MITSUBISHI HEAVY INDUSTRIES, LTD.
16-5, KONAN 2-CHOME, MINATO-KU
TOKYO, JAPAN

April 09, 2009

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Mr. Jeffrey A. Ciocco,

Docket No. 52-021
MHI Ref: UAP-HF-09165

Subject: MHI's Responses to US-APWR DCD RAI No. 198-2069 Revision 0

Reference: 1) "Request for Additional Information No. 198-2069 Revision 0, SRP Section: 14.03.11 - Containment Systems and Severe Accidents - Inspections, Tests, Analyses, and Acceptance Criteria" dated February 09, 2009.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Responses to Request for Additional Information No. 198-2069 Revision 0."

Enclosed is the responses to Questions 14.03.11-18 through 14.03.11-27 that are contained within Reference 1.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of the submittals. His contact information is below.

Sincerely,

Y. Ogata

Yoshiki Ogata,
General Manager- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

Enclosure:

1. Responses to Request for Additional Information No.198-2069 Revision 0

CC: J. A. Ciocco
C. K. Paulson

Contact Information
C. Keith Paulson, Senior Technical Manager
Mitsubishi Nuclear Energy Systems, Inc.
300 Oxford Drive, Suite 301
Monroeville, PA 15146
E-mail: ck_paulson@mnes-us.com
Telephone: (412) 373-6466

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Docket No. 52-021
MHI Ref: UAP-HF-09165

Enclosure 1

UAP-HF-09165
Docket No. 52-021

Responses to Request for Additional Information No.198-2069
Revision 0

April 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

04/09/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 198-2069 REVISION 0**
SRP SECTION:	**14.03.11 - Containment Systems and Severe Accidents-Inspections, Tests, Analyses, and Acceptance Criteria**
APPLICATION SECTION:	**DCD SECTION 2.11**
DATE OF RAI ISSUE:	**02/09/2009**

QUESTION NO.: 14.03.11-18

The following typographical or editorial errors were noted in US-APWR Tier 2, Chapter 6, Section 6.2 and Tier 1, Chapter 2, Section 2.11:

1. Page 6.2-3, top paragraph, last sentence: "The effects of maximum injection flow..." should be "The effects of minimum injection flow..."

ANSWER:

For the maximum containment pressure analysis regarding loss-of-coolant accident, the assumption of the single failure and service outage of the engineered safety features (ESFs) are provided as following conditions.

- Containment Heat Removal System: Minimum Operation
- Safety Injection: Confirmation of the operating condition is necessary by sensitivity analysis

The last sentence indicates that another assumption of the ESF operation is additionally considered. The DCD will be revised as is presented in the next item.

Impact on DCD

See Attachment 2 for a mark-up of DCD Tier 2, Section 6.2.1.1.1, Revision 2.

The fifth paragraph of Tier 2 section 6.2.1.1.1 will be revised as follows:

The single failure condition related to containment pressure and temperature calculations is the failure of one of the four emergency power sources. In addition, another emergency power source is assumed to be out of service, which leads to only two emergency power sources being available. This results in minimum containment heat removal capability and minimum safety injection flow. The effect of maximum injection flow is evaluated assuming **<u>all four-train of pumped safety</u>**

injection operating, combined with single failure plus the outage of one train of the four-train containment heat removal system **as a sensitivity study**.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

04/09/2009

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QUESTION NO.: 14.03.11-19

Discuss the verification of proper post-tensioning of the containment tendons prior to performance of the containment Structural Integrity Test (SIT).

Design commitment noted in item 1 of Table 2.11.1-2 states that the PCCV pressure boundary is designed to meet ASME Code, Section III requirements and Refers to Section 2.2 ITAAC for the appropriate Inspections, Tests and Analyses. A critical part of the containment performance capabilities is the post-tensioning of the installed tendons. Neither Section 2.2 ITAAC nor Section 2.11 ITAAC discusses the verification of proper post-tensioning prior to the performance of the SIT.

