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

October 26, 2011

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-11363

Subject: **MHI's Amended Response to US-APWR DCD RAI No. 742-5703 Revision 3 (SRP 03.12)**

Reference: [1] "REQUEST FOR ADDITIONAL INFORMATION 742-5703 REVISION 3, SRP Section: 03.12 – ASME Code Class 1, 2, and 3 Piping System and Piping Components and Their Associated Supports, Application Section: 3.12," dated 4/27/2011.

[2] MHI letter UAP-HF-11212 "MHI's Responses to US-APWR DCD RAI No. 742-5703 Revision 3," dated 7/8/2011.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Amended Response to Request for Additional Information No. 742-5703 Revision 3".

Enclosure 1 contains the amended response to Question 3.12-25 contained within Reference 2. MHI replaces the previous letters (Reference 2) with this amended response letter.

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.

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NRO

Enclosures:

1. Amended Response to Request for Additional Information No. 742-5703 Revision 3

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

Docket No. 52-021
MHI Ref: UAP-HF-11363

Enclosure 1

UAP-HF-11363
Docket No. 52-021

Amended Response to Request for Additional Information
No. 742-5703 Revision 3

October 2011

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

10/26/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 742-5703 REVISION 3**
SRP SECTION:	**03.12 – Piping Design Review**
APPLICATION SECTION:	**3.12**
DATE OF RAI ISSUE:	**4/27/2011**

QUESTION NO. RAI 03.12-25:

Section 3.12.5.10 of US-APWR DCD states that structural integrity of the pressurizer surge line of the US-APWR plant is to be assured by performing monitoring activities for the first US-APWR plant.

In order to use the first US-APWR initial plant operation to verify that the design transients for the surge line are representative, the applicant has to assure that all US-APWR plants have to use the same heatup and cooldown procedure/method. Currently, most of the US plants heatup/cooldown procedures are not the same as the heatup/cooldown procedures used by many Japanese units. How does Mitsubishi ensure that all US-APWR plants will use the same heatup and cooldown procedure/method?

ANSWER(ORIGINAL RESPONSE DATED 7/8/2011):

The performance of the Reactor Coolant System (RCS), including the pressurizer surge line will be subject to extensive thermal expansion and operational verification testing during Hot Functional Testing (HFT) for the first US-APWR constructed. The testing is conducted in a tightly controlled manner with the RCS being heated (by the Reactor Coolant Pumps) in a slow and methodical manner. Temperature sensors are arrayed on the RCS boundary (metal surface), including the pressurizer surge line, as well as inside the RCS itself. The rate of expansion is measured and monitored to verify the design basis as well as to confirm that thermal expansion clearances are adequate. During heatup and cooldown, the pressurizer spray valve is slightly open to maintain a small but continuous flow through the pressurizer heated water volume and through the surge line to help maintain quasi isothermal conditions in this line and to minimize thermal stratification. The HFT will also verify that any temperature stratification or surge line differential temperatures that does occur is within the analyzed values, and that the surge line operating characteristics meet the applicable analyzed ASME Code Section III requirements as shown in the enclosure of the MHI letter "Revised Design Completion Plan for US-APWR Piping Systems and Components" dated May 12, 2011{ML11136A234}. The results of the HFT will be used to confirm adequate design margins for the surge line. It is normal practice for the RCS heatup/cooldown rates to be limited in the plant licensing documents (technical specifications). This in turn is subsequently made part of the generic MHI US-APWR operating procedures as well as plant specific operating procedures.

MHI will prepare generic operating procedures (guidelines) to assist US-APWR owners in formulating plant specific operating procedures. These generic procedures capture the allowable heatup and cooldown rates for the RCS, including the pressurizer surge line and provide guidance to plant owners on allowable rates (ASME based analysis and actual field testing as described above). Licensees will use these generic procedures to assist in the formulation of plant-specific procedures. A statement will be added to note the activities required to assure the structural integrity of the pressurizer surge line for subsequent plants to DCD Subsection 3.12.5.10. The heatup and cooldown operations are also related to the low temperature over pressure protection design bases, and the outline of the operation are described in the Subsections 5.2.2.2.2.1 and 5.2.2.2.2.2. DCD Subsection 3.12.5.10 will include a statement to clarify that items 2 through 4 of the activities in the first US-APWR plant will not need to be performed in subsequent plants, if the fatigue evaluation results comply with the ASME Code.

Impact on DCD

See Attachment for the mark-up of DCD Tier 2, Section 3.12, changes to be incorporated.

- Revise the last paragraph of Subsection 3.12.5.10 to read as follows:

  "Structural integrity of the pressurizer surge line of the US-APWR plant is to be assured by performing the following activities for the first US-APWR plant constructed.

