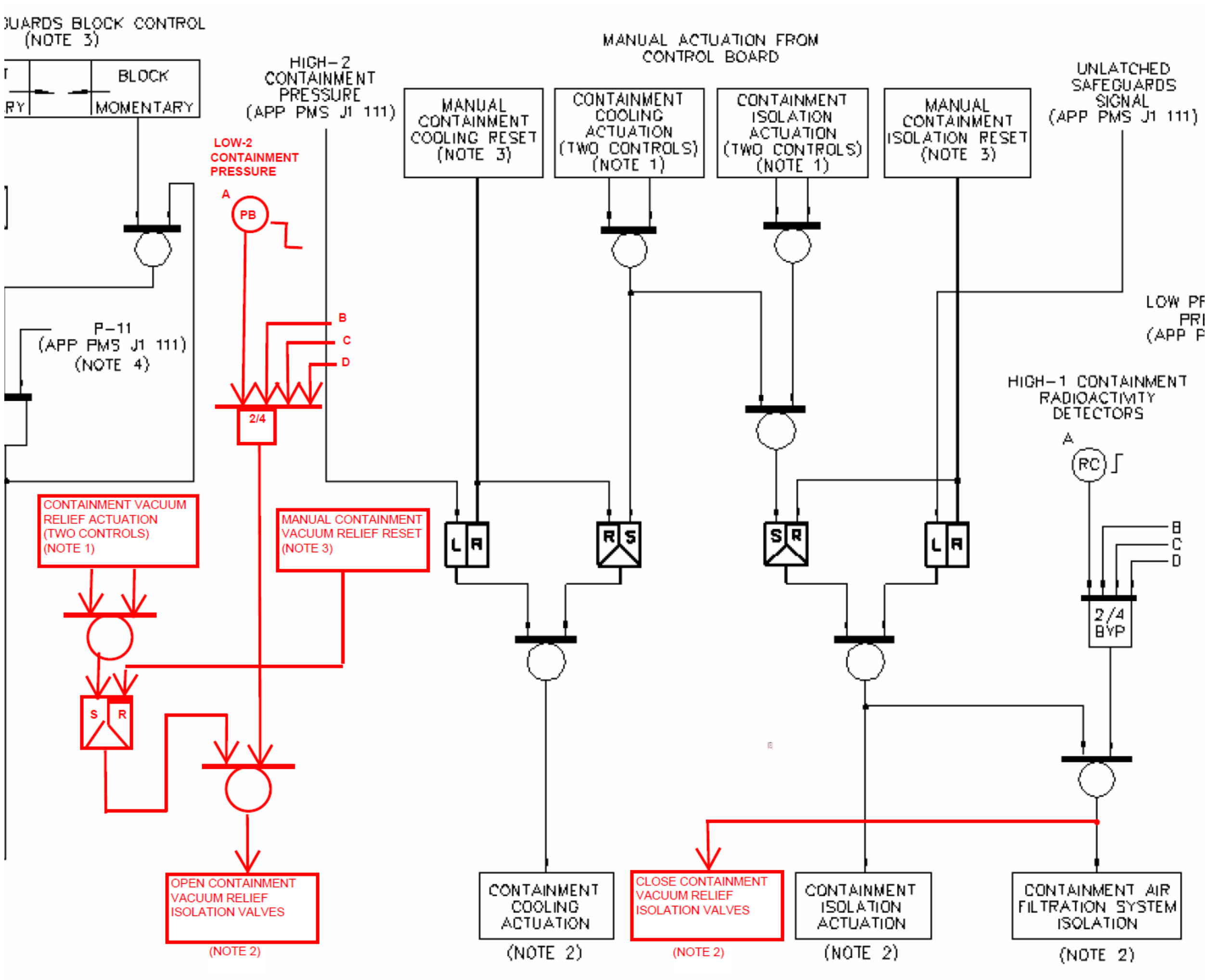


Table 7.3-1	Engineered Safety Features Actuation Signals

Table 7.3-1 (Sheet 9 of 9)

ENGINEERED SAFETY FEATURES ACTUATION SIGNALS

Actuation Signal	**No. of Divisions/ Controls**	**Actuation Logic**	**Permissives and Interlocks**
25. Pressurizer Heater Trip (Figure 7.2-1, Sheets 6 and 12)			
a. Core makeup tank injection	(See items 6a through 6e)		
b. High-3 pressurizer level	4	2/4 BYP[1]	Manual block permitted below P-19 Automatically unblocked above P-19
26. Steam Generator Relief Isolation (Figure 7.2-1, Sheet 9)			
a. Manual initiation	2 controls	½ controls	None
b. Low lead-lag compensated steam line pressure[4]	4/steam line	2/4-BYP[1] in either steam line	Manual block permitted below P-11 Automatically unblocked above P-11
27. Containment Vacuum Relief (Figure 7.2-1, Sheet 13)			
a. Low-2 containment pressure	4	2/4	None
b. Manual initiation	2 controls	1/2 controls	None

ATTACHMENT 20

Section Text 7.3.1	Engineered Safety Features Description

Subsection 7.3.1.2 provides a functional description of the signals and initiating logic for each of the engineered safety features. Figure 7.2-1 presents the functional diagrams for engineered safety features actuation.

and Section 6.2

Table 7.3-1 summarizes the signals and initiating logic for each of the engineered safety features initiated by the protection and safety monitoring system. Most of the functions provide protection against design basis events which are analyzed in Chapter 15. However, not all the functions listed in Table 7.3-1 are necessary to meet the assumptions used in performing the safety analysis. For example, the design provides features which provide automatic actuations which are not required for performing the safety analysis. In addition, some functions are provided to support assumptions used in the probabilistic risk assessment, but are not used to mitigate a design basis accident. Only those functions which meet the 10 CFR 50.36(c)(2)(ii) criteria are included in the AP1000 DCD, Section 16.1, Technical Specifications. This accounts for any difference between functions listed in Table 7.3-1 and functions which are included in the Technical Specifications.

7.3.1.1 Safeguards Actuation (S) Signal

A safeguards actuation (S) signal is used in the initiation logic of many of the engineered safety features discussed in subsection 7.3.1.2. In addition, as described in Section 7.2, the safeguards actuation signal also initiates a reactor trip. The variables that are monitored and used to generate a safeguards actuation signal are typically those that provide indication of a significant plant transient that requires a response by several engineered safety features.

The safeguards actuation signal is generated from any of the following initiating conditions:

ATTACHMENT 21

Section Text 7.3.1.2.25	Containment Vacuum Relief

7.3.1.2.25 Containment Vacuum Relief

A signal for opening the containment vacuum relief valves is generated from the following condition:

1. Low-2 containment pressure
2. Manual initiation

Condition 1 results from the incidence of containment pressure reaching the Low-2 set point in any two of the four divisions.

Condition 2 consists of two momentary controls. Manual actuation of either of the two controls will result in opening of the containment vacuum relief valves.

Either signal will actuate two motor operated containment isolation valves to break the containment vacuum.

The functional logic relating to containment vacuum relief is illustrated in Figure 7.2-1, sheet 13.

ATTACHMENT 22

Section Text 7.3.1.5.5	Design Basis: Engineered Safety Features for Malfunctions, Accidents, Natural Phenomena, or Credible Events

7.3.1.5.4 Design Basis: Limits for Engineered Safety Features Parameters in Various Reactor Operating Modes (Paragraph 4.3 of IEEE 603-1991)

During startup or shutdown, various engineered safety features actuation can be manually blocked. These functions are listed in Table 7.3-1.

During testing or maintenance of the protection and safety monitoring system, certain channels used for engineered safety features may be bypassed. Although no setpoints are changed for bypassing, the logic is automatically adjusted, as described in subsection 7.3.1.4. The safeguards channels that can be bypassed in the protection and safety monitoring system are listed in Table 7.3-1.

7.3.1.5.5 Design Basis: Engineered Safety Features for Malfunctions, Accidents, Natural Phenomena, or Credible Events (Paragraph 4.7 and 4.8 of IEEE 603-1991)

and Section 6.2

The accidents that the various engineered safety features are designed to mitigate are detailed in Chapter 15. Table 15.0-6 contains a summary listing of the engineered safety features actuated for various Condition II, III, or IV events. It relies on provisions made to protect equipment against damage from natural phenomena and credible internal events. Consequently, there are no engineered safety features actuated by the protection and safety monitoring system to mitigate the consequences of events such as fires.