Also applicable to the following ITAAC:

ITAAC Item 2 in Table 2.11.1-2

ANSWER:

Tier 1 Table 2.11.1-2, ITAAC Items 1 and 2 respectively require the PCCV to meet ASME Code Section III requirements, and retain structural integrity at a design pressure of 68 psig. Both of these ITAAC items reference Section 2.2 ITAAC. ITAAC Item 5 in Table 2.2-4 requires an ASME design report to conclude the as-built PCCV is designed based on the structural design basis loads. DCD Tier 2 Subsection 3.8.1.5.2.2 references ASME III Subarticle CC-3433, which specifies limits on allowable tendon stresses. DCD Tier 2 Section 3.8.1.6 states that US-APWR quality control programs are in accordance with applicable portions of Articles CC-4000 and CC-5000 of the ASME Code, Section III. Construction testing and examination of the PCCV is addressed by Article CC-5000 of ASME Section III. CC-5421 specifies that "design, fabrication, and installation of pre-stressing systems shall be in accordance with the Construction Specification." Further, CC-5426 specifies that the "tensioning of tendons shall be examined for conformance with written procedures."

ITAAC Item 3 in Table 2.2-4 requires the Structural Integrity Test to be performed in accordance with ASME Section III. As described in DCD Tier 2 Subsection 3.8.1.7, *Testing and Inservice Inspection Requirements,* preoperational structural testing of the PCCV is in accordance with ASME III, Division 2, Articles CC-3000 and CC-6000. ASME III Subarticle CC-6140 pretest conditions for the SIT require the containment to be structurally complete.

Verification of the proper post-tensioning of the containment tendons prior to performance of the containment SIT will be inherently addressed via construction testing and examination required by the ASME Code. The current ITAAC in Table 2.2-4, by reference to ASME code requirements, provide assurance that tendon post-tensioning will be adequately addressed.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 14.03.11-20

ITAAC Item 5.b in Table 2.11.2-2

This ITAAC should be configured with same three sub-steps as Item 5.a in this same table.

Applicable to the following ITAAC:

ITAAC Item 5.b in Table 2.11.3-5

ANSWER:

MHI believes that the current description of Item 5.b is reasonable. Item i, location of piping, is essentially same as ITAAC item 1. Therefore, ITAAC for item i is included in ITAAC item 1. With regard to items ii and iii, their analyses or inspections are included in item 5.b.

Design commitment of ITAAC item 1.a in Table 2.11.3-5 refers to Subsection 2.11.3.1, Design Description, but it does not clearly state the piping location. Therefore, Subsection 2.11.3.1, Location and Functional Arrangement, will be revised to add the reference of Table 2.11.3-1.

Similar response is provided in MHI's responses to RAI 184-1912 question 14.03.07-30 and RAI 193-1842 question 14.03.04-26.

Impact on DCD

Subsection 2.11.3.1, Location and Functional Arrangement, will be revised as follows:

The refueling water storage pit (RWSP) and the containment spray header are located inside the containment. All other major CSS components are located in the reactor building (R/B). Figure 2.11.3-1 illustrates the CSS, showing the arrangement of the equipment and piping. **Table 2.11.3-1 also provides a tabulation of the location of CSS equipment.** The CSS and the residual heat removal system (RHRS) share major components which are containment spray/residual heat removal (CS/RHR) pumps and heat exchangers.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 14.03.11-21

ITAAC Item 6.a.i in Table 2.11.2-2

The design commitment is more definitive than the acceptance criteria for this ITAAC. The acceptance criterion can be more definitive than the design commitment, but not vice versa.

Applicable also to the following ITAAC:

ITAAC Item 6.a.i in Table 2.11.3-5

ANSWER:

The acceptance criteria cited in this question will be revised to be consistent with the design commitment.

Impact on DCD

The Acceptance Criteria for ITAAC Item 6.a.i in Table 2.11.2-2 will be revised as follows:

6.a	The Class 1E equipment identified in Table 2.11.2-1 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.a.i	Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	6.a.i	The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.11.2-1 as being qualified for a harsh environment can withstand the environmental conditions **<u>that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function</u>**.
		6.a.ii	An inspection will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii	The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.11.2-1 as being qualified for a harsh environment are bounded by type tests and/or analyses.