  1. Fatigue evaluation is to be performed by considering the repeated event of thermal stratification occurring in the pressurizer surge line. It will be confirmed by analysis and hot functional testing that thermal deflections of the piping do not result in adverse conditions.

     If the fatigue evaluation results comply with the ASME Code Section III, items 2 through 4 will not be performed in subsequent US-APWR plants.

     If the fatigue evaluation results yield noncompliance with the ASME Code Section III, items 2 through 4 below, are to be performed.
  2. Plant heatup and cooldown are the most severe conditions for thermal stratifications of the pressurizer surge line due to developing the largest difference of temperature between the hot leg and the pressurizer, which are to be considered for mitigation of thermal stratification in the US-APWR.
  3. The temperature of the surge line is to be monitored for the effects of thermal stratification at heatup and at cooldown during hot functional testing.
  4. Monitoring results are to be included in stress and fatigue analysis to ensure ASME Code Section III compliance.

  The outline of the heatup and cooldown operation are described in the Subsection 5.2.2.2.2.1 and 5.2.2.2.2.2."

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

AMENDMENT RESPONSE:

The original RAI response is hereby amended to monitor the temperature difference between the pressurizer fluid temperature and the RCL hot leg temperature by including the responses below.

NRC Comment No. 1: MHI stated that PZR surge line monitoring will be monitored during hot functional testing (HFT). The staff has reviewed Chapter 14 which did not mention any activity related to PZR surge line stratification monitoring. The staff requests the applicant provide additional information including a test abstract including stating the standard operating conditions in Chapter 14 that identifies the Objective, Prerequisites, Test Method, Data Required, and Acceptance Criteria for Surge Line Thermal Monitoring that complies with NRC Bulletin 88-11.

Response to Comment No. 1: A test to evaluate the temperature and deflection of the pressurizer surge line will be part of the HFT program as outlined in Chapter 14 of the DCD. The proposed changes and test outline are shown in the following DCD Impact section (See Attachment).

NRC Comment No. 2: In general, surge line monitoring activity shall be the COL's responsibility. However, this activity has not been listed as COL action item in DCD. The staff asked MHI to clarify the responsibility. If this activity is to be completed by COL, DCD should be modified to add this activity as COL action item.

Response to Comment No. 2: Monitoring will be performed to demonstrate the satisfactory response of the pressurizer surge line during the first plant HFT and will be continued during the first year of operation. The monitoring during HFT will be added to Chapter 14 as part of the HFT program, and a COL item for the HFT of the first plant is described in COL 14.2(11) of the DCD. Monitoring during the first cycle operation will be a COL action item of the first US-APWR plant. COL action item to define the first cycle monitoring is described in the DCD Section 3.12.5.10 and Section 3.12.7 (See Attachment).

NRC Comment No. 3: MHI stated that it is normal practice for the RCS heatup/cooldown rate to be limited in the plant licensing documents (Tech Specs). This in turn is subsequently made part of the generic MHI US-APWR operating procedures as well as plant specific operating procedures. The staff noted that limited to the same hu/cd rate **does not provide sufficient basis for pressurizer surge line subject to the same transients.** Surge line stratification cycles/transients were controlled by the RCS and PZR temperature difference, RCP status, and other pertinent parameters. The response does not provide sufficient basis for monitoring the first US-APWR can represent all US-APWR plants. There are different ways to heatup/cooldown the RCS with different RCPs and PZR heater operation which significantly impact the system ΔT and cycles.

Response to Comment No. 3: A statement describing limits on pressurizer surge line temperature differences during heatup and cooldown will be added to DCD Subsection 3.12.5.10 The proposed changes are shown in the following DCD Impact section (See Attachment).

NRC Comment No. 4: The markup for the change does not provide enough detail to address this issue. Specifically, MHI stated that "If the fatigue evaluation result yield noncompliance with the ASME Code Sect. III, items 2 through 4 below are to be performed." Items 2 through 4 showed that a continuous monitoring program for the life of the plant will be used to ensure ASME Sect. III compliance. Is this a commitment and also a COL action item? This statement also indicated that initial fatigue evaluation will not be qualified per ASME Code. This is not an acceptable position to the staff.

Response to Comment No. 4: The monitoring will be continued during the first cycle operation of the first US-APWR plant, which is a COL action item. The proposed changes are shown in the following Impact on DCD section (See Attachment).

NRC Comment No. 5: The mark-up of DCD stated that "The outline of the heatup and cooldown operation are described in the Subsection 5.2.2.2.2.1 and 5.2.2.2.2.2". This statement does not provide any significant support to address this original RAI.

Response to Comment No. 5: This statement is replaced by Attachment that describes a limit on the pressurizer surge line temperature difference during heatup and cooldown. The proposed change is shown in the following DCD Impact section.