Functional diversity is used in determining the actuation signals for engineered safety features. For example, a safeguards actuation signal is generated from high containment pressure, low pressurizer pressure, and low compensated steam line pressure. Engineered safety features are not normally actuated by a single signal. The extent of this diversity is seen from the initiating signals presented in subsections 7.3.1.1 and 7.3.1.2. Table 7.3-1 also lists the engineered safety features signals and the conditions that result from their actuation.

Redundancy provides confidence that engineered safety features are actuated on demand, even when the protection and safety monitoring system is degraded by a single random failure. The single-failure criterion is met even when engineered safety features channels are bypassed.

ATTACHMENT 23

Table 7.3-3	System-Level Manual Input to the Engineered Safety Features Actuation System

Table 7.3-3 (Sheet 2 of 2)

SYSTEM-LEVEL MANUAL INPUT TO THE ENGINEERED SAFETY FEATURES ACTUATION SYSTEM

Manual Control	**To Divisions**				**Figure 7.2-1 Sheet**
Manual passive containment cooling actuation #1	A	B	C	D	13
Manual passive containment cooling actuation #2	A	B	C	D	13
Manual passive containment isolation actuation #1	A	B	C	D	13
Manual passive containment isolation actuation #2	A	B	C	D	13
Manual depressurization system stages 1, 2, and 3 actuation #1 & #2	A	B	C	D	15
Manual depressurization system stages 1, 2, and 3 actuation #3 & #4	A	B	C	D	15
Manual depressurization system stage 4 actuation #1 & #2	A	B	C	D	15
Manual depressurization system stage 4 actuation #3 & #4	A	B	C	D	15
Manual IRWST injection actuation #1 & #2	A	B	C	D	16
Manual IRWST injection actuation #3 & #4	A	B	C	D	16
Manual containment recirculation actuation #1 & #2	A	B	C	D	16
Manual containment recirculation actuation #3 & #4	A	B	C	D	16
Manual control room isolation and air supply initiation #1	A	B	C	D	13
Manual control room isolation and air supply initiation #2	A	B	C	D	13
RCS pressure CVS/PRHR block control #1	A				6
RCS pressure CVS/PRHR block control #2		B			6
RCS pressure CVS/PRHR block control #3			C		6
RCS pressure CVS/PRHR block control #4				D	6
Normal residual heat removal system isolation safeguards block control #1	A				13
Normal residual heat removal system isolation safeguards block control #2		B			13
Boron dilution block control #1	A				3
Boron dilution block control #2		B			3
Boron dilution block control #3			C		3
Boron dilution block control #4				D	3
Manual RNS isolation #1 & #3	A	B		D	18
Manual RNS isolation #2 & #4	A	B		D	18
CVS letdown isolation block control #1	A				16
CVS letdown isolation block control #2				D	16
Manual containment vacuum relief actuation #1	A		C		13
Manual containment vacuum relief actuation #2	A		C		13

Table 7.5-1	Post-Accident Monitoring System

Table 7.5-1 (Sheet 3 of 12)

POST-ACCIDENT MONITORING SYSTEM

Variable	Range/ Status	Type/ Category	Qualification		Number of Instruments Required	Power Supply	QDPS Indication (Note 2)	Remarks
			Environmental	Seismic				
Startup feedwater flow	0-600 gpm	F2	Mild	Yes	1/steam generator (Note 11)	1E	No	
Startup feedwater control valve status	Open/ Closed	D2, F3	Harsh	Yes	1/valve (Note 7)	1E	Yes	
Containment pressure	-5 to 10 psig	B1, C2, D2, F2	Harsh	Yes	3 (Note 4)	1E	Yes	
Containment pressure (extended range)	0 to 240 psig	C1	Harsh	Yes	3 (Note 4)	1E	Yes	
Containment area radiation (high range)	10^0-10^7 R	C1, E2, F2	Harsh	Yes	3 (Note 4)	1E	Yes	
Reactor vessel hot leg water level	0-100% of span	B2, B3	Harsh	Yes	1	1E	Yes	Two instruments are provided
Plant vent radiation level	(Note 3)	C2, E2	Mild	None	1	Non-1E	No	
Remotely operated containment isolation valve status	Open/ Closed	B1, D2	Harsh/mild	Yes	1/valve (Note 7)	1E	Yes	Separate divisions on series valves
Containment vacuum relief valves	Open/ Closed	D2	Mild	Yes	1/valve (Note 7)	1E	Yes	
Boundary environs radiation	N/A	C3, E3	None	None	N/A	Non-1E	No	Site specific
Hydrogen concentration	0-20%	C3	None	None	1	Non-1E	No	Three instruments are provided

ATTACHMENT 25

Section Text 9.4.7.1.1	Containment Air Filtration System Safety Design Basis

9.4.7.1.1 Safety Design Basis

The containment air filtration system serves no safety-related function, other than provides the safety-related functions of containment isolation and containment vacuum relief. , and therefore has no nuclear safety design basis except for containment isolation. The containment isolation function is described in Section 6.2.3. The containment vacuum relief function automatically adjusts the internal containment pressure as it approaches the analyzed design parameters described in Section 6.2.1.1.4. This adjustment in the pressure across the containment shell preserves the structural integrity of the shell by maintaining the differential pressure within the allowable limits as defined by the structural analysis described in Section 3.8.2. The vacuum relief function is actuated on the Low-2 containment pressure signal and manually. See subsection 6.2.3 for a description of the containment isolation function and subsection 9.4.7 for a description of the containment vacuum relief function. System equipment and ductwork whose failure could affect the operability of safety-related systems or components are designed to seismic Category II requirements. The remaining portion of the system is non-seismic.

A secondary function of the containment isolation system is to provide containment vacuum relief by automatically adjusting the internal containment pressure once it approaches design parameters reflected in Section 6.2.1.1.4. This adjustment in pressure across the containment shell preserves the structural integrity of the shell by maintaining the differential pressure within allowable limits as defined by structural analysis. The VFS also provides a vacuum relief system for the containment vessel to prevent overpressurization from external pressure.

ATTACHMENT 26

Section Text 9.4.7.2.1	Containment Air Filtration System General Description

9.4.7.2.1 General Description

The exhaust air filtration units are located within the radiologically controlled area of the annex building at elevation 135′-3″ and 146′-3″. The filtration units are connected to a ducted system with isolation dampers to provide HEPA filtration and charcoal adsorption of exhaust air from the containment, fuel handling area, auxiliary and annex buildings. A gaseous radiation monitor is located downstream of the exhaust air filtration units in the common ductwork to provide an alarm if abnormal gaseous releases are detected. The plant vent exhaust flow is monitored for gaseous, particulate and iodine releases to the environment. During containment purge, the exhaust air filtration units satisfy 10 CFR 50 Appendix I guidelines (Reference 20) for offsite releases and meets 10 CFR 20 (Reference 21) allowable effluent concentration limits when combined with gaseous releases from other sources. During conditions of abnormal airborne radioactivity in the fuel handling area, auxiliary and/or annex buildings, the filtration units provide filtered exhaust to minimize unfiltered offsite releases.

The size of the containment air filtration system supply and exhaust air lines that penetrate the containment pressure boundary is 36 inches in diameter. Each penetration includes an inboard and outboard branch connection with 16 inch diameter containment isolation valves that are opened when the containment air filtration system is connected to the containment. The ends of the 36 inch containment penetrations are capped for possible future addition of a high volume purge system. In the event of a loss-of-coolant accident (LOCA) while the containment air filtration system is aligned to containment, there will not be a significant release of radioactivity during closure of the 16 inch diameter supply and exhaust valves. The maximum time for valve closure (see Table 6.2.3-1) is consistent with the analysis assumptions for radiological consequences (see Table 15.6.5-2). The closure time is also consistent with the basis (compliance with 10 CFR Part 100) for Branch Technical Position CSB 6-4 to Standard Review Plan 6.2.4 (Reference 23) or described in Subsection 6.2.1.5.