ITAAC Item 6.a.i in Table 2.11.3-5 will be revised as follows.

6.a	The Class 1E equipment identified in Table 2.11.3-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.a.i	Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	6.a.i	The results of the type tests and/or analyses concludes that the Class 1E equipment identified in Table 2.11.3-2 as being qualified for a harsh environment can withstand the environmental conditions **<u>that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function</u>**.
		6.a.ii	Inspections will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii	The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.11.3 -2 as being qualified for a harsh environment are bounded by type tests and/or analyses.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 14.03.11-22

ITAAC Item 6.b in Table 2.11.2-2

Revise the inspection, test, and analysis and the associated acceptance criteria to more closely verify the design commitment in item 6.b in Table 2.11.2-2.

The design commitment is to verify that components listed in Table 2.11.2-1 are powered from their respective Class 1E divisions. Injection of a test signal does not verify where the components derive their power by itself. The presence of a test signal at a component does not verify a component will operate.

The acceptance criterion should state that the signal is present only for the equipment associated with the division being tested.

The ITA should state that the divisions are tested one at a time.

Applicable also to the following ITAAC:

ITAAC Item 6.b in Table 2.11.3-5

ANSWER:

Refer to response to RAI 184-1912, question 14.03.07-16, which addresses ITAAC similar to those cited in this question. The design commitments for ITAAC of this type require that the Class 1E components are powered from their respective Class 1E division. This design commitment may be shown to be met by verifying that a simulated test signal that is injected only in the division under test, is detected at the equipment under test (in the same division as the simulated test signal).

Impact on DCD

ITAAC Item 6.b in Table 2.11.2-2 will be revised as follows:

6.b The Class 1E components, identified in Table 2.11.2-1, are powered from their respective Class 1E division.	6.b ~~Tests~~ **A test** will be performed on **each division of** the as-built **components** ~~CIS~~ by providing a simulated test signal **only in the** ~~in each~~ Class 1E division **under test.**	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.11.2-1 under **test.** ~~tests in the as-built CIS~~

ITAAC Item 6.b in Table 2.11.3-5 will be revised as follows:

6.b The Class 1E components, identified in Table 2.11.3-2, are powered from their respective Class 1E division.	6.b ~~Tests~~ **A test** will be performed on **each division of** the as-built **components** ~~CSS~~ by providing a simulated test signal **only in the** ~~in each~~ Class 1E division **under test.**	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.11.3-2 under **test.** ~~tests in the as-built CSS~~

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 14.03.11-23

ITAAC Item 6.c in Table 2.11.2-2

The design commitment is concerned with separation between Class 1E divisions and between those divisions and non-Class 1E cable. The acceptance criterion is concerned only with raceways. What about those other plant installations other than raceways where separation has to be maintained between Class 1E divisions?

ANSWER:

Refer to MHI's response to RAI 191 question 14.03.04-9.

Impact on DCD

For changes to ITAAC Item 6.c in Table 2.11.2-2 refer to RAI 191 question 14.03.04-9.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 14.03.11-24

ITAAC Items 8 and 9 in Table 2.11.2-2

The acceptance criteria of these two ITAAC state that the closure times and the leakage of the valves are within design limits. What are those design limits, and why are they not stated?

ANSWER:

ITAAC Item 9 in Table 2.11.2-2 will be revised in response to RAI 50-329, question 06.02.06-13 dated September 17, 2008. The revised ITAAC acceptance criteria require the leakage limits to be less than the 10CFR 50 Appendix J allowable leakage rate.

As stated in response to RAI 184-1912, question 14.03.07-27, MHI will consolidate the CIVs into Table 2.11.2-1. ITAAC Item 8 will be expanded to include CIV closure time acceptance criteria. The closure times for the main steam isolation valves (MSIVs) and main steam bypass isolation valves (MSBIVs) will be verified via ITAAC Item 14 in Tier 1 Table 2.7.1.2-5 as stated in response to RAI 191-2048 question 14.03.04-04.