Impact on DCD

DCD Tier 2, Chapter 14 will be revised to incorporate the following changes:

- Add the following as a new subsection at the end of Subsection 14.2.12.1: (See Attachment-1)

  "14.2.12.1.119 Pressurizer Surge Line HFT Performance Test

  (Perform on first plant. For subsequent plants, see discussion in Subsection 14.2.8.2.)

  Monitoring will be performed to demonstrate the satisfactory response of the pressurizer surge line during the first plant HFT.

  A. Objectives

  1. Monitoring will be performed to demonstrate the satisfactory response of the pressurizer surge line.
  2. To verify the as-designed, constructed, and tested pressurizer surge line operating characteristics meet the design basis as described in the DCD and to address the issues described in NRC Bulletin No. 88-11 (Ref. 14.2-35).

  B. Prerequisites

  1. Required construction testing is completed.
  2. Component testing and instrument calibration are completed.
  3. Test instrumentation is available and calibrated.
  4. Required support systems are available.
  5. Required electrical power supplies and control circuits are operational.
  6. The plant is heating up, cooling down, or at no-load operating temperature and pressure with RCPs running, and hot functional testing in progress.
  7. The letdown and charging portions of the CVCS are available to vary pressurizer water level.

8. The CVCS is available to provide seal water to the RCPs and RCS makeup/letdown.
9. SGs are in service with emergency feedwater available.
10. SG relief valves are functioning to control RCS temperature, or other means are available.

C. Test Method

The test method includes the recording by visual inspections and instruments of the pressurizer surge line temperatures at various points of its horizontal line, including the adjacent points to hot leg and pressurizer connection, at least the top, midpoint and bottom of the line at multiple locations, and deflection measurements (indicators attached to the line). The data collection equipment will most likely be used as part of the RCS thermal expansion program testing.

1. The pressurizer surge line testing will be conducted in conjunction with other pressurizer tests so detailed coordination will be required in the specific test procedures.
2. During heat-up, the pressurizer surge line temperatures and deflections are measured and recorded.
3. During the no-load condition, the pressurizer surge line temperatures and deflections are measured and recorded.
4. During cool-down, the pressurizer surge line temperatures and deflections are measured and recorded.
5. During RCP pump start/stops, the pressurizer surge line temperatures and deflections are measured and recorded.

   Note: The maximum allowable differential temperature between the pressurizer fluid and the RCS hot leg fluid at the ends of the pressurizer surge line is 145°F. This limit applies to heatup, cooldown, and normal operation.

D. Acceptance Criteria

1. The measured pressurizer surge line temperatures and deflections are within allowable values.

- Add the following as a new row after 14.2.12.1.107 in item C-6 of Subsection 14.2.12.1.1 (See Attachment-2):

  "14.2.12.1.119 Pressurizer Surge Line HFT Performance Test"

- Add the following as a new row after 14.2.12.1.118 in Table 14.2-1 (See Attachment-3):

  "14.2.12.1.119 Pressurizer Surge Line HFT Performance Test"

- Add the following as a new paragraph 14.2.8.2.2 (See Attachment-4)

  Pressurizer Surge Line HFT Performance Test for the first plant is performed in accordance with Subsection 14.2.12.1.119 to verify that the pressurizer surge line operating characteristics are within allowable values and that there is no excessive thermal stratification in the surge line that could result in undue stresses and fatigue to the surge line. For subsequent plants, the COL Applicant either performs the test or provides a justification for not performing the test, based on an evaluation of the results of previous pressurizer surge line HFT performance test.

- Add the following as a new reference at the end of Subsection 14.2.14 (See Attachment-5):

"14.2-35

Pressurizer Surge Line Thermal Stratification. NRC Bulletin No. 88-11, U.S. Nuclear Regulatory Commission, Washington, DC, 1988."

- Add the followings to Table 14A-1, Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (See Attachment-6):

RG 1.68 Appendix A	Section Number	Typical Test
1.a.(2) (a)	14.2.12.1.119	Pressurizer surge line HFT performance test

DCD Tier 2, Section 3.9.1.1 will be revised to incorporate the following change (See Attachment-7):

- The last paragraph of Section 3.9.1.1 will be changed to read:

"The effect of thermal stratification and thermal striping is considered in the stress and fatigue evaluations of components and piping. The issues identified in NRC Bulletins 88-08 and 88-11 (References 3.9-3 and 3.9-4) are factored into this analysis. Confirmation of design margins and acceptable operational conditions is verified during Hot Functional Testing as described in Chapter 14."

DCD Tier 2, Section 3.12 will be changed as follows.