The exhaust air containment penetration also includes a containment vessel vacuum relief function to protect containment from reaching the containment shell design external design pressure.

The exhaust air containment penetrations also serve as a connection for the containment integrated leak rate test system to pressurize and depressurize the containment during integrated leak rate testing. Otherwise, the containment air filtration exhaust subsystem is not involved with the containment integrated leak rate test and is isolated from the containment during this time period.

ATTACHMENT 27

Section Text 9.4.7.2.2	Containment Air Filtration System Component Description

Supply and Exhaust Fans

The supply and exhaust air fans are centrifugal type, single width single inlet (SWSI), with high efficiency wheels and backward inclined blades to produce non-overloading horsepower characteristics. Fan performance is rated in accordance with ANSI/AMCA 210 (Reference 4), ANSI/AMCA 211 (Reference 5) and ANSI/AMCA 300 (Reference 6).

Containment Penetrations

The containment penetrations include containment isolation valves, interconnecting piping, and vent and test connections with manual test valves. The containment isolation components that maintain the integrity of the containment pressure boundary after a LOCA are classified as Safety Class B and seismic Category I. Seismic Category I debris screens are mounted on Safety Class C, seismic Category I pipe to prevent entrainment of debris through the supply and exhaust openings that may prevent tight valve shutoff. The screens are designed to withstand post-LOCA pressures.

The vent and purge line containment isolation valves inside and outside the containment have air operators. The valves are designed to fail closed in the event of loss of electrical power or air pressure. These valves are controlled by the protection and plant safety monitoring system as discussed in subsection 7.1.1. The valves shut tight against the containment pressure following a design basis accident.

The vacuum relief containment isolation valves have motor operators outside containment and are controlled by the protection and plant safety monitoring system as discussed in subsection 7.1.1. The valves inside containment are self actuated check valves. These motor operated valves and check valves shut tight against the containment pressure following a design basis accident.

Ductwork and Accessories

Ductwork, duct supports and accessories are constructed of galvanized steel. Ductwork subject to fan shutoff pressures is structurally designed to accommodate fan shutoff pressures. The system air ductwork inside containment meets seismic Category II criteria so that it will not fall and damage any safety-related equipment following a safe shutdown earthquake. Ductwork, supports and accessories meet the design and construction requirements of SMACNA Rectangular and Round Industrial Duct Construction Standards (References 16 and 34) and SMACNA HVAC Duct Construction Standard - Metal and Flexible (Reference 17). The exhaust air ductwork and supports meet the design and construction requirements of ASME AG-1 (Reference 36), Article SA-4500.

ATTACHMENT 28

Section Text 9.4.7.3	Containment Air Filtration System Safety Evaluation

9.4.7.3 Safety Evaluation

The containment air filtration system has ~~no~~ the safety-related functions of~~, other than~~ containment isolation and vacuum relief..~~, and therefore requires no nuclear safety evaluation.~~ The containment isolation function is evaluated in subsection 6.2.3. Two independent lines with an automatic isolation valve are provided on the positive pressure side of the system along with two independent lines with a check valve on the negative pressure side of the system penetrate containment. The lines share a common containment penetration. Therefore, there are no single active failures which would prevent the system from performing its function.

The failure of equipment and ductwork will not reduce the functioning of safety-related systems, structures or components that are required to close to maintain containment isolation integrity after a design basis accident. Ductwork that is located inside containment whose failure may affect any safety-related equipment is designed to seismic Category II requirements.

ATTACHMENT 29

Figure 9.4.7-1	Containment Air Filtration System Piping and Instrumentation Diagram

