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November 1, 2011

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

Attention: Mr. Jeffery A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-11371

Subject: MHI's Responses to US-APWR DCD RAI No. 802-5931 REVISION 3, (SRP 03.09.01)

Reference: 1) "REQUEST FOR ADDITIONAL INFORMATION 802-5931 REVISION 3, SRP Section: 03.09.01 - Special Topics for Mechanical Components, Application Section: 3.9.1" dated 8/10/2011.

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. 802-5931 REVISION 3".

Enclosed are the responses to one RAI contained within Reference 1. This transmittal completes the response to this RAI.

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

Sincerely,

Y. Ogata

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

Enclosure:

1. Responses to Request for Additional Information No. 802-5931 REVISION 3.

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-11371
Docket No. 52-021

Responses to Request for Additional Information No. 802-5931,Revision 3

November, 2011

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

11/01/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.:	**NO. 802-5931 REVISION 3**
SRP SECTION:	**03.09.01 – Special Topics for Mechanical Components**
APPLICATION SECTION:	**3.9.1**
DATE OF RAI ISSUE:	**8/10/2011**

QUESTION NO.: 03.09.01-7

This question is a follow-up to question 03.09.01-1, Item 6, RAI 296-2254.

In RAI 3.9.1-1, Item 6, the applicant was asked about DCD section 3.9.1.1.1.10 which addresses the core lifetime extension transient. SRP 3.9.1 section III.1 states that any deviation from previous accepted practice be justified. The use of a decreased RCS average temperature with turbine inlet valve adjustments to extend the life of the core is a new transient that has not previously been approved. The applicant was asked to provide additional information and justification for this transient including impacts on core design and performance.

In a May 14, 2009, response to RAI 3.9.1-1, Item 6 (Accession Number ML091380159), the applicant clarified for this transient, that they assume two weeks as a maximum core lifetime extension. The applicant also stated that the required temperature decrease to achieve criticality is conservatively determined by the analysis. The applicant clarified that the US-APWR is not performing core lifetime extension evaluations at this time. The applicant indicated that such evaluations will be performed in the future by the respective licensees as part of the license renewal process in accordance with 10 CFR Part 54.
The applicant clarified that this event is included among the US-APWR design transients to confirm that the stress evaluation is acceptable when core lifetime extension evaluations are conducted in the future.

The staff finds that the applicant's response to RAI 3.9.1-1, Item 6 is incomplete and a portion of the applicants' response does not appear to be consistent with the description in Section 3.9.1.1.1.10 of the DCD. For instance, the DCD indicates that the Core Lifetime Extension transient is assumed to occur at the end of an operating cycle and is assumed to occur 60 times during the plant design lifetime; not at some future time. The following is requested:

1. Provide clarification on how a future effort to extend the life of the plant under the license renewal process is related to this Core Lifetime Extension transient.

2. If there is no direct connection, explain why the inclusion of this transient is required to provide acceptable stress for the future core lifetime extension.

3. Confirm whether the core-reload analyses for each cycle address a core lifetime extension transient as described in the DCD. As a follow-up to RAI 3.9.1-1, Item 6, provide a detailed discussion regarding the impacts of this transient on core design and performance.

4. Provide clarification on any safety concerns or operational concerns with operating outside of the normal programmed RCS average temperature band for two weeks during this transient.

ANSWER:

Question: 1) Provide clarification on how a future effort to extend the life of the plant under the license renewal process is related to this Core Lifetime Extension transient.

Answer: 1)
The US-APWR is not performing core lifetime extension evaluations at this time. However, the core lifetime extension is included in the normal operating condition design transients in case a future US-APWR plant conducts core lifetime extension evaluations in support of such a license amendment. The licensee will decide if and when to process such a license amendment for the core lifetime extension operation. The duration of core lifetime extension operation and the band of the RCS average temperature decrease will be specified by the licensee based on the desirable operating duration and the ability of 100% power operation.

Question: 2) If there is no direct connection, explain why the inclusion of this transient is required to provide acceptable stress for the future core lifetime extension.

Answer: 2)
Since the core lifetime extension evaluation is not performed, this core lifetime extension transient has no direct relation to a future effort to extend the life of plant under the license renewal process. This core lifetime extension transient is included in the design transients considering the conservatism for the equipment stress analysis.