- Revise the last paragraph of Subsection 3.12.5.10 to read as follows (See Attachment-8):

"The temperature difference between the pressurizer fluid temperature and the RCL hot leg temperature at the two ends of the pressurizer surge line during Plant Heatup and Cooldown is not permitted to exceed 145°F. This value conservatively limits the potential for detrimental thermal stratification within the surge line and assures acceptable fatigue results for the design life of the plant. The measured thermal stratification temperatures from the HFT surge line performance test (described in DCD Section 14.2.12.1.119) will be compared with the values used in the design analysis to confirm the design margins. The monitoring will be continued during the first cycle operation of the first US-APWR plant. The COL applicant addresses the applicability of the monitoring of the first cycle operation.

DCD Section 3.12.7 will be changed to add COL 3.12(5) (See Attachment-9).

> COL 3.12(5): The COL holder for the first plant is to perform the pressurizer surge line monitoring subsequent to the COL item 14.2(11).

Impact on R-COLA

Pressurizer surge line HFT performance test will be added to Table 14.2-202.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

There is no impact on a Technical/Topical Report.

This completes MHI's supplemental response to the NRC's question.

3. The associated equipment and accessories satisfactorily pass an inspection following static and operational (dynamic load) testing in accordance with NUREG-0612 (Reference 14.2-21) and NUREG-0554 (Reference 14.2-24).

4. Testing and inspection demonstrates compliance with testing and inspection requirements specified by NUREG-0554 (Reference 14.2-24), ASME NOG-1 (Reference 14.2-30) and NUREG-0612 (Reference 14.2-21) as applicable.

14.2.12.1.119 Pressurizer Surge Line HFT Performance Test

DCD_3.12-25

(Perform on first plant. For subsequent plants, see discussion in Subsection 14.2.8.2.)

Monitoring will be performed to demonstrate the satisfactory response of the pressurizer surge line during the first plant HFT.

A. Objectives

1. Monitoring will be performed to demonstrate the satisfactory response of the pressurizer surge line.

2. To verify the as-designed, constructed, and tested pressurizer surge line operating characteristics meet the design basis as described in the DCD and to address the issues described in NRC Bulletin No. 88-11 (Ref. 14.2-35).

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration are completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required electrical power supplies and control circuits are operational.

6. The plant is heating up, cooling down, or at no-load operating temperature and pressure with RCPs running, and hot functional testing in progress.

7. The letdown and charging portions of the CVCS are available to vary pressurizer water level.

8. The CVCS is available to provide seal water to the RCPs and RCS makeup/letdown.

9. SGs are in service with emergency feedwater available.

10. SG relief valves are functioning to control RCS temperature, or other means are available.

C. Test Method DCD_3.12-25

The test method includes the recording by visual inspections and instruments of the pressurizer surge line temperatures at various points of its horizontal line, including the adjacent points to hot leg and pressurizer connection, at least the top, midpoint and bottom of the line at multiple locations, and deflection measurements (indicators attached to the line). The data collection equipment will most likely be used as part of the RCS thermal expansion program testing.

1. The pressurizer surge line testing will be conducted in conjunction with other pressurizer tests so detailed coordination will be required in the specific test procedures.

2. During heat-up, the pressurizer surge line temperatures and deflections are measured and recorded.

3. During the no-load condition, the pressurizer surge line temperatures and deflections are measured and recorded.

4. During cool-down, the pressurizer surge line temperatures and deflections are measured and recorded.

5. During RCP pump start/stops, the pressurizer surge line temperatures and deflections are measured and recorded.

Note: The maximum allowable differential temperature between the pressurizer fluid and the RCS hot leg fluid at the ends of the pressurizer surge line is 145°F. This limit applies to heatup, cooldown, and normal operation.

D. Acceptance Criteria

1. The measured pressurizer surge line temperatures and deflections are within allowable values.

14.2.12.1.69 Containment Fan Cooler System Preoperational Test

14.2.12.1.71 RCS Leak Rate Preoperational Test

14.2.12.1.72 Loose Parts Monitoring System Preoperational Test

14.2.12.1.76 Remote Shutdown Preoperational Test

14.2.12.1.83 Steam Generator Blowdown System Preoperational Test

14.2.12.1.84 Sampling System Preoperational Test

14.2.12.1.87 Component Cooling Water System Preoperational Test

14.2.12.1.107 Pressurizer Heater and Spray Capability and Continuous Spray Flow Verification Test

14.2.12.1.119 Pressurizer Surge Line HFT Performance Test DCD_3.12-25

7. The leakage control program plant procedures which implement Technical Specifications program 5.5.2, Primary Coolant Sources Outside Containment, are performed while the plant is in hot standby.

D. Acceptance Criteria

1. The RCS is operated at full-flow conditions above the required operating temperature for a period sufficiently long to identify run-in type failures.