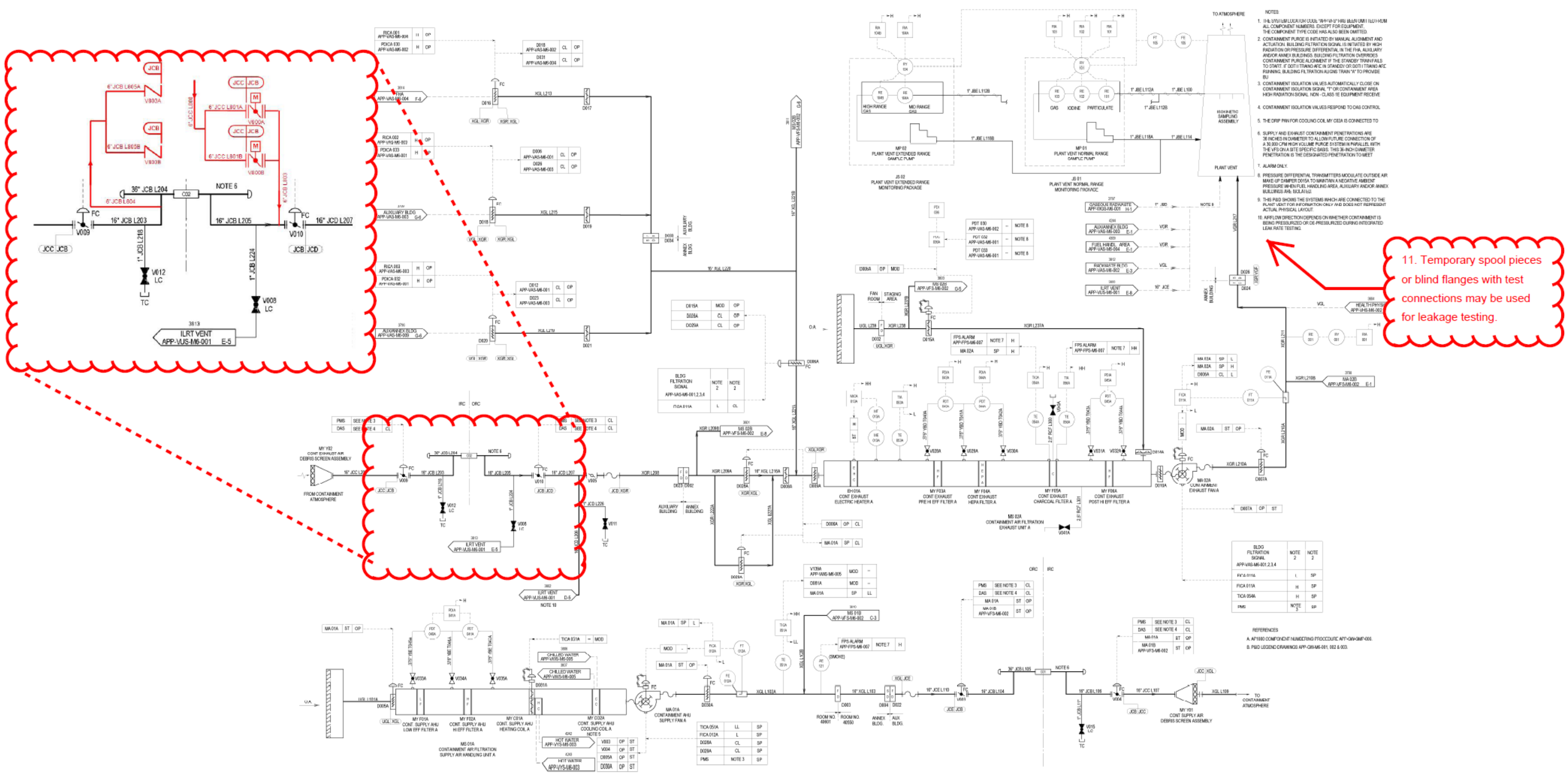


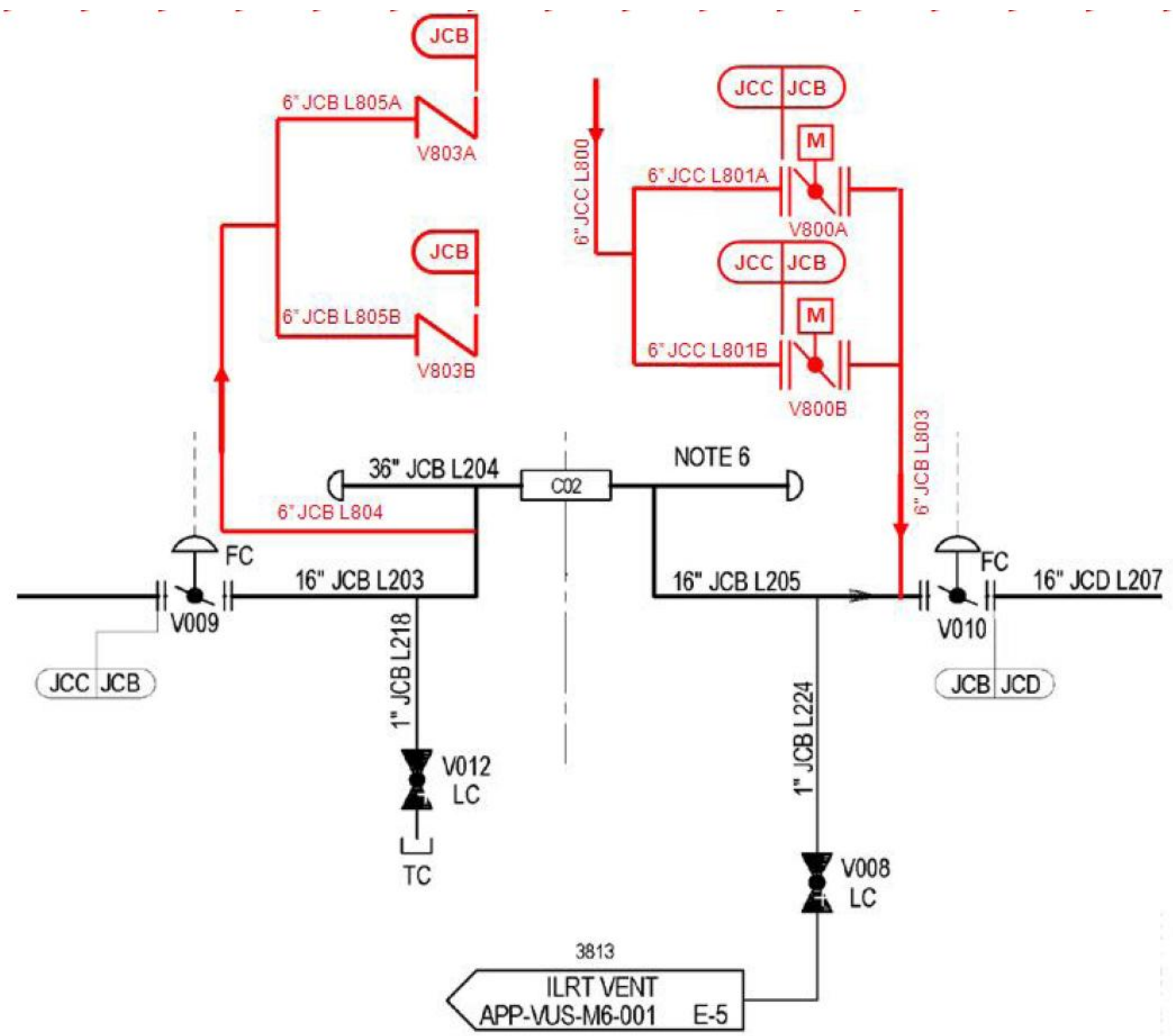
Figure 9.4.7-1 (Sheet 1 of 2)

Containment Air Filtration System Piping and Instrumentation Diagram
(REF) VFS 001

Figure represents system functional arrangement. Details internal to the system may differ as a result of implementation factors such as vendor-specific component requirements.

ATTACHMENT 29 (CONTINUED)

Figure 9.4.7-1	Containment Air Filtration System Piping and Instrumentation Diagram



ATTACHMENT 30

Table 9A-2	Safe Shutdown Components

Table 9A-2 (Sheet 8 of 14)

SAFE SHUTDOWN COMPONENTS

Fire Area/ Fire Zone	**System**	**Description**	**Class 1E Division**			
			A	**C**	**B**	**D**
1200 AF 01	SFS	Discharge Line Cont. Isol. Valve	V038			
	VFS	Containment Purge Discharge Cont. Isolation Valve	V010			
	VFS	Vacuum Relief Containment Isolation Valve	V800A	V800B		
	RNS	Discharge Cont. Isolation Valve	V011			
		Suction Header Cont. Isolation Valve	V022			
1200 AF 03	IDS	Class 1E Cable Trays			Note 1	Note 1
1201 AF 02	IDSB	24 Hr Battery 1A			DB-1A	
		24 Hr Battery 1B			DB-1B	
		72 Hr Battery 2A			DB-2A	
		72 Hr Battery 2B			DB-2B	
		250 Vdc Distribution Panel			DD-1	
		208/120 Vac Distribution Panel			EA-1	
		208/120 Vac Distribution Panel			EA-2	
		208/120 Vac Distribution Panel			EA-3	
		250 Vdc Switchboard			DS-1	

ATTACHMENT 31

Tech Spec 3.3.2	ESFAS Actuation Instrumentation

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
CC. Required Action and associated Completion Time not met in MODES 1, 2, 3 or 4.	CC.1.1 Be in MODE 3. AND CC1.2 Be in MODE 5 with containment equipment hatch or containment airlock open. OR CC.2 Reduce differential temperature to [≤ 90]°F.	6 hours 36 hours 36 hours
DD. Required Action and associated Completion Time not met in MODES 5 or 6.	DD.1 Be in MODE 5 or 6 with containment equipment hatch or containment airlock open. OR DD.2 Reduce differential temperature to ≤ [90]°F.	6 hours 6 hours

ATTACHMENT 31 (CONTINUED)

Tech Spec 3.3.2	ESFAS Actuation Instrumentation

TABLE 3.3.2-1 (PAGE 14 OF 14)
ENGINEERED SAFEGUARDS ACTUATION SYSTEM INSTRUMENTATION

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS
31. Containment Vacuum Relief Valve Isolation				
a. Containment Radioactivity – High 1	1,2,3,4[(j)]	4	B,Z	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
b. Containment Pressure – High 2	1,2,3,4	4	B,O	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
b. Manual Initiation of Passive Containment Cooling	1,2,3,4, 5[(e,m)],6[(e,m)]	Refer to Function 12.a (Passive Containment Cooling Actuation) for initiating functions and requirements.		
d. Manual Containment Isolation Actuation	1,2,3,4, 5[(m)], 6[(m)]	Refer to Function 3.a (Containment Isolation) for initiating functions and requirements.		
32. Containment Vacuum Relief Valve Actuation				
a. Containment Pressure –Low 2	1[(s)],2[(s)],3[(s)],4[(s)]	4	B,CC	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
	5[(s,t)],6[(s,t)]	4	B,DD	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
b. Manual Initiation	1[(s)],2[(s)],3[(s)],4[(s)]	2 controls	E,CC	SR 3.3.2.3
	5[(s,t)],6[(s,t)]	2 controls	E,DD	SR 3.3.2.3

(e) With decay heat > 9.0 MWt.

(j) With the RCS not being cooled by the Normal Residual Heat Removal System (RNS).

(m) Not applicable for valve isolation Functions whose associated flow path is isolated.

(s) When containment inside to outside differential air temperature > [90]°F.

(t) With containment equipment hatch and both containment airlocks closed.

APPLICABLE SAFETY ANALYSES, LCOs, and APPLICABILITY (continued)

30. Component Cooling Water System Containment Isolation Valve Closure

The function of the Component Cooling Water System (CCS) containment isolation valve closure is to ensure that the CCS flow paths can be isolated during an RCP heat exchanger tube rupture event. The CCS flow paths must be isolated following an RCP heat exchanger tube rupture event to minimize radiological releases from the ruptured tube into the turbine building. The CCS flow path is isolated by the closure of the CCS containment isolation valves, which receive a close signal on high RCP bearing water temperature.

30.a. Reactor Coolant Pump Bearing Water Temperature – High

The CCS containment isolation valves are closed if two-out-of-four sensors on any RCP indicate high bearing water temperature. This Function is required to be OPERABLE in MODES 1 and 2. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function.

31. Containment Vacuum Relief Valve Isolation

Containment Vacuum Relief Valve Isolation provides isolation of the containment atmosphere and selected process systems which penetrate containment from the environment. This Function is necessary to prevent or limit the release of radioactivity to the environment in the event of a large break LOCA.

