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December 2, 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-11420

Subject: Amended MHI's Response to US-APWR DCD RAI No. 770-5739 REVISION 0 (SRP 03.09.01)

Reference: 1) "Request for Additional Information EMB1 5739 Revision 3, SRP Section: 03.09.01 – Special Topics for Mechanical Components, Application Section: 03.09.01", dated June 15, 2011.
2) "MHI's Response to US-APWR DCD RAI No. 770-5739 Revision 0 (SRP 03.09.01)", UAP-HF-11233, dated July 26, 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. 770-5739 Revision 0".

Enclosed is the response to one (1) RAI contained within Reference 1. This response amend the previously transmitted responses submitted under MHI's Reference UAP-HF-111233 on July 26, 2011 (Reference 2) in order to correct description of responses to US-APWR DCD RAI No. 770-5739 Revision 0 (Reference 1).
And this response include the contents of confirmation that MHI was audited by NRC in August 2011.

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.770-5739 Revision 0

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-11420
Docket Number 52-021

Amended Response to Request for Additional Information
No. 770-5739 Revision 0

December 2011

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/2/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 770-5739**
SRP Section:	**03.09.01 – Special Topics for Mechanical Components**
DATE OF RAI ISSUE:	**06/15/2011**

QUESTION NO.: RAI 03.09.01-6

This question is a supplement to question 3.9.1-2. The staff reviewed US- APWR technical reports providing summary stress analysis results (including MUAP-9004 through 9013, and MUAP-11003) submitted by MHI and found that there are computer codes that were used for the design of Seismic Category I piping, components and supports that are not listed and discussed in US-APWR DCD subsections 3.9.1.2, 3.12.4.1 or Appendix C. Computer codes are also listed in a Revised Completion Plan for US-APWR Piping Systems and Components submitted by Mitsubishi Heavy Industries, Ltd. (MHI), on May 12, 2011 (ML11136A234).

MHI is requested to include computer programs in DCD Section 3.9.1.2, "Computer Programs Used in Analyses," used in the analysis and design of US-APWR safety-related piping, components and supports in conformance with SRP Sections 3.9.1 and 3.12. The information should include program name, dated version and brief description of the program application. Since these programs were used for design of US-APWR Seismic Category I components, confirm whether these computer codes were previously reviewed and approved by the NRC staff. If yes, provide dates and versions of the program that was reviewed and approved by the staff, including the submitted dates and reference documents for acceptance. If not, MHI is requested to provide evidence of the computer code verification and validation documentation for design of the ASME Class 1, 2 and 3 components and piping in accordance with Appendix B to 10 CFR 50.55 or ASME code NQA-1 Code. Confirm that the documentation of these computer codes is available for staff review. The information should include the author, source code, dated version, and facility; the program users' manual and theoretical description, the extent and limitation of the program application; and the benchmarking problems, the QA control and maintenance of the program.

Amended ANSWER:

MHI is providing the requested information on the Computer Codes listed in Table-1 of Attachment A. These Computer Codes were already audited by the staff in August 2011, then MHI have already provided the information such as author, source code, dated version,

and facility; user manual and theoretical description, the extent and limitation of the program application; and the test runs, QA control and maintenance reports.

Impact on DCD

DCD Subsection 3.9.1.2, "Computer Programs Used in Analyses" and 3.12.4.1, "Computer Codes" will be revised as shown in Attachment A.

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.

Impact on Technical / Topical Report

There is no impact on Technical / Topical Report.

3.9.1.1.5.1 Primary-Side Hydrostatic Test

Both factory and plant site hydrostatic tests occur as a result of component or system testing. This hydrostatic test is performed at a water temperature compatible with reactor material ductility requirements and a test pressure of 3,107 psig (1.25 times design pressure). This transient is assumed to occur five times during the plant design life.

3.9.1.1.5.2 Secondary-Side Hydrostatic Test

The secondary side of the SG is pressurized to 1.25 times the design pressure, with a minimum water temperature of 120°F. This transient is assumed to occur five times during the plant design life.

3.9.1.2 Computer Programs Used in Analyses

3.9.1.2.1 List of Programs

A number of computer programs are used for static, dynamic, and hydraulic transient analysis. The computer programs used in piping analysis are listed in Section 3.12. The following is a list of programs used for the mechanical system component analysis.

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- Abaqus ~~FE structural analysis program (Reference 3.9-6)~~Abaqus is a computer program for temperature distribution analysis and stress analysis of components.(Reference 3.9-6).
- ANSYS ~~FE structural analysis program (Reference 3.9-7)~~ANSYS is a computer program for structure analysis such as dynamic response analysis (Reference 3.9-7).
- RELAP-5 ~~Transient hydraulic analysis program (Reference 3.9-8)~~RELAP-5 is a computer program for analyzing thermal-hydraulic transient analysis within primary coolant system and secondary system (Reference 3.9-8).
- GOTHIC GOTHIC code is a computer program for thermal-hydraulic analysis within a containment building and subcompartments (Reference 3.9-65).
- MULTIFLEX ~~Thermal-hydraulic-structural system analysis program (Reference 3.9-9)~~MULTIFLEX code is a computer program for analyzing thermal-hydraulic-structural system dynamics within a primary coolant system (Reference 3.9.-9).
- NASTRAN ~~FE structural analysis program (Reference 3.9-10)~~NASTRAN is a computer program for structure analysis such as dynamic analysis (Reference 3.9-10).
- EVALPRI EVALPRI is a computer code for evaluating the primary stress of a general axi-symmetric or three-dimensional solid model or tube

sheet and channel head junction for structural strength due to design and seismic load.