Impact on DCD

Refer to MHI's responses to RAI 50-329, question 06.02.06-13, RAI 184-1912, question 14.03.07-27 and RAI 191-2048 question 14.03.04-04.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 14.03.11-25

ITAAC Item 7.a in Table 2.11.3-5

The ITA rand acceptance criterion reference sections of the design description in subsection 2.11.2. The ITAAC states that the CSS system provides containment isolation, whereas it is the CIS systems that do that. In addition, the ITAAC should reference another ITAAC not a section of the design description.

ANSWER:

The US-APWR DCD considers systems such as CSS that include containment isolation system (CIS) components, to have a containment isolation function. DCD changes in response to RAI 184-1912 question 14.03.07-27 will provide more consistent and specific cross references, from the CSS system description to DCD Tier 1 Subsection 2.11.2 and specific ITAAC to describe the containment isolation function. ITAAC Item 7.a in Table 2.11.3-5 will be deleted in response to RAI 184-1912 question 14.03.07-27.

Impact on DCD

Refer to MHI's response to RAI 184-1912, question 14.03.07-27.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 14.03.11-26

ITAAC Items 10.c and 10.d in Table 2.11.3-5

The design commitments reference an interlock that prevents the stated conditions from occurring. The acceptance criteria should state that an interlock prevents the stated conditions from occuring also. The operating procedures could prevent the stated conditons from occuring by operator actions. The acceptance criteria need to be clarified.

Revise the acceptance criteria listed in item 10d in Table 2.11.3-5 to identify the required condition of the two in-series CS/RHR pump hot leg isolation valves.

The design commitment is to provide an interlock that permits opening the containment spray header isolation valve only if the corresponding two in-series CS/RHR pump hot leg isolation valves are closed. The current acceptance criteria do not require these valves to be closed.

ANSWER:

The acceptance criteria for ITAAC Items 10.c and 10d in Table 2.11.3-5 will be modified to be consistent with the design commitments and the design description in Tier 1 Section 2.11.3.1. The ITAAC will also be clarified to apply to each division of the CS/RHR systems.
In addition, "either or both of" is added before "the corresponding two in-series CS/RHR pump hot leg isolation valves" to provide a specific clarification in the design commitment 10.d.

Impact on DCD

ITAAC Item 10.c and Item 10.d in Table 2.11.3-5 will be revised as follows:

10.c	~~The~~ **An** interlock is provided **for each division of CS/RHR** to preclude the simultaneous opening of both the RHR discharge line containment isolation valves and the corresponding containment spray header containment isolation valve.	10.c	Tests will be performed on ~~the~~ **each** as-built **interlock for the** RHR discharge line containment isolation valves and the containment spray header containment isolation valve.	10.c	~~The~~ **Each** as-built **interlock for the** RHR discharge line containment isolation valves and the corresponding containment spray header containment isolation valve **preclude the simultaneous opening of both the RHR discharge line containment isolation valves and the corresponding containment spray header containment isolation valve**. ~~do not open simultaneously.~~
10.d	~~The~~ **An** interlock is provided **for each division of CS/RHR** to allow opening of the containment spray header containment isolation valve only if **either or both of** the corresponding two in-series CS/RHR pump hot leg isolation valves are closed.	10.d	Tests will be performed on ~~the~~ **each** as-built **interlock for** the containment spray header containment isolation valves and CS/RHR pump hot leg isolation valves.	10.d	~~The~~ **Each** as-built **interlock for the** containment spray header containment isolation valve **and corresponding two in-series CS/RHR pump hot leg isolation valves will allow opening of the containment spray header containment isolation valve only if either or both of the corresponding two in-series CS/RHR pump hot leg isolation valves are closed.** ~~can be opened only if the corresponding two in-series CS/RHR pump hot leg isolation valves .~~

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 14.03.11-27

ITAAC Item 12 in Table 2.11.3-5

This ITAAC is concerned with RSC displays/and or controls for the CSS are identified in Table 2.11.3-4. The acceptance criteria only is concerned with controls at the RSC, however there should also be controls and alarms at the MCR panels. Revise this ITAAC according to whether controls and alarms are available at the MCR panels.

ANSWER:

ITAAC Item 11 is concerned with displays in the MCR that are identified in Table 2.11.3-4. The ITAAC will be revised to address alarms and displays in the MCR. Controls are in separate ITAAC such as ITAAC Items 8 and 10.a.