2. The acceptance criteria for individual systems are a part of the individual test procedures sequenced by this procedure.

14.2.12.1.2 Pressurizer Pressure and Water Level Control Preoperational Test

A. Objectives

1. To demonstrate the stability and response of the pressurizer pressure control system, including the verification of alarm and control functions.

2. To demonstrate the stability and response of the pressurizer water level control system, including the verification of alarm and control functions.

3. To perform preliminary adjustment of the pressurizer continuous spray flow valves. The final adjustment of the continuous spray flow valves is performed during startup testing.

4. To demonstrate the proper operation for the pressurizer proportional heaters, backup heaters, and the pressurizer heater cutoff for low-low pressurizer water level.

B. Prerequisites

Attachment-3

Table 14.2-1 Comprehensive Listing of Tests (Sheet 4 of 5)

Section	Test
14.2.12.1.117	Compressed Gas System Preoperational Test
14.2.12.1.118	Equipment Hatch Hoist Preoperational Test
14.2.12.1.119	Pressurizer Surge Line HFT Performance Test DCD_3.12-25
14.2.12.2.1.1	RCS Sampling for Fuel Loading
14.2.12.2.1.2	Fuel Loading Instrumentation and Neutron Source Requirements Test
14.2.12.2.1.3	Initial Fuel Loading
14.2.12.2.1.4	Inverse Count Rate Ratio Monitoring for Fuel Loading
14.2.12.2.1.5	Precritical Test Sequence
14.2.12.2.1.6	Rod Drop Time Measurement Test
14.2.12.2.1.7	CRDM Operational Test
14.2.12.2.1.8	Rod Position Indication Test
14.2.12.2.1.9	Rod Control System Test
14.2.12.2.1.10	Reactor Protection System Test
14.2.12.2.1.11	RCS Final Leak Test
14.2.12.2.1.12	Incore Detector Test
14.2.12.2.1.13	RCS Flow Coastdown Test
14.2.12.2.1.14	Operational Alignment of Process Temperature Instrumentation Test
14.2.12.2.2.1	Initial Criticality Test Sequence
14.2.12.2.2.2	Initial Criticality
14.2.12.2.2.3	Determination of Core Power Range for Physics Testing
14.2.12.2.3.1	Low Power Test Sequence
14.2.12.2.3.2	Boron Endpoint Determination Test
14.2.12.2.3.3	Isothermal Temperature Coefficient Measurement Test
14.2.12.2.3.4	RCCA Bank Worth Measurement at Zero Power Test
14.2.12.2.3.5	Pseudo Rod Ejection Test
14.2.12.2.3.6	Operational Alignment of Nuclear Instrumentation Test
14.2.12.2.3.7	Dynamic Automatic Turbine Bypass Control Test
14.2.12.2.3.8	Pressurizer Heater and Spray Capability and Continuous Spray Flow Verification Test
14.2.12.2.3.9	Natural Circulation Test
14.2.12.2.3.10	Automatic Low Power SG Water Level Control Test
14.2.12.2.4.1	Power Ascension Test Sequence
14.2.12.2.4.2	Power Coefficient Determination Test
14.2.12.2.4.3	Axial Flux Difference Instrumentation Calibration Test and Axial Distribution Oscillation Test
14.2.12.2.4.4	Flux Map Test
14.2.12.2.4.5	RCCA Misalignment Measurement and Radial Power Distribution Oscillation Test
14.2.12.2.4.6	Remote Shutdown Test
14.2.12.2.4.7	Loose Parts Monitoring System Test (Continuation of 14.2.12.1.72)
14.2.12.2.4.8	Automatic Rod Control System Test
14.2.12.2.4.9	Operational Alignment of Process Temperature Instrumentation at Power Test

the RCS Flow Measurement Test in Subsection 14.2.12.2.4.12 and during the RCS Flow Coastdown Test in Subsection 14.2.12.2.1.13) are comparable with the US-APWR reference prototype plant.

- The results of the natural circulation test from the US-APWR reference prototype plant are incorporated into a plant-referenced simulator that meets the requirements of 10 CFR § 55.46 (c) and used in the operator training program to provide training on plant evaluation and off-normal events for each operating shift.

14.2.8.2.2 Pressurizer Surge Line HFT Performance Test

DCD_3.12-25

Pressurizer Surge Line HFT Performance Test for the first plant is performed in accordance with Subsection 14.2.12.1.119 to verify that the pressurizer surge line operating characteristics are within allowable values and that there is no excessive thermal stratification in the surge line that could result in undue stresses and fatigue to the surge line. For subsequent plants, the COL Applicant either performs the test or provides a justification for not performing the test, based on an evaluation of the results of previous pressurizer surge line HFT performance test.