Manual and automatic initiation of Containment Vacuum Relief Valve Isolation must be OPERABLE in MODES 1, 2, 3, and 4, when containment integrity is required. Manual initiation is required in MODE 5 and MODE 6 for closure of open penetrations providing direct access from the containment atmosphere to the outside atmosphere. Manual initiation of this Function in MODES 5 and 6 is not applicable if the direct access lines penetrating containment are isolated. Initiation of containment isolation by manual initiation of passive containment cooling in MODE 5 or 6 with decay heat ≤ 9.0 MWt is not required because OPERABILITY of the passive containment cooling system is not required when air cooling is sufficient. This provides the capability to manually initiate containment isolation during all MODES. Automatic Safeguards Actuation is required

APPLICABLE SAFETY ANALYSES, LCOs, and APPLICABILITY (continued)

in MODE 5 for closure of open penetrations providing direct access from the containment atmosphere to the outside atmosphere. Automatic Safeguards Actuation is not required in MODE 6 because manual initiation is sufficient to mitigate the consequences of an accident in this MODE.

31.a. Containment Radioactivity – High 1

Four channels of Containment Radioactivity – High 1 are required to be OPERABLE in MODES 1, 2, 3, and 4 with the RCS not being cooled by the RNS, when the potential exists for a LOCA, to protect against radioactivity inside containment being released to the atmosphere. These Functions are not required to be OPERABLE in MODE 4 with the RCS being cooled by the RNS or MODES 5 and 6, because any DBA release of radioactivity into the containment in these MODES would not require containment isolation.

31.b. Containment Pressure – High 2

This signal provides protection against a LOCA or SLB inside containment. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function.

The transmitters and electronics are located outside containment; thus, they will not experience harsh environmental conditions and the NTS reflects steady-state instrument uncertainties. The Containment Pressure – High 2 setpoint has been specified as low as reasonable, without creating potential for spurious trips during normal operations, consistent with the TMI action item (NUREG-0933, Item II.E.4.2) guidance.

3.b. Manual Initiation of Passive Containment Cooling (Function 12.a)

Containment Vacuum Relief Valve Isolation is also initiated by Manual Initiation of Passive Containment Cooling. This is accomplished as described for ESFAS Function 12.a, but is not applicable if the vacuum relief flow paths are isolated.

31.d. Manual Containment Isolation Actuation (Function 3.a)

Containment Vacuum Relief Valve Isolation is also initiated by Manual Initiation of Containment Isolation. This is accomplished as described for ESFAS Function 3.a, but is not applicable if the vacuum relief flow paths are isolated.

32. Containment Vacuum Relief Valve Actuation

APPLICABLE SAFETY ANALYSES, LCOs, and APPLICABILITY (continued)

The purpose of the vacuum relief lines is to protect the containment vessel against damage due to a negative pressure (i.e., a lower pressure inside than outside).

Manual and automatic Containment Vacuum Relief Valve actuation must be OPERABLE in MODES 1 through 4 when containment inside to outside differential air temperature > [90]°F and in MODES 5 and 6 with containment equipment hatch and both containment airlocks closed and the containment inside to outside differential air temperature > [90]°F.

32.a. Containment Pressure – Low 2

This signal provides protection against a negative pressure in containment due to loss of AC power or inadvertent actuation of containment cooling and a low outside ambient air temperature in combination with limited containment heating that reduces the atmospheric temperature (and hence pressure) inside containment.

Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function.

32.b. Manual initiation

The operator can open the vacuum relief valves at any time from the main control room by actuating either of the two containment cooling actuation switches. There are two switches in the main control room, either of which will actuate containment cooling in all divisions.

ESFAS instrumentation satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

ACTIONS (continued)

BB.1 and BB.2

With one channel inoperable, the inoperable channel must be placed in bypass and the hot leg level continuously monitored.

If one channel is placed in bypass, automatic actuation will not occur. Continuous monitoring of the hot leg level provides sufficient information to permit timely operator action to ensure that ADS Stage 4 actuation can occur, if needed to mitigate events requiring RCS makeup, boration, or core cooling. Operator action to manually initiate ADS Stage 4 actuation is assumed in the analysis of shutdown events (Reference 10). It is also credited in the shutdown PRA (Reference 11) when automatic actuation is not available.

CC.1.1,CC.1.2, and CC.2

In MODE 1, 2, 3, or 4, if the vacuum relief valve actuation function cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 with containment equipment hatch or a containment airlock open, within 36 hours. Opening of the hatch or an airlock provides the required vacuum relief path in the event of a low pressure event. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

Alternatively the plant may be placed outside of the Applicability by reducing the containment ambient air temperature to achieve an inside to outside differential air temperature of ≤ [90]°F, thus precluding a containment cooling event that produces a negative containment pressure below the design limit. Compliance with LCO 3.6.4, Containment Pressure, must be maintained during the temperature reduction.

DD.1 and DD.2

In MODE 5 or 6, if the vacuum relief valve actuation function cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the containment equipment hatch or a containment airlock must be opened, within 6 hours. Opening of the hatch or an airlock provides the required vacuum relief path in the event of a low pressure event. The allowed Completion Time is reasonable, for opening the hatch or an airlock in an orderly manner.

Alternatively the plant may be placed outside of the Applicability by reducing the containment ambient air temperature to achieve an inside to outside differential air temperature of ≤ [90]°F, thus precluding a containment cooling event that produces a negative containment pressure below the design limit.

ATTACHMENT 33

Tech Spec Bases B 3.6.4	Containment Pressure Bases

BASES

APPLICABLE SAFETY ANALYSES (continued)

Inadvertent Incontainment Refueling Water Storage Tank (IRWST) drain

Inadvertent Passive Containment Cooling System (PCS) actuation

~~Since the containment external pressure design limits can be met by ensuring compliance with the initial pressure condition, NUREG-1431 LCO 3.6.12, Vacuum Relief System is not applicable to the AP1000 containment.~~

Containment pressure satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

Maintaining containment pressure at less than or equal to the LCO upper pressure limit ensures that, in the event of a DBA, the resultant peak containment accident pressure will remain below the containment design pressure. Maintaining containment pressure at greater than or equal to the LCO lower pressure limit ensures that the containment will not exceed the design negative differential pressure following negative pressure transients.

APPLICABILITY

In MODES 1, 2, 3, and 4, a DBA could cause a release of radioactive material to containment. Since maintaining containment pressure within limits is essential to ensure initial conditions assumed in the accident analyses are maintained, the LCO is applicable in MODES 1, 2, 3, and 4.

In MODES 5 and 6, the probability and consequences of these events are reduced due to the pressure and temperature limitations of these MODES. Therefore, maintaining containment pressure within the limits of the LCO is not required in MODE 5 or 6.

ACTIONS

A.1

When containment pressure is not within the limits of the LCO, it must be restored within 1 hour. The Required Action is necessary to return operation to within the bounds of the containment analysis. The 1 hour Completion Time is consistent with the ACTIONS of LCO 3.6.1, “Containment,” which requires that containment be restored to OPERABLE status within 1 hour.

ATTACHMENT 34

Tech Spec 3.6.10	Vacuum Relief Valves

3.6 CONTAINMENT SYSTEMS

3.6.10 Vacuum Relief Valves

LCO 3.6.10 Two vacuum relief lines shall be OPERABLE.