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- EVALSEFAV — EVALSEFAV is a computer program for evaluating the primary plus secondary stress and fatigue in accordance with ASME Code Section III NB-3220 and NG-3220 ().
- EVALIRAMJ — EVALIRAMJ is a computer program for evaluating environmental fatigue based on NUREG/CR-6909.
- RATCHET — RATCHET is a computer program for evaluating thermal stress ratcheting.
- RIGHT — RIGHT is a computer program used to create the internal heating files of 3D solid Models.
- SABRINA — SABRINA is a computer program used to perform the stress evaluation for the threaded structural fasteners (TSFs) of the Core Support Structures (CSS).

3.9.1.2.2 Program Validations

The verification and validation of computer programs is performed in compliance with the established quality assurance program (QAP). Error reporting and resolution of the errors are tracked following a QAP. The QAP is described in Chapter 17. The computer programs are validated using one of the methods described below. Verification tests demonstrate the capability of a computer program to produce valid results for the test problems encompassing the range of permitted usages defined by the program documentation.

- Hand calculations
- Known solution for similar or standard problem
- Acceptable experimental test results
- Published analytical results
- Results from other similar verified programs

3.9.1.3 Experimental Stress Analysis

Experimental stress analysis is not used for the US-APWR.

3.9.1.4 Considerations for the Evaluation for the Faulted Condition

Analytical methods used to evaluate faulted condition (Level D loading) for ASME Code, Section III (Reference 3.9-1), Class 1, 2, and 3 components are described in Subsection 3.9.3.

Analysis Results for Main Steam Piping inside Containment, MUAP-09013 Rev. 0 (Proprietary) and MUAP-09013 Rev. 0 (Non-Proprietary), March 2009.

3.9-60 Guidelines for Inservice Testing at Nuclear Power Plants, NUREG-1482, U.S. Nuclear Regulatory Commission, Washington, DC, April 1995.

3.9-61 MOV Periodic Verification (PV) Study, MPR 2524-a, Joint Owners Group (JOG), November 2006.

3.9-62 Joint Owners Group Air Operated Valve Program Document, Revision 1, December 13, 2000.

3.9-63 Comments on Joint Owners' Group Air Operated Valve Program Document, USNRC Letter from Eugene V. Imbro to Mr. David J. Modeen, Nuclear Energy Institute, October 8, 1999.

3.9-64 Resolution of Generic Safety Issue 158: Performance of Safety-Related Power-Operated Valves Under Design Basis Conditions, Regulatory Issue Summary RIS 2000-03, U.S. Nuclear Regulatory Commission, Washington, DC, March 15, 2000.

3.9-65 ~~PICEP: Pipe Crack Evaluation Program. NP-3596-SR, Rev.1, Electric Power Research Institute, 1987.~~GOTHIC, Containment Analysis Package User Manual, Version 7.2a (QA), NAI 8907-02, Rev. 17, Numerical Applications Inc., Richmond, WA, January 2006. DCD_03.09.01-6

3.9-66 Qualification of Active Mechanical Equipment Used in Nuclear Power Plants, American Society of Mechanical Engineers (ASME) QME-1-2007. DCD_03.09.06-49

3.9-67 Alternative Rules for Preservice and Inservice Testing of Certain Motor-Operated Valve Assemblies in Light-Water Reactor Power Plants, American Society of Mechanical Engineers (ASME) Code Case OMN-1, Rev. 0, 1999. DCD_03.09.06-58

This program is used for temperature distribution analysis and thermal stress analysis according to piping geometries and design transients such as fluid temperature, coefficient of heat transfer, and flow rate.

- ANSYS

  ANSYS (Reference 3.12-20) is a general purpose finite element structural analysis computer program.

- RELAP-5

  RELAP-5 (Reference 3.12-21) is a computer program for the fluid transient analysis.

  This program is used for the analysis of a behavior, such as water hammer, safety/relief valve discharge etc. by modeling flow volume and flow path.

  The pressure and flow rate time-history can be obtained.