Question: 3) Confirm whether the core-reload analyses for each cycle address a core lifetime extension transient as described in the DCD. As a follow-up to RAI 3.9.1-1, Item 6, provide a detailed discussion regarding the impacts of this transient on core design and performance.

Answer: 3)
The core lifetime extension evaluation is not performed at this time, as described in item 2 above. Therefore, the transient conditions are not considered in the actual reload core analysis.
If the core lifetime extension with the decrease of RCS average temperature is implemented in future, there could be impacts on the core power distributions and reactivity coefficients due to increased burn-up compared to the case without the core lifetime extension. However the impacts would be incorporated in the reload design by evaluating the reload checklist values at the extended EOC (End of Cycle).

Question: 4) Provide clarification on any safety concerns or operational concerns with operating outside of the normal programmed RCS average temperature band for two weeks during this transient.

Answer: 4)
In the core lifetime extension operation, secondary side coolant temperature/pressure decreases according to the decrease in reactor coolant temperature. The decrease of reactor coolant temperature causes an increase in safety margin for the thermal transient. On the other hand, the decrease in main steam pressure results in the increase of the delta between operational pressure and set point pressure of the main steam safety valve opening. Therefore, when a transient or an accident occurs in the core lifetime extension operation, it will take a longer time

period to initiate the opening of the main steam safety valve, compared to the amount of time taken during normal operation. However, this impact to the safety margin will be small. Therefore, plant operability is hardly impacted by core lifetime extension. Stable plant operation will be achieved by the adjustment of reactor control system set points associated with the programmed RCS average temperature. Such analysis/transient concerns will need to be addressed in core lifetime extension evaluations in support of a license amendment, if a licensee decides to pursue approval of such operation.

Impact on DCD

DCD Subsection 3.9.1.1.1.10 Core Lifetime Extension will be revised as follows:
(See Attachment-1)

This transient is assumed to occur at the end of an operating cycle when the critical boron concentration is required to reach less than achievable, full thermal power condition. The method of core life extension is as follows.

- The RCS average temperature is decreased to below the normal programmed temperature; this results in adding reactivity to the core through the negative moderator temperature coefficient.
- The turbine is controlled with a full load until the turbine inlet valves are fully opened.

The US-APWR is not performing core lifetime extension evaluations. However, the core lifetime extension is included in the design transients considering the case where the core lifetime extension is conducted in the plant which adopts the US-APWR design in the future. This transient is assumed to occur 60 times during the plant design life.

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.

intermittently. This transient is assumed to occur every two hours at hot standby or no-load, and is assumed to occur 2,100 times during the plant design life.

3.9.1.1.1.10 Core Lifetime Extension

This transient is assumed to occur at the end of an operating cycle when the critical boron concentration is required to reach less than achievable, full thermal power condition. The method of core life extension is as follows.

- The RCS average temperature is decreased to below the normal programmed temperature; this results in adding reactivity to the core through the negative moderator temperature coefficient.
- The turbine is controlled with a full load until the turbine inlet valves are fully opened.

The US-APWR is not performing core lifetime extension evaluations, however, the core lifetime extension is included in the design transients considering the case where the core lifetime extension is conducted in the plant which adopts the US-APWR design in the future. DCD_03.09.01-7

This transient is assumed to occur 60 times during the plant design life.

3.9.1.1.1.11 Refueling

After the temperature of the reactor coolant is decreased to 140°F at the end of the plant cooldown operations, the RV head is removed and the refueling canal is filled. The refueling water is supplied by the refueling water recirculation pump from the RWSP, which is assumed to be 32°F, into the RCS. The cold water at 32°F is assumed to flow directly to the RV through the reactor coolant piping. This transient is assumed to occur 60 times during the plant design life.

3.9.1.1.1.12 Turbine Roll Test

This transient occurs during the required check of the turbine cycle during hot functional testing. The RCP is used to heat the reactor coolant to the operating temperature (no-load conditions), and the SG is used to perform a turbine roll test. The plant cooldown rate during this test exceeds the 100°F per hour design rate. This transient is assumed to occur 10 times during the plant design life.

3.9.1.1.1.13 Primary-Side Leakage Test

A primary-side leakage test is performed after opening of the RCS. During this test, the primary system pressure is raised to 2,500 psia (i.e., design pressure) and the system temperature above the minimum temperature given by the RV material ductility requirements, and then the system is inspected to establish that a leak does not occur. This transient is assumed to occur 120 times during the plant design life.