APPLICABILITY: MODES 1, 2, 3, and 4 with containment inside to outside differential air temperature > [90]°F.
MODES 5 and 6 with both containment equipment hatches and both containment airlocks closed with containment inside to outside. differential air temperature > [90]°F.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One vacuum relief line inoperable.	A.1 Restore vacuum relief line to OPERABLE status.	72 hours
B. Required Action and associated Completion Time not met in MODES 1, 2, 3 or 4.	B.1.1 Be in MODE 3. AND B1.2 Be in MODE 5 with a containment equipment hatch or containment airlock open. OR B.2 Reduce differential temperature to [≤ 90]°F.	6 hours 36 hours 36 hours

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Required Action and associated Completion Time not met in MODES 5 or 6.	C.1 Be in MODE 5 or 6 with containment equipment hatch or containment airlock open. OR C.2 Reduce differential temperature to ≤ [90]°F.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.6.10.1	Verify each vacuum relief line is OPERABLE in accordance with the Inservice Testing Program.	In accordance with the Inservice Testing Program

ATTACHMENT 35

Tech Spec B 3.6.10	Vacuum Relief Valves Bases

B 3.6 CONTAINMENT SYSTEMS

B 3.6.10 Vacuum Relief Valves

BASES

BACKGROUND

The purpose of the vacuum relief lines is to protect the containment vessel against damage due to a negative pressure (i.e., a lower pressure inside than outside). Excessive negative pressure inside containment can occur, if there is a loss of AC power (VCS containment heating not available, reactor trip decay heating only) with a differential (inside to outside) ambient temperature ≥ [90]°F. In this case, the relative low outside ambient temperature may cool containment faster than the available heat sources (primarily, reactor decay heat) can heat containment, resulting in a reduction of the containment temperature and pressure below the negative pressure design limit, since normal, non-safety related pressure control means are not available due to loss of AC power. In addition, excessive negative pressure inside containment can occur, in the event of malfunction of the Containment Fan Coolers (VFS) control, in combination with low outside ambient temperature, that reduces containment temperature.

The containment pressure vessel contains two, parallel, 100% capacity vacuum relief lines with a shared containment penetration that protect the containment from excessive external pressure loading. Each line outside containment contains a normally-closed, motor-operated valve (MOV). The MOVs receive an ESF "open" signal on low containment pressure < -[0.8] psig. The MOVs close on an ESF containment isolation signal, as well as on High-2 containment pressure signal and High-1 containment radioactivity. Each line inside containment contains a normally-closed, self-actuated check valve inside containment that opens on a negative differential pressure of 0.2 psi. A vacuum relief line consists of one MOV and one check valve and the shared containment penetration.

Tech Spec B 3.6.10	Vacuum Relief Valves Bases

APPLICABLE SAFETY ANALYSES

Design of the vacuum relief lines involves calculating the effect of loss of AC power, and an ambient air temperature in combination with limited containment heating that reduces the atmospheric temperature (and hence pressure) inside containment (Ref. 1). Conservative assumptions are used for relevant parameters in the calculation: for example inside containment temperature, outside air temperature, etc. The resulting containment pressure versus time is calculated, including the effect of the opening of the vacuum relief lines when their negative pressure setpoint is reached. It is also assumed that one valve fails to open.

The containment was designed for an external pressure load equivalent to -1.5 psig. The excessive containment cooling events were analyzed to determine the resulting reduction in containment pressure. The initial pressure condition used in this analysis was -0.2 psig. This resulted in a minimum pressure inside containment of [-1.3] psig, which is less than the design load.

The vacuum relief valves must also perform the containment isolation function in a containment high pressure event. For this reason, the system is designed to take the full containment positive design pressure and the environmental conditions (temperature, pressure, humidity, radiation, chemical attack, etc.) associated with the containment DBA.

The vacuum relief valves satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

Tech Spec B 3.6.10	Vacuum Relief Valves Bases

BASES

LCO

The LCO establishes the minimum equipment required to accomplish the vacuum relief function following excessive containment cooling events. Two 100% vacuum relief lines are required to be OPERABLE to ensure that at least one is available, assuming one or both valves in the other line fail to open.

APPLICABILITY

In MODES 1 through 6, when the inside to outside differential air temperature > [90]°F the potential exists for excessive containment cooling events to produce a negative containment pressure below the design limit. However, in MODE 5 or 6 a containment equipment hatch or airlock may be opened (LCO 3.6.8, Containment Penetrations), providing a vacuum relief path that is sufficient to preclude a negative containment pressure below the design limit.

Therefore, the vacuum relief lines are required to be OPERABLE in MODES 1 through 4 when containment inside to outside differential air temperature > [90]°F and in MODES 5 and 6 with both containment equipment hatches and both containment airlocks closed, when and the containment inside to outside differential air temperature > [90]°F.

ACTIONS

A.1

When one of the required vacuum relief lines is inoperable, the inoperable line must be restored to OPERABLE status within 72 hours. The specified time period is consistent with other LCOs for the loss of one train of a system required to mitigate the consequences of a LOCA or other DBA.

B.1.1, B1.2, and B.2

In MODE 1, 2, 3, or 4, if the vacuum relief line cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 with a containment equipment hatch or a containment airlock open, within 36 hours. Opening of a hatch or an airlock provides the required vacuum relief path in the event of a low pressure event. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

Tech Spec B 3.6.10	Vacuum Relief Valves Bases

Alternatively the plant may be placed outside of the Applicability by reducing the containment ambient air temperature to achieve an inside to outside differential air temperature of ≤ [90]°F, thus precluding a containment cooling event that produces a negative containment pressure below the design limit. Compliance with LCO 3.6.4, Containment Pressure, must be maintained during the temperature reduction.

C.1 and C.2

In MODE 5 or 6, if the vacuum relief line cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, a containment equipment hatch or a containment airlock must be opened, within 6 hours. Opening of a hatch or an airlock provides the required vacuum relief path in the event of a low pressure event. The allowed Completion Time is reasonable, for opening the hatch or an airlock in an orderly manner.

Alternatively the plant may be placed outside of the Applicability by reducing the containment ambient air temperature to achieve an inside to outside differential air temperature of ≤ [90]°F, thus precluding a containment cooling event that produces a negative containment pressure below the design limit.

ATTACHMENT 35 (CONTINUED)

Tech Spec B 3.6.10	Vacuum Relief Valves Bases

BASES

SURVEILLANCE REQUIREMENTS

SR 3.6.10.1

This SR cites the Inservice Testing Program, which establishes the requirement that inservice testing of the ASME Code Class 1, 2, and 3 pumps and valves shall be performed in accordance with the ASME Code (Ref. 2). Therefore, SR Frequency is governed by the Inservice Testing Program.

REFERENCES

1. DCD, Section 6.2.
2. ASME Code for Operation and Maintenance of Nuclear Power Plants.

ATTACHMENT 36

Table 18.12.2-1	Minimum Inventory of Fixed Position Controls, Displays, and Alerts

Table 18.12.2-1 (Sheet 2 of 2)

MINIMUM INVENTORY OF FIXED POSITION CONTROLS, DISPLAYS, AND ALERTS

Description	Control	Display	Alert(2)
Manual reactor trip (Also initiates turbine trip Figure 7.2-1, sheet 19.)	x		
Manual safeguards actuation	x		
Manual CMT actuation	x		
Manual main control room emergency habitability system actuation(4)	x		
Manual ADS actuation (1-3 and 4)	x		
Manual PRHR actuation	x		
Manual containment cooling actuation	x		
Manual IRWST injection actuation	x		
Manual containment recirculation actuation	x		
Manual containment isolation	x		
Manual main steamline isolation	x		
Manual feedwater isolation	x		
Manual containment hydrogen igniter (nonsafety-related)	x		
Manual Vacuum Relief Actuation	x		

Notes:

1. Although this parameter does not satisfy any of the selection criteria of subsection 18.12.2, its importance to manual actuation of ADS justifies its placement on this list.
2. These parameters are used to generate visual alerts that identify challenges to the critical safety functions. For the main control room, the visual alerts are embedded in the safety-related displays as visual signals. For the remote shutdown workstation, the visual alerts are embedded in the nonsafety-related displays as visual signals.
3. These instruments are not required after 24 hours. (Subsection 7.5.4 includes more information on the class 1E valve position indication signals, specified as part of the post-accident monitoring instrumentation.)
4. This manual actuation capability is not needed at the remote shutdown workstation.

5.0 CONTAINMENT VESSEL EXTERNAL PRESSURE ANALYSIS

Ch. 6 Safety Analysis (6.2.1.1.4):

Table 1 documents the differences in key assumptions associated with the AP1000 DCD external pressure analysis from Rev. 15 to the proposed version in Rev. 18.