- E/PD STRUDL

  ~~E/PD STRUDL (Reference 3.12-22) is a computer program that has the capability to perform the structural analysis of pipe supports in compliance with ASME Code, Section III, Section NF (Reference 3.12-2), and AISC Codes (Reference 3.12-23).~~

  ~~This computer program is designed to perform analysis of the pipe support structure, including the base plate flexibility per NRC IE Bulletin 79-02 (Reference 3.12-24) as applicable and perform a code stress check of the various components of the support assembly (e.g., structural stock items, welds, anchor bolts, and support vendor components based on data used from vendor's catalog values per vendor's certified design reports).~~E/PD STRUDL (Reference 3.12-22) is a computer program that has the capability to perform coupled structural analysis of piping and pipe supports in compliance with ASME Code, Section III, and AISC Codes (Reference 3.12-23), as envisioned in Section 3.12.3. DCD_03.09.01-6

  This program is used for the analysis of ASME Code, Section III, Class 2 and 3 (Reference 3.12-2) and ASME B31.1 (Reference 3.12-1) piping systems under various load conditions.

  Static analysis includes deadweight, thermal expansion, internal pressure, applied forces, and moments of displacements.

  Dynamic analysis includes response spectra analysis and time-history analysis.

  This computer program is designed to perform analysis of the pipe support structure, including the base plate flexibility per NRC IE Bulletin 79-02 (Reference 3.12 24) as applicable and perform a code stress check of the various components of the support assembly (e.g., structural stock items, welds, anchor

bolts, and support vendor components based on data used from vendor's catalog values per vendor's certified design reports).

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- STAAD.Pro ~~v8i~~

  ~~STAAD.Pro is a general purpose structural analysis program. The program is used for steel stress analysis of piping supports.~~STAAD.Pro (Reference 3.12-44) is a general purpose structural analysis program. The program is used for steel stress analysis of piping supports.

- P4TEDIA

  P4TEDIA is a computer program to calculate ΔT1, ΔT2, Ta and Tb (defined in ASME Code Section III, Subsection NB Class 1 piping) from the temperature distribution analysis results generated by ABAQUS

- P2DLOP

  P2DLOP is a computer program to convert time histories of parameters generated by RELAP5-3D such as pressure, temperature and flow rate into force time histories for piping structural analysis.

- CEFF-N

  CEFF-N is a computer program for the Class 1 piping fatigue analysis in LWR environment. This program calculates the cumulative usage factor in LWR environment using the fatigue analysis result in air and time histories of ΔT1, Ta and Tb. These results are generated by PIPESTRESS and P4TEDIA, respectively.

- MCPEVALPRI

  MCPEVALPRI is a computer program for calculating temperature data (ΔT1, ΔT2, Ta, Tb) from the ABAQUS heat transfer analysis result in accordance with ASME Code Section III NB-3653.

- MCPEVALSI

  MCPEVALSI is a computer program for calculating stress and usage factors in accordance with ASME Code Section III NB-3650.

- MCPFEM

  MCPFEM is a computer program for performing mesh division for the ABAQUS input files.

- US-CHERRY

  US-CHERRY is a computer program for developing floor response spectra.

3.12-32 ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NF, 2001 Edition including 2003 addenda, The American Society of Mechanical Engineers. DCD_03.12-27

3.12-33 ASME Boiler and Pressure Vessel Code, Section III, Division 1 – Appendices, Nonmandatory Appendix F, 2001 Edition including 2003 addenda. DCD_03.12-27

3.12-34 Structural Welding Code – Steel. AWS D1.1/D1.1M, American Welding Society, 2006.

3.12-35 Service Limits and Loading Combinations for Class 1 Linear-Type Supports. Regulatory Guide 1.124, Rev. 2, U.S. Nuclear Regulatory Commission, Washington, DC, February 2007.

3.12-36 Service Limits and Loading Combinations for Class 1 Plate-and-Shell-Type Component Supports. Regulatory Guide 1.130, Rev. 2, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

3.12-37 ~~Code Requirements for Nuclear Safety Related Concrete Structures. ACI 349, American Concrete Institute, 2001.~~Code Requirements for Nuclear Safety-Related Concrete Structures (ACI-349-06) and Commentary, American Concrete Institute, 2006. MIC-03-03-00066

3.12-38 Anchoring Components and Structural Supports in Concrete. Regulatory Guide 1.199, U.S. Nuclear Regulatory Commission, Washington, DC, November 2003.

3.12-39 IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations, IEEE Std 344-2004, Institute of Electrical and Electronic Engineers Power Engineering Society, New York, New York, June 2005.

3.12-40 Evaluation of Potential for Pipe Breaks, Report of U.S. NRC Piping Review Committee. NUREG-1061, Volume 4, U.S. Nuclear Regulatory Commission, Washington, DC, 1984.

3.12-41 Dynamic Analysis of Piping, Using the Structural Overlap Method. NUREG/CR-1980, U.S. Nuclear Regulatory Commission, Washington, DC, March 1981.

3.12-42 ASME Boiler and Pressure Vessel Code, Section II, 2001 Edition including 2003 Addenda, The American Society of Mechanical Engineers. DCD_03.12-27

3.12-43 Guideline for Evaluation of High-Cycle Thermal Fatigue of a pipe, JSME S 017-2003, November 2003. DCD_03.12-29

3.12-44 STAAD.Pro, Bentley Systems Inc., 1600 Riviera Avenue, Suite 300 Walnut Creek, California 94596. DCD_03.09.01-6