14.2.9 Trial Testing of Plant Operating and Emergency Procedures

Plant operating and emergency procedures are, to the extent practical, developed, trial-tested, and corrected during the ITP prior to fuel loading to establish their adequacy. Preoperational and startup test procedures utilize plant operating, surveillance, emergency, and abnormal procedures either by reference or verbatim incorporation in the performance of tests. This verifies the plant procedures by actual use and provides experience to the plant personnel.

The COL Applicant provides a schedule for the development of plant procedures that assures that required procedures are available for use during the preparation, review and performance of preoperational and startup testing.

14.2.9.1 Operator Training during Special Low-Power Testing

At approval to load fuel, by virtue of being licensed by the NRC to operate the plant, the ROs/SROs have a responsibility for the operation of the plant. Therefore, at this point, the plant operations organization assumes responsibility for the plant. This period is used to further the training of licensed operators and provide training for operator trainees. This includes identifying the specific operator training to be conducted as a part of the use-testing during the special low power testing program required by the resolution of NUREG-0737 (Reference 14.2-7) TMI action plan item I.G.1. Meeting this requirement includes identifying proposed tests to be conducted, submitting analysis to support the test, submitting the test procedure, training to the test procedure and evaluating and documenting the results of the training.

14.2.10 Initial Fuel Loading and Initial Criticality

Fuel loading and initial criticality is conducted in accordance with the guidance of RG 1.68 (Reference 14.2-10). This phase of the ITP is performed in a controlled manner as

14.2-27 Code on Nuclear Air and Gas Treatment, ASME/ANSI AG-1-1997, American Society of Mechanical Engineers

14.2-28 Control Room Habitability at Light-Water Nuclear Power Reactors, Regulatory Guide 1.196, Rev. 1, U.S. Nuclear Regulatory Commission, Washington, DC January 2007

14.2-29 US-APWR Test Program Description Technical Report, MUAP-08009, Revision 1, October, 2009

14.2-30 Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder), ASME NOG-1-2004, American Society of Mechanical Engineers.

14.2-31 Below-the-Hook Lifting Devices, ASME B30.20-2006, American Society of Mechanical Engineers.

14.2-32 Performance-Based Containment Leak-Test Program, Regulatory Guide 1.163, Rev. 0, U.S. Nuclear Regulatory Commission, Washington, DC September 1995

14.2-33 Industry Guideline for Implementing Performance-Based Option of 10 CFR 50 Appendix J, NEI 94-01, Rev. 0, Nuclear Energy Institute, July 1995

14.2-34 Containment System Leakage Testing Requirements, ANSI/ANS-56.8-1994, American National Standard Institute, January 1994

14.2-35 Pressurizer Surge Line Thermal Stratification. NRC Bulletin No. 88-11. U.S. Nuclear Regulatory Commission. Washington. DC. 1988 DCD_3.12-25

APPENDIX 14A

COMPARISON OF RG 1.68 APPENDIX A VERSUS US-APWR TEST ABSTRACTS

This appendix provides the matrix of applicable guidance of RG 1.68 Appendix A versus typical test abstracts. In general, redundancy and electrical independence tests (i.e. RG-1.41) are applicable for safety-related systems only (this test is performed in the 14.2.12.1.45 and 14.2.12.1.47). And testing specified in RG 1.68 at the 25% test power plateau is performed at 30% based on MHI's startup experience. Other exceptions are identified in this matrix with justification.

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 1 of 17)

RG 1.68 Appendix A		Section Number	Typical Test
1.a.(1)		14.2.12.1.1 14.2.12.1.52	RCS Hot Functional Preoperational Test Thermal Expansion Testing
1.a.(2)	(a)	14.2.12.1.2 14.2.12.1.119	Pressurizer Pressure and Water Level Control Preoperational Test Pressurizer surge line HFT performance test
1.a.(2)	(b)	14.2.12.1.3	RCP Initial Operation Preoperational Test
1.a.(2)	(c)	14.2.12.1.8 14.2.12.1.29	RCS Cold Hydrostatic Preoperational Test Feedwater System Preoperational Test The above integrated hydrostatic test and shop test is applicable instead of the component test.
1.a.(2)	(d)	14.2.12.1.4 14.2.12.1.5	Pressurizer Safety Depressurization Valve (SDV) Preoperational Test Pressurizer Relief Tank Preoperational Test
1.a.(2)	(e)	-	Not applicable. US-APWR does not have main steam isolation valves in the reactor coolant system.
1.a.(2)	(f)	14.2.12.1.6	RCS Preoperational Test
1.a.(2)	(g)	14.2.12.1.2 14.2.12.1.19	Pressurizer Pressure and Water Level Control Preoperational Test Resistance Temperature Detectors (RTDs)/Thermocouple Cross-calibration Preoperational Test
1.a.(2)	(h)	14.2.12.1.7	Reactor Internals Vibration Test
1.a.(2)	(i)	14.2.12.1.6	RCS Preoperational Test
1.a.(2)	(j)	-	Not applicable. This is not a design feature of the US-APWR.