Table 1: DCD Analysis Assumptions

Assumption	Rev. 15	Rev. 18
Containment Heat Rate	0 Btu/s	469.2(Btu/s)[1]
Initial Humidity	100%	100%
Initial Containment Internal Temperature	120°F	120°F
Initial Containment External Temperature	-40°F	33°F[2]
Initial Containment Shell Temperatures	60°F	Equilibrium[3]
PCS Air-flow	24.8 ft/s	24.8 ft/s[4]
External Temperature (Transient)	N/A	Cosine Distribution[5]

[1]For the proposed Rev. 18 analysis containment heat rate prior to transient initiation is assumed to be 469.2 BTU/s. This value is approximately 1/5 the design heat rate of 2366.7 Btu/s used to size the heat removal capability of the fan coolers without the 15% sizing margin required for the fan cooler sizing by the Utility Requirements Document (URD). This value is calculated from CENTS which is a two-phase transient analysis tool, and is based on conservative heat losses through RCS piping and components. The main reason for the large difference in the heat rates is the CENTS code does not account for the heat losses of major RCS component support anchors. These are the main supports for components such as Steam Generators (SGs), Pressurizer (PZR)…etc. These supports cannot be insulated due to concrete temperature concerns, but are rigidly attached metallic supports and will generate a substantial amount of heat into the RCS.

[2]The containment external temperature of 33F is determined based on equilibrium transients performed to determine what external temperature will yield 120°F inside containment, as this will provide the most bounding external pressure scenario. The equilibrium transients assumed the design heat rate of 2366.7 Btu/s and no active containment cooling. This assumption will maximize the containment internal temperature and maximize the associated external pressure excursion at transient initiation.

[3]The same equilibrium runs depicted in footnote 2 were used to determine the containment internal/external equilibrium metal temperatures. This is still conservative as the assumptions on heat transfer incorporated in the Rev. 15 DCD external pressure model were assumed for the proposed DCD Rev. 18 model. This is conservative as the external pressure model minimizes the internal heat transfer mechanisms, and maximizes the external heat transfer mechanisms.

[4]For the proposed analysis for Rev. 18, the PCS is assumed to be in natural convection during the pre-transient equilibrium phase. This minimizes heat transfer, and at transient initiation the wind is assumed to step change to 24.8 ft/s forced convection. This will maximize heat transfer and the associated negative pressure excursion.

[5]For the proposed Rev. 18 analysis the external temperature is assumed to begin decreasing from 33°F at transient initiation according to a chopped cosine distribution. The distribution proceeds to reduce temperature from 33°F to 13 °F in 12 hours. This is done to conservatively represent a change from night and day meteorological attributes.

Summary

The proposed Rev. 18 analysis uses an equilibrium run to determine more credible initial conditions. Sensitivities performing the entire transient in one run were performed, however it is impossible to have 100% humidity and be in equilibrium, because the containment shell is always below the dew point temperature, and the humidity always equilibrates below 50% within 1,000-2,000 seconds. The humidity assumption was kept in the analysis because it is conservative, albeit thermodynamically impossible. Also, the containment equilibrium temperature was achieved without the active cooling system in operation. This is also conservative, as it will maximize internal temperature. This also provides a conservative basis for the Tech Spec changes on temperature.

Figures 1-2 show the -40 °F transients. Figure 1 represents the pressure response for the combined equilibrium transient, and Figure 2 represents the response for the 100% humidity transient.

Figures 3-4 show the 8 °F transients. Figure 3 represents the pressure response for the combined equilibrium transient, and Figure 4 represents the response for the 100% humidity transient.

Figures 5-6 show the 33°F transients. Figure 5 represents the pressure response for the combined equilibrium transient, and Figure 6 represents the response for the 100% humidity transient.

Table 2 shows the pressure at 1 hour for each transient. ***The most extreme pressure listed in Table 2 is used to determine the maximum depressurization rate, and is used to size and verify the setpoint of the vacuum relief system.*** **The 33 °F 100% humidity is the most severe case and will be used to size the vacuum relief system.**

Table 2: Pressure Response Magnitude Values

(psia)	**LOAC**	**H100%**
P8	13.4278	13.0446
P33	13.5262	12.9112
N40	13.3497	13.2404

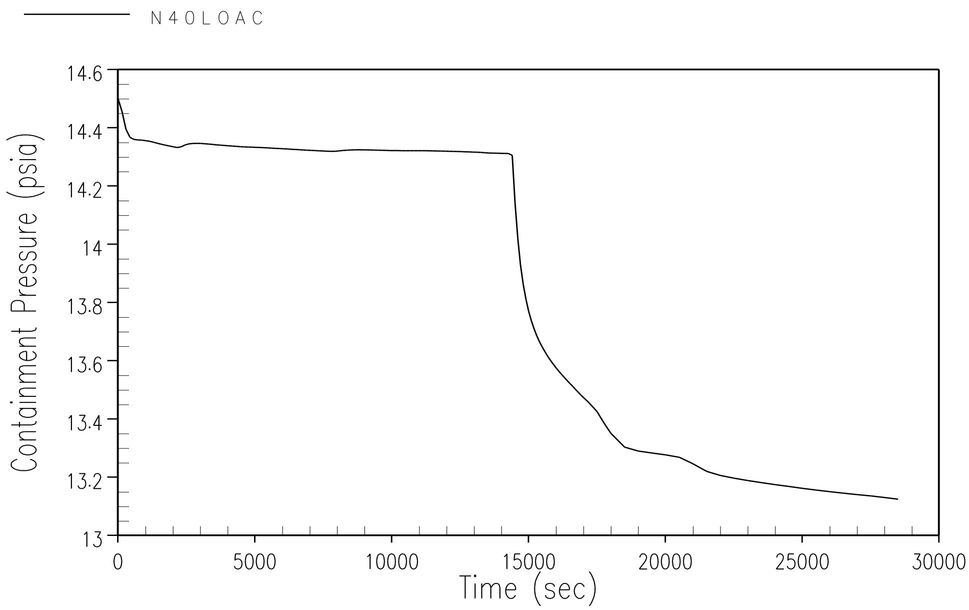


Figure 1: Containment Pressure Response at -40 F and 50% humidity.

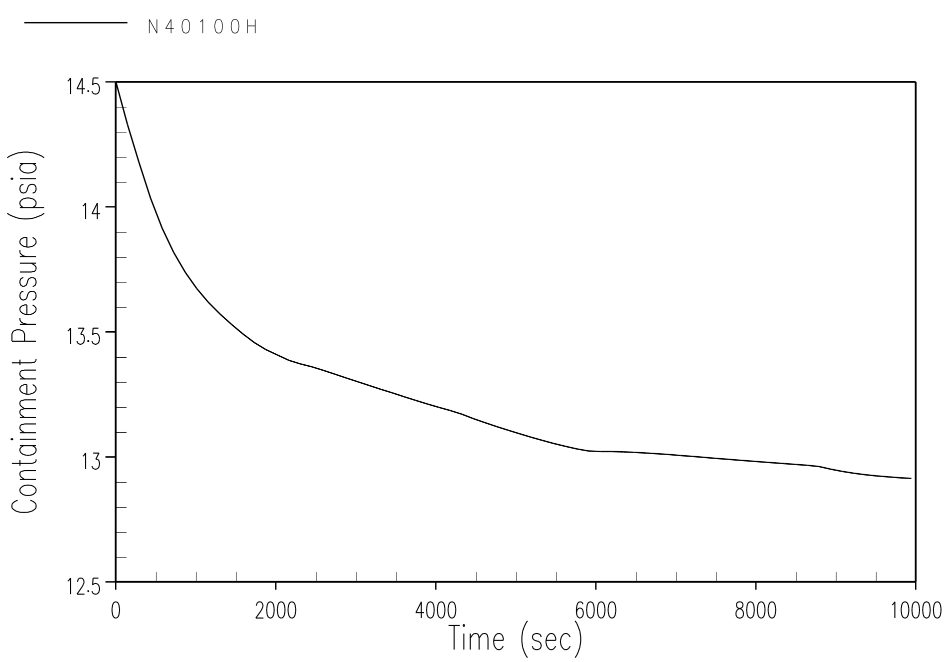


Figure 2: Containment Pressure Response at -40 F and 100% humidity.