ITAAC Item 12 is concerned with displays and controls on the RSC that are identified in Table 2.11.3-4. The ITAAC will be revised to address alarms, displays and controls on the RSC.

In addition, Table 2.11.3-4 will be revised to indicate that the alarms, displays and controls are located at both the MCR and RSC.

Impact on DCD

ITAAC Item 11 and Item 12 in Table 2.11.3-5 will be revised as follows:

11. **MCR alarms and displays** ~~Displays~~ of the parameters identified in Table 2.11.3-4 can be retrieved in the MCR.	11. Inspections will be performed for retrievability of the CSS parameters in the as-built MCR.	11. ~~The~~ **MCR alarms and** displays identified in Table 2.11.3-4. can be retrieved in the as-built MCR.
12. Remote shutdown console (RSC) **alarms,** displays and/~~or~~ controls ~~provided for the CSS~~ are identified in Table 2.11.3-4.	12. Inspections **of the as-built RSC alarms, displays and controls** will be performed. ~~on the as-built RSC displays and/or controls for the CSS~~	12. **Alarms, displays** ~~Displays~~ and/~~or~~ controls exist on the as-built RSC as identified in Table 2.11.3 -4.

The heading line of Table 2.11.3-4 will be revised as follows.

Equipment Name	**MCR/RSC Alarm**	**MCR Display**	**MCR/RSC Control Function**	**RSC Display**
CS/RHR Pump RWSP Suction Isolation Valves (CSS-MOV-001 A, B, C, D)	No	Yes	Yes	Yes
Containment Spray Header Containment Isolation Valves (CSS-MOV-004 A, B, C, D)	No	Yes	Yes	Yes
Containment Pressure (CSS-PT-950, 951, 952, 953)	Yes	Yes	Yes	Yes
Containment Temperature (CSS-TE-1990, 1991)	No	Yes	No	Yes

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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Attachment 1

US-APWR DCD Tier 1 Section 2.11 Mark-up
RESPONSE TO RAI No. 198-2069 Revision 0

Table 2.11.2-2 Containment Isolation System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5.a The seismic Category I equipment is designed to withstand seismic design basis loads without loss of safety function.	5.a.i Inspections will be performed to verify that the seismic Category I as-built equipment are located in the containment and the reactor building.	5.a.i The seismic Category I as-built equipment is located in the containment and the reactor building.
	5.a.ii Type tests and/or analyses of seismic Category I equipment will be performed.	5.a.ii The results of the type tests and/or analyses concludes that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
	5.a.iii Inspections will be performed the as-built equipment including anchorage.	5.a.iii The as-built equipment including anchorage is seismically bounded by the tested or analyzed conditions.
5.b Each of the seismic Category I lines is designed to withstand combined normal and seismic design basis loads without loss of its functional capability.	5.b Inspections will be performed on the as-built piping.	5.b Each of the as-built seismic Category I piping meets the seismic category requirements.
6.a The Class 1E equipment identified in Table 2.11.2-1 as being qualified for a harsh environment is designed to withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.a.i Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	6.a.i The results of the type tests and/or analyses conclude that the Class 1E equipment identified in Table 2.11.2-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	6.a.ii An inspection will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.11.2-1 as being qualified for a harsh environment are bounded by type tests and/or analyses.