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resulting from any single operator error or control malfunction, transients caused by a fault in a system component requiring its isolation from the system, and transients due to a loss of load or power. Level B service conditions include any abnormal incidents not resulting in a forced outage and also forced outages for which the corrective action does not include any repair of mechanical damage. The estimated duration of Level B service condition is included in the design specifications.

Level C Service Conditions – (Emergency Conditions, Infrequent Incidents)

These conditions include those deviations from Level A service conditions that require shutdown for correction of the conditions or repair of damage. These conditions have a low probability of occurrence but are included to establish that no gross loss of structural integrity will result as a concurrent effect of any damage developed in a system. The postulated occurrences for such events which result in more than 25 strong stress cycles are evaluated for cyclic fatigue using Level B service limits. Strong stress cycles are those having an alternating stress intensity value greater than that for 10^6 cycles from the applicable fatigue design curves.

Level D Service Conditions – (Faulted Conditions, Limiting Faults)

These conditions include those combinations of conditions associated with extremely low-probability postulated events whose consequences are such that the integrity and operability of the nuclear energy system may be impaired to the extent that considerations of public health and safety are involved. Such considerations require compliance with safety criteria as may be specified by regulatory authorities.

Testing Conditions

Testing conditions are those pressure overload tests that include primary and secondary hydrostatic tests and SG tube leak tests specified. Other types of tests are classified under one of the other service condition categories.

The design transient selected is also considered the plant condition (PC) categorization and frequency in ANS N51.1 (Reference 3.9-2), but the frequency in some cases is different from ANS N51.1 (Reference 3.9-2).

The design transients and the number of occurrences for fatigue analysis of components are shown in Table 3.9-1.

The effect of thermal stratification and thermal striping is considered in the stress and fatigue evaluations of components and piping. The issues identified in NRC Bulletins 88-08 and 88-11 (References 3.9-3 and 3.9-4) are factored into this analysis. Confirmation of design margins and acceptable operational conditions is verified during Hot Functional Testing as described in Chapter 14.~~The effect of thermal stratification and thermal striping is considered in the stress and fatigue evaluation of components and piping. The requirements in the NRC Bulletins 88-08, 88-11 (References 3.9-3, 3.9-4) and other applicable design standards are considered in this evaluation.~~ DCD_3.12-25

Provisions of the thermal stratification of the feedwater nozzle are described in Subsection 5.4.2.1.2.12.

NRC Bulletin 88-11 (Reference 3.12-29) was issued after Portland General Electric Company experienced difficulties in setting whip restraint gap sizes on the pressurizer surge line at the Trojan plant.

At the horizontal portion of the pressurizer surge line, thermal stratification is expected to occur if the surge flow velocity is low, and to disappear if the velocity is high. At normal operation, a low flow-rate out-surge flow in the line connecting the pressurizer to the hot leg may occur due to a continuous spray, which could lead to a thermal stratification in the cross section of pressurizer surge line in accordance with the temperature difference between pressurizer and hot leg. When a high-flow rate out-surge flow or in-surge flow occurs during transient events, this thermal stratification disappears. The low flow-rate out-surge flow is recovered as soon as out-surge or in-surge ends, thus, reproducing the thermal stratification.

Structural integrity of the pressurizer surge line of the US-APWR plant is to be assured by performing the following activities for the first US-APWR plant.

1. Fatigue evaluation is to be performed by considering the repeated event of thermal stratification occurring in the pressurizer surge line. It will be confirmed by analysis and hot functional test that thermal deflections of piping do not result in adverse consequences.

   If the fatigue evaluation results comply with the ASME Code Section III, items 2 through 4 will not be performed in subsequent US-APWR plants. DCD_03.12-25

   If the fatigue evaluation results yield noncompliance with the ASME Code Section III, items 2 through 4 below, are to be performed.

2. ~~Operational alternatives such as plant start-up and cooldown, which~~Plant heatup and cooldown are the most severe conditions for thermal stratifications of the pressurizer surge line due to developing the largest difference of temperature between hot leg and pressurizer, which are to be considered for mitigation of thermal stratification in the US-APWR.

3. The temperature of the surge line is to be monitored for the effects of thermal stratification at heatup and cooldown during hot functional testing.