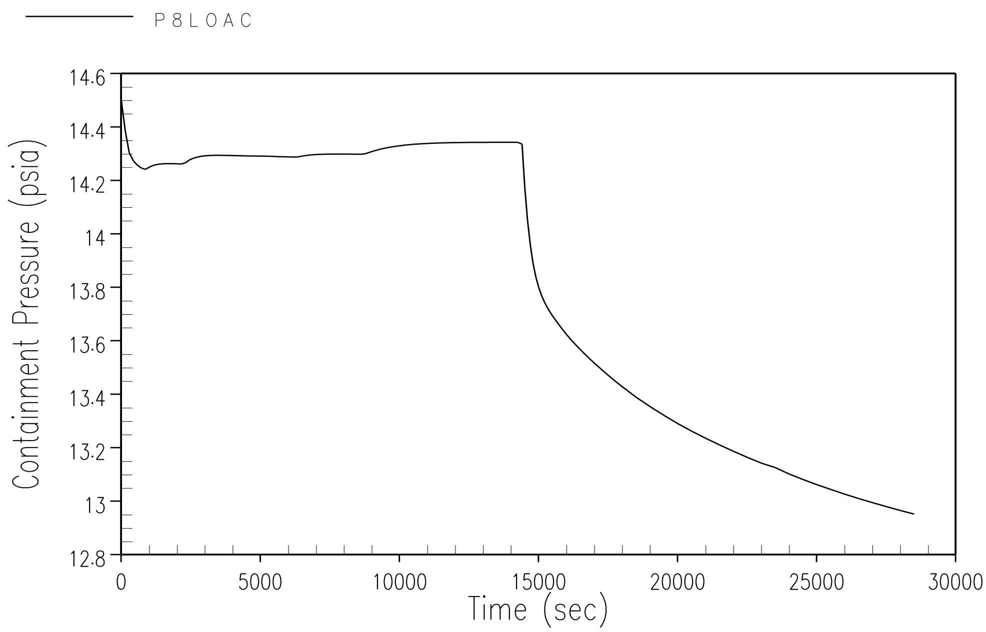


Figure 3: Containment Pressure Response at 8 F and 50% humidity.

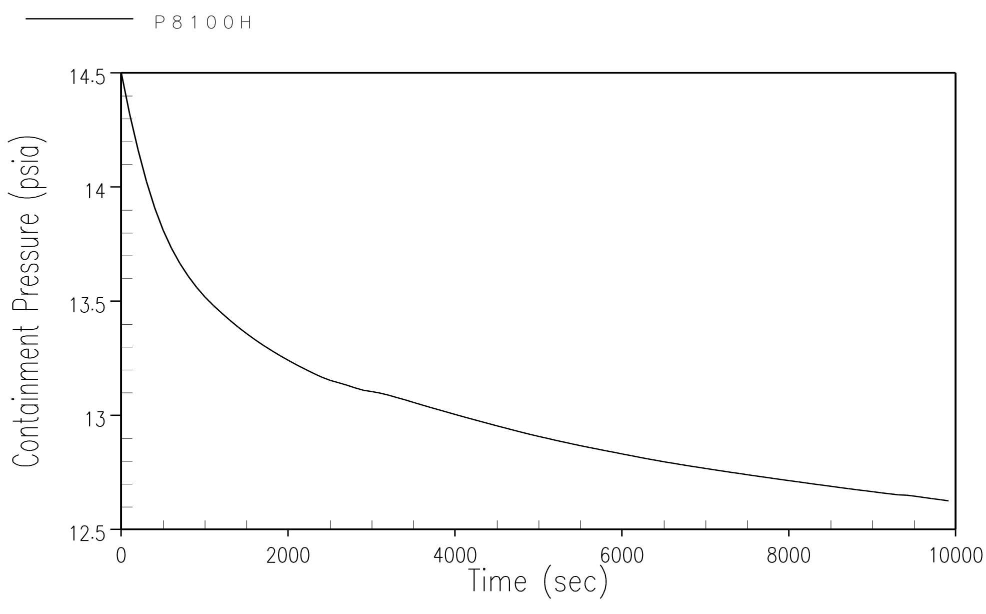


Figure 4: Containment Pressure Response at 8 F and 100% humidity

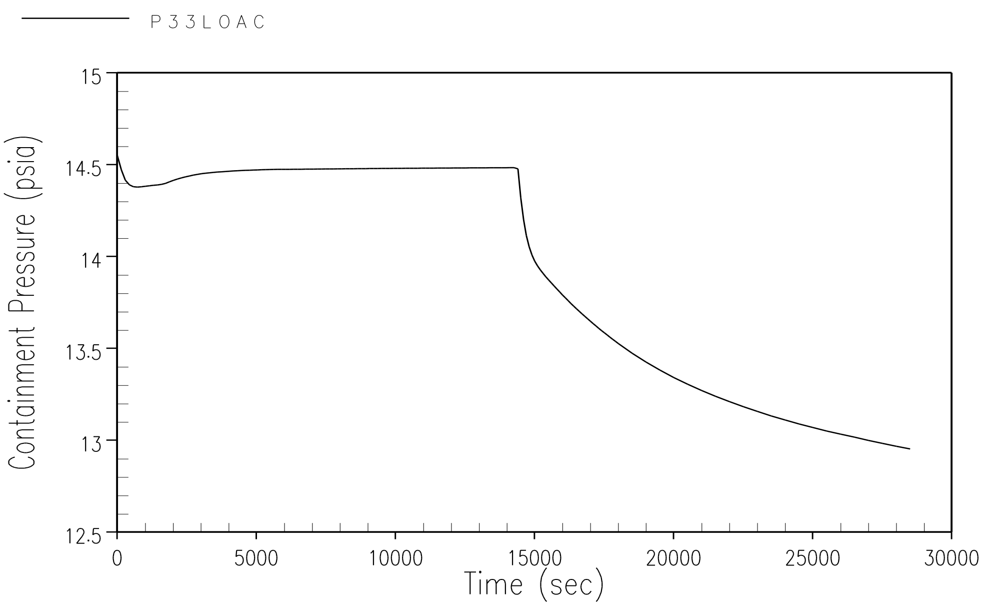


Figure 5:**Containment Pressure Response at 33 F and 50% humidity**

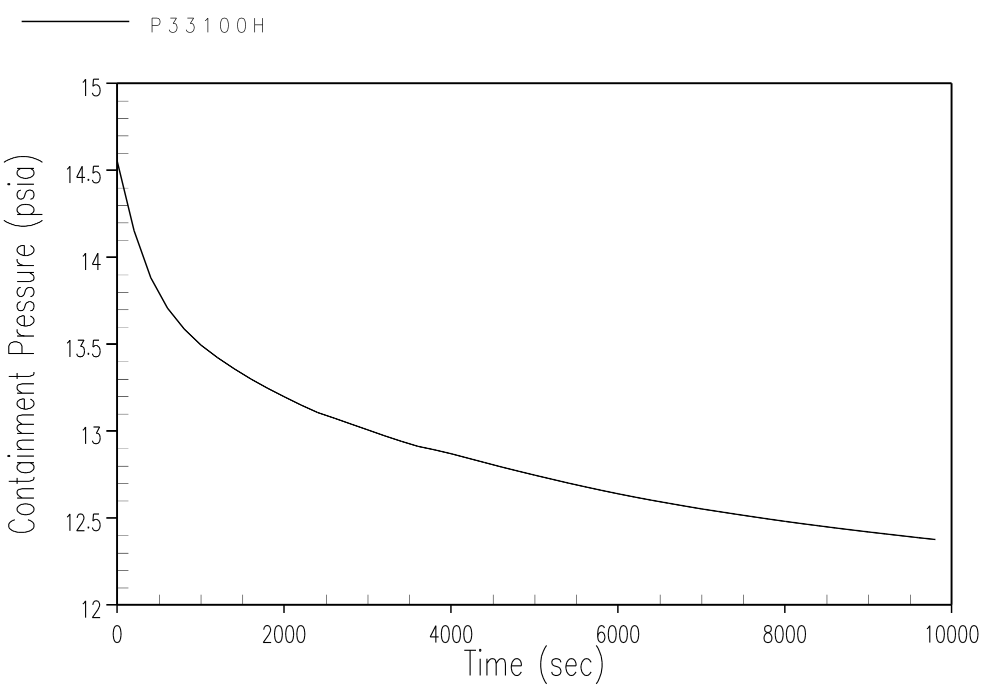


Figure 6: Containment Pressure Response at 33 F and 100% humidity