RAI 191
14.03.04-09
RAI 198
14.03.11-22

Table 2.11.2-2 Containment Isolation System Inspections, Tests, and Acceptance Criteria (Sheet 3 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6.b The Class 1E components, identified in Table 2.11.2-1, are powered from their respective Class 1E division.	6.b A Tests will be performed on each division of the as-built componentsCIS by providing a simulated test signal only in thein each Class 1E division under test.	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.11.2-1 under tests in the as-built CIS.
6.c Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	6.c Inspections of the as-built Class 1E divisional cables and raceways will be conducted.	6.c The as-built Class 1E electrical cables with only one division are routed in raceways assigned to the same division. There are no other safety division electrical cables in a raceway assigned to a different division. Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.
7. CIS isolates containment upon receipt of a containment isolation signal.	7. Tests will be performed to verify that the as-built containment isolation air operated valves and motor operated valves close on receipt of an isolation signal.	7. The as-built containment isolation air operated valves and motor operated valves close on receipt of an isolation signal.
8. Containment isolates within the design time limit.	8. Tests will be performed to verify as-built containment valve isolation closure times.	8. The as-built containment isolation valve closure times are within design limits.
9. The systems penetrating containment retain their containment inventory during containment isolation.	9. Tests will be performed to verify the as-built containment isolation valve leakage.	9. The as-built containment isolation valve leakage is within design limits.
10. Control exist in the MCR to cause the remotely operated valves to perform active function.	10. Tests will be performed on the as-built remotely operated valves using controls in the MCR.	10. Controls in the MCR operate to cause the as-built remotely operated valves to perform active function.
11. Displays of the parameters identified in Table 2.11.2-1 can be retrieved in the MCR.	11. Inspections will be performed for retrievability in the as-built MCR.	11. The as-built displays identified in Table 2.11.2-1 can be retrieved in the as-

2.11.3 Containment Spray System (CSS)

2.11.3.1 Design Description

System Purpose and Functions

The CSS is a safety-related system. The purposes of the CSS are to cool the containment and remove fission products following an accident, thus the system serves as a dual-function engineered safety feature (ESF).

The CSS functions by automatically spraying borated water into the containment upon receipt of a containment spray signal. This action limits the containment internal peak pressure to well below the design pressure and reduces it to approximately atmospheric pressure in a design basis LOCA or secondary system piping failure.

Location and Functional Arrangement

The refueling water storage pit (RWSP) and the containment spray header are located inside the containment. All other major CSS components are located in the reactor building (R/B). Figure 2.11.3-1 illustrates the CSS, showing the arrangement of the equipment and piping. Table 2.11.3-1 also provides a tabulation of the location of CSS equipment. The CSS and the residual heat removal system (RHRS) share major components which are containment spray/residual heat removal (CS/RHR) pumps and heat exchangers. The CSS includes:

- four CS/RHRS pumps (included in RHRS)
- four CS/RHRS heat exchangers (included in RHRS)
- a spray ring header composed of four concentric interconnected rings, piping, spray nozzles and valves

Key Design Features

The CSS includes four 50% capacity CS/RHR pumps trains, assuming one is out of service for maintenance and one becomes inoperative due to a single failure upon the initiation of the CSS. Other key design features include:

- The emergency power source supplies electrical power to the essential components of the CSS, so that safety functions can be maintained during a loss of offsite power.
- The CSS design permits periodical tests and inspections to verify integrity and operability.
- To ensure reliable containment spray pattern coverage, each spray ring is located at a different containment elevation, and spray rings are supplied from the four 50% capacity trains of containment spray.

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**Table 2.11.3-5 Containment Spray System Inspections, Tests, A
and Acceptance Criteria (Sheet 3 of 5)**

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6.a The Class 1E equipment identified in Table 2.11.3-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.	6.a.i Type tests and/or analyses will be performed on the Class 1E equipment located in a harsh environment.	6.a.i The results of the type tests and/or analyses concludes that the Class 1E equipment identified in Table 2.11.3-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
	6.a.ii Inspections will be performed on the as-built Class 1E equipment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table 2.11.3 -2 as being qualified for a harsh environment are bounded by type tests and/or analyses.
6.b The Class 1E components, identified in Table 2.11.3-2, are powered from their respective Class 1E division.	6.b ~~A~~ Tests will be performed on each division of the as-built ~~CSS~~ components by providing a simulated test signal only ~~in each~~ in the Class 1E division under test.	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.11.3-2 under tests ~~in the as-built CSS~~.
6.c Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E cable.	6.c Inspections of the as-built Class 1E divisional cables ~~and raceways~~ will be conducted.	6.c ~~The as-built Class 1E electrical cables with only one division are routed in raceways assigned to the same division. There are no other safety division electrical cables in a raceway assigned to a different division.~~ Physical separation or electrical isolation is provided between the as-built cables of Class 1E divisions and between Class 1E divisions and non-Class 1E cables.
7.a The CSS provides containment isolation of the CSS piping that penetrating the containment.	7.a See Subsection 2.11.2 (Containment Isolation Systems).	7.a See Subsection 2.11.2 (Containment Isolation Systems).
7.b The CSS provides	7.b The as-built CS/RHR	7.b Two as-built CS/RHR