4. Monitoring results are to be included in stress and fatigue analysis to ensure ASME Code Section III compliance. DCD_03.12-25

The temperature difference between the pressurizer fluid temperature and the RCL hot leg temperature at the two ends of the pressurizer surge line during Plant Heatup and Cooldown is not permitted to exceed 145°F. This value conservatively limits the potential for detrimental thermal stratification within the surge line and assures acceptable fatigue results for the design life of the plant. The measured thermal stratification temperatures from the HFT surge line performance test (described in DCD Section 14.2.12.1.119) will be compared with the values used in the design analysis to confirm the design margins. DCD_3.12-25

The monitoring will be continued during the first cycle operation of the first US-APWR plant. The COL applicant addresses the applicability of the monitoring of the first cycle operation. DCD_3.12-25

3.12.5.11 Safety Relief Valve Design, Installation, and Testing

The requirements of "Rules for the Design of Safety Valve Installations", ASME Code, Appendix O (Reference 3.12-30) are followed in the design and installation of safety valves and relief valves for overpressure protection.

Discharge forces of safety or relief valves using open vent stacks to discharge directly to the atmosphere are normally calculated using static methods and a conservative dynamic load factor. While performing stress analysis, these discharge forces are applied to evaluate stresses and restraint/support design loads using static equivalent force analysis methods.

Discharge forces of safety or relief valves using piped discharges to vessels or headers are not considered as steady state forces, but are analyzed as forces acting at changes in directions (elbows and branch connections) during the initial discharge phase. A static equivalent force analysis or a time-history dynamic force analysis are performed on the piping system to evaluate resulting stresses and support/restraint design loads. See Subsection 3.12.4.1.1 for the computer program used in the analysis (Reference 3.12.21).

If several relief or safety valves are placed on a common header, the most adverse sequence of valve discharges are used to calculate piping stresses and support/restraint design loads.

3.12.5.12 Functional Capability

The functional capability requirements for ASME piping systems that must maintain an adequate fluid flow path to mitigate a Level C or D service conditions are shown in Table 3.12-5. These requirements are based on NUREG-1367 (Reference 3.12-31).

3.12.5.13 Combination of Inertial and Seismic Anchor Motion Effects

The inertial effects and anchor movement effects due to an earthquake are analyzed separately. The results from these two separate analyses are combined by the absolute summation method for support design loads and for the fatigue analysis of ASME Code, Section III, Class 1 (Reference 3.12-2) piping systems.

3.12.5.14 Operating-Basis Earthquake as a Design Load

For US-APWR piping design, the main earthquake load used is defined in Section 3.7.

By virtue of the design criteria used for piping components and supports, this design basis criterion assures that SSE controls the seismic design of systems and components.

3.12.7 Combined License Information

COL 3.12(1) *Deleted*

COL 3.12(2) *If any piping is routed in tunnels or trenches in the yard, the COL Applicant is to generate site-specific seismic response spectra, which may be used for the design of these piping systems.*

COL 3.12(3) *If the COL Applicant finds it necessary to lay ASME Code, Section III (Reference 3.12-2), Class 2 or 3 piping exposed to wind or tornado loads, then such piping must be designed to the plant design basis loads.*

COL 3.12(4) *The COL Applicant is to screen piping systems that are sensitive to high frequency modes for further evaluation.*

COL 3.12(5) *The COL holder for the first plant is to perform the pressurizer surge line monitoring subsequent to the COL item 14.2(11).* DCD_3.12-25

3.12.8 References

3.12-1 Code for Pressure Piping, Power Piping. ASME B31.1, 2004 Edition, American Society of Mechanical Engineers.

3.12-2 ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsections NB, NC and ND, 1992 Edition including 1992 Addenda, The American Society of Mechanical Engineers.

3.12-3 General Design Criteria for Nuclear Power Plants, Domestic Licensing of Production and Utilization Facilities, Energy. Title 10, Code of Federal Regulations, Part 50, Appendix A, U.S. Nuclear Regulatory Commission, Washington, DC.

3.12-4 Earthquake Engineering Criteria for Nuclear Power Plants, Domestic Licensing of Production and Utilization Facilities, Energy. Title 10, Code of Federal Regulations, Part 50, Appendix S, U.S. Nuclear Regulatory Commission, Washington, DC.

3.12-5 Code Cases: Nuclear Components, Boiler and Pressure Vessel Code. 1992 Edition, American Society of Mechanical Engineers.

3.12-6 Design, Fabrication, and Materials Code Case Acceptability, ASME Section III. Regulatory Guide 1.84, Rev. 34, U.S. Nuclear Regulatory Commission, Washington, DC, August 2005.

3.12-7 ASME Code Cases Not Approved For Use, Regulatory Guide 1.193, Rev. 1, U.S. Nuclear Regulatory Commission, Washington, DC, August 2005.

3.12-8 Seismic Subsystem Analysis, Design of Structures, Components, Equipment, and Systems, Standard Review Plan for the Review of Safety Analysis