Table 2.11.3-5 Containment Spray System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 5)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10.b The containment spray header containment isolation valve opens upon receipt of a signal.	10.b Tests of the as-built containment spray header containment isolation valve will be performed using simulated signal.	10.b The as-built containment spray header containment isolation valve opens upon receipt of a signal.
10.c ~~The~~ An interlock is provided for each division of CS/RSR to preclude the simultaneous opening of both the RHR discharge line containment isolation valves and the corresponding containment spray header containment isolation valve.	10.c Tests will be performed on ~~the~~ each as-built interlock for the RHR discharge line containment isolation valves and the containment spray header containment isolation valve.	10.c ~~The~~ Each as-built interlock for the RHR discharge line containment isolation valves and the corresponding containment spray header containment isolation valve preclude the simultaneous opening of both the RHR discharge line containment isolation valves and the corresponding containment spray header containment isolation valve. ~~do not open simultaneously.~~
10.d ~~The~~ An interlock is provided for each division of CS/RSR to allow opening of the containment spray header containment isolation valve only if either or both of the corresponding two in-series CS/RHR pump hot leg isolation valves are closed.	10.d Tests will be performed on ~~the~~ each as-built interlock for the containment spray header containment isolation valves and CS/RHR pump hot leg isolation valves.	10.d ~~The~~ Each as-built interlock for the containment spray header containment isolation valve and corresponding two in-series CS/RHR pump hot leg isolation valves will allow opening of the containment spray header containment . isolation valve only if either or both of the corresponding two in-series CS/RHR pump hot leg isolation valves are closed. ~~can be opened only if the corresponding two in-series CS/RHR pump hot leg isolation valves.~~
11. ~~Displays~~ MCR alarms and displays of the parameters identified in Table 2.11.3-4 can be retrieved in the MCR.	11. Inspections will be performed for retrievability of the CSS parameters in the as-built MCR.	11. ~~The~~ MCR alarms and displays identified in Table 2.11.3-4 can be retrieved in the as-built MCR.
12. Remote shutdown console (RSC) alarms, displays and/~~or~~ controls ~~provided for the CSS~~ are identified in Table 2.11.3-4.	12. Inspections of the as-built RSC alarms, displays and controls will be performed ~~on the as-built RSC displays and/or controls for the CSS~~.	12. Alarms, ~~D~~displays and/~~or~~ controls exist on the as-built RSC as identified in Table 2.11.3 -4.

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Attachment 2

US-APWR DCD Tier 2 Section 6.2 Mark-up
RESPONSE TO RAI No. 198-2069 Revision 0

Attachment 2

RAI 198
No Changes

The containment function described above is maintained also in the hot shutdown conditions, Modes 3 and 4 described in Chapter 16, when the postulated accident could cause a release of radioactive material in the containment and an increase in containment pressure and temperature. The conditions for Mode 1 or Mode 2 are assumed for the containment analyses in this section because the energy sources including reactor coolant fluid and metal energy, steam generator fluid and metal energy, core stored energy, and decay heat are much larger than that in the Mode 3 and 4 shutdown condition.

6.2.1.1 Containment Structure

6.2.1.1.1 Design Bases

As presented in Sections 3.2 and 3.8, the containment is designed and constructed to withstand a broad spectrum of seismic events. To comply with GDC 16, the containment is designed to ensure leak tightness during normal operations and, under postulated accident conditions, the containment is designed and built to safely withstand an internal pressure of 68 psig. The containment design pressure 68 psig is based on the LOCA event which bounds the SLB event, from the containment peak pressure standpoint. Adequate design margin is demonstrated by a containment test pressure of 78.2 psig. The containment design temperature is 300°F.

Table 6.2.1-1 summarizes containment temperature and pressure (and comparisons to design pressure), for a broad range of postulated breaks, and assumed system and component failures. Figure 6.2.1-1 through Figure 6.2.1-4 are plots of containment internal pressure and temperature versus time for the most severe primary and secondary system piping failures. These figures show that internal containment pressure is reduced to less than 50% of the peak value 24 hours after event initiation.

Table 6.2.1-1 and Figure 6.2.1-1 through Figure 6.2.1-4 are based on evaluations where uncertainties and tolerances with respect to the containment and its heat removal systems are biased to generate conservatively high values. The results show that the containment heat removal system is adequate to maintain containment conditions within design limits assuming a worst single failure condition in addition to one heat removal train being out of service. For primary system piping breaks, loss of offsite power (LOOP) is assumed. For secondary system piping breaks, the cases where LOOP is not assumed are also considered, since the LOOP can possibly reduce releases to the containment. The containment heat removal systems are described in detail in Section 6.2.2. Additional information about the bases for Table 6.2.1-1 and Figure 6.2.1-1 through Figure 6.2.1-4 is given in Subsection 6.2.1.1.3.

Subsections 6.2.1.3 and 6.2.1.4 describe evaluations performed to determine the sources and amounts of mass and energy that might be released into the containment. Specific time-dependent mass and energy release rate results from these evaluations are described in Subsections 6.2.1.3 and 6.2.1.4.

The single failure condition related to containment pressure and temperature calculations is the failure of one of the four emergency power sources. In addition, another emergency power source is assumed to be out of service, which leads to only two emergency power sources being available. This results in minimum containment heat removal capability and minimum safety injection flow. The effect of maximum injection flow is evaluated assuming all four-train of pumped safety injection operating, combined with single failure plus the outage of one train of the four-train containment heat removal system as a sensitivity study.

The containment depressurization rate, as shown in Figure 6.2.1-1 and Figure 6.2.1-3, is established by two trains of the containment heat removal systems. These figures show that internal containment pressure is reduced to less than 50% of the peak value within 24 hours after event initiation, which is consistent with the assumptions used in the calculations of the offsite radiological consequences of the accident.

Evaluations are performed to calculate a time-dependent "minimum" containment pressure transient during a postulated LOCA. In this evaluation, which is described in Subsection 6.2.1.5, uncertainties and tolerances are biased to generate conservatively low pressure values. The results from this evaluation are used in ECCS performance analysis reported in the LOCA analyses section in Chapter 15. These minimum containment pressure values are used for conservatism, because a high containment pressure value leads to non-conservative fuel clad temperature calculations during the reflood stage of a large-break LOCA, when the reactor vessel internal pressure is essentially the same as the containment pressure.

Numerous operational sequences addressing low-power and shutdown operations are provided in Chapter 19, Subsection 19.1.6.1. These plant operation state (POS) consider assumed plant configuration, potential initiators and plant response, including the potential for various loss of decay heat removal capability such as loss of steam generator(s), CCW/ESWS and RHRS. Remedial operations are described including use of the CVCS and SIS. These POSs provide a bases for operational responses to the postulated events.

6.2.1.1.2 Design Features

The containment is a prestressed, post-tensioned concrete structure with a cylindrical wall, hemispherical dome, and a flat, reinforced concrete foundation slab. It is often described in this DCD as "prestressed concrete containment vessel" (PCCV), containment vessel, or simply "containment." The inner height of the containment is approximately 226.5 ft and the inside diameter of the containment cylinder measures approximately 149 ft. The containment dome is 3 ft.-8 in. or 4 ft.-4 in. thick, while the containment wall thickness is 4 ft.-4 in. The inner surface of containment includes a 0.25 in. welded steel plate liner anchored to the concrete. The containment is equipped with a polar crane, which transfers its load to the containment wall via a crane girder.

The US-APWR containment is designed to withstand a negative pressure of 3.9 psi (vacuum) relative to ambient (i.e., external pressure 3.9 psig higher than internal pressure). An evaluation concludes that this design feature provides sufficient margin in the event of containment pressure reduction caused by inadvertent initiation of the containment spray system, and discussed in Subsection 6.2.1.1.3.

The containment has a 60-year design life.