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June 5, 2009

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-09282

Subject: MHI's Response to US-APWR DCD RAI No. 359-2590

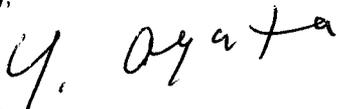
Reference: 1) "Request for Additional Information No. 359-2590 Revision 0, SRP Section: 03.05.01.01 – Internally Generated Missiles (Outside Containment), Application Section: 3.5.1.1," dated 5/13/09.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No. 359-2590, Revision 0."

Enclosed is the response to 1 RAI 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 this submittal. His contact information is provided below.

Sincerely,



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

Enclosure:

1. Response to Request for Additional Information No. 359-2590, Revision 0

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

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NR0

Contact Information

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Docket No. 52-021
MHI Ref: UAP-HF-09282

Enclosure 1

UAP-HF-09282
Docket No. 52-021

Response to Request for Additional Information No. 359-2590,
Revision 0

June, 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/05/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO. 359-2590 REVISION 0

SRP SECTION: 03.05.01.01 – Internally Generated Missiles (Outside Containment)

APPLICATION SECTION: 3.5.1.1

DATE OF RAI ISSUE: 05/13/09

QUESTION NO. RAI 3.5.1.1.3-S01 (P2 - Supplemental RAI):

The Nuclear Regulatory Commission's (NRC) Standard Review Plan (SRP) Section 3.5.1.1 (III) (4) states that the applicant needs to address the procedures, analysis, and design to ensure that pressurized gas bottles will not become missiles capable of damaging SSCs important to safety to the extent that safety-related functions are compromised. The NRC staff has reviewed Revision 1 of the Tier 1 Design Control Document (DCD) for the US-Advanced Pressurized Water Reactor (US-APWR). As previously noted by the NRC staff in **RAI 3.5.1.1-03**, the staff requested the applicant to revise DCD Tier 2, Table 1.8.2, "Compilation of All Combined License Applicant Items for Chapters 1-19," to include a COL information item which requires the COL holder to establish/provide procedures to ensure that portable pressurized gas cylinders located/stored outside containment will not become/generate missiles that may adversely impact safety-related SSCs during seismic events.

In the response dated 01/28/09, to RAI 3.5.1.1-03, Mitsubishi declined to include a new COL item to require the COL holder to establish procedures to ensure that pressurized gas cylinders located/stored outside containment will not become or generate missiles that may adversely impact safety-related SSCs. In its response Mitsubishi stated that the design features addressed in the Mitsubishi response are provided through standard plant criteria and would not necessitate a site specific COL item. While the staff agreed with Mitsubishi's description of pressurized gas bottle design features, the staff concludes that the requirements to restrain gas cylinders as well as to store in an orientation to minimize the potential for missile generation are operational issues that require the use of procedures to ensure consistent implementation.

Therefore, revise DCD Tier 2, Table 1.8.2, "Compilation of All Combined License Applicant Items for Chapters 1-19," to include a COL information item which requires the COL holder to establish procedures to ensure that portable pressurized gas cylinders located/stored outside containment will not become/generate missiles that may adversely impact safety-related SSCs during seismic events. This COL information item should also address implementation of procedures to remove unsecured maintenance equipment located outside the containment, prior to operations, to a location where it is not potential hazard to SSCs important to safety or seismically restrained to prevent it from becoming a missile. In addition, provide a schedule as to when these procedures will be implemented. The staff believes that these procedural controls should be in-place prior to fuel load. Provide a markup of the DCD in your response and identify in which revision the change will appear.

ANSWER:

Item 4.d of DCD Revision 1, Subsection 3.5.1.1.2.1, states the COL Applicant is to prepare plant procedures that specify unsecured equipment required for maintenance or undergoing maintenance is to be removed from containment prior to operation, moved to a location where it is not a potential hazard to SSCs important to safety, or seismically restrained to prevent it from becoming a missile. Portable pressurized gas cylinders, in the context of equipment required for maintenance, may become/generate gravitational missiles if not properly secured. Therefore, the COL Applicant is currently committed to procedurally secure portable pressurized gas cylinders used for maintenance activities to prevent an adverse impact to SSCs inside containment that are important to safety. However, clarification will be added during Revision 2 of the DCD by stating procedural controls relating to unsecured equipment includes portable pressurized gas cylinders.

In response to RAI 127-1641, Question 3.5.1.1-01, discussion of COL Applicant responsibility is to be moved to DCD Subsection 3.5.1.2.4 during Revision 2. Subsection 3.5.1.2.4 discussion is consistent with SRP 3.5.1.2 Review Procedures III, Item 3, for controls relating to unsecured maintenance equipment inside containment. Similar discussion does not exist within SRP 3.5.1.1 relating to controls for unsecured maintenance equipment outside containment.

However, MHI agrees that procedural controls relating to unsecured maintenance equipment are necessary to prevent a potential hazard to important to safety SSCs whether it is located inside or outside containment. Therefore, DCD Subsection 3.5.1.1.4 will be revised to require the COL Applicant to have plant procedures in place prior to fuel load that specify unsecured equipment, including portable pressurized gas cylinders, located inside or outside containment and required for maintenance or undergoing maintenance is to be removed from containment prior to operation, moved to a location where it is not a potential hazard to SSCs important to safety, or seismically restrained to prevent it from becoming a missile.

The requirements stipulated in Subsection 3.5.1.1.4 are also applicable to inside containment as discussed in Subsection 3.5.1.2.4. Therefore, the COL Applicant statement, moved to the second paragraph of Subsection 3.5.1.2.4 as a result of RAI 127-1641, Question 3.5.1.1-01, is to be relocated to Subsection 3.5.1.1.4 and modified as discussed above.

Impact on DCD

See Attachment 1 for the mark-up of DCD Tier 2, Section 3.5, Revision 2, changes to be incorporated.

- Insert the following as a new paragraph in Subsection 3.5.1.1.4, which was created by the response to RAI 127-1641, Question 3.5.1.1-01:

“The COL Applicant is to have plant procedures in place prior to fuel load that specify unsecured equipment, including portable pressurized gas cylinders, located inside or outside containment and required for maintenance or undergoing maintenance is to be removed from containment prior to operation, moved to a location where it is not a potential hazard to SSCs important to safety, or seismically restrained to prevent it from becoming a missile.”

- Delete the entire second paragraph in Subsection 3.5.1.2.4, which was created by the response to RAI 127-1641, Question 3.5.1.1-01.

- Change COL 3.5(1) in Subsection 3.5.4 to the following: *"The COL Applicant is to have plant procedures in place prior to fuel load that specify unsecured equipment, including portable pressurized gas cylinders, located inside or outside containment and required for maintenance or undergoing maintenance is to be removed from containment prior to operation, moved to a location where it is not a potential hazard to SSCs important to safety, or seismically restrained to prevent it from becoming a missile."*

See Attachment 2 for the mark-up of DCD Tier 2, Section 1.8, Revision 2, changes to be incorporated.

- Change COL 3.5(1) in Table 1.8-2 (sheet 4 of 44) to the following: *"The COL Applicant is to have plant procedures in place prior to fuel load that specify unsecured equipment, including portable pressurized gas cylinders, located inside or outside containment and required for maintenance or undergoing maintenance is to be removed from containment prior to operation, moved to a location where it is not a potential hazard to SSCs important to safety, or seismically restrained to prevent it from becoming a missile."*

Impact on COLA

FSAR sections corresponding to the impacted DCD sections will need to be revised to be consistent with the DCD, including revising the COL Item statement in FSAR Table 1.8-201.

Impact on PRA

There is no impact on the PRA.

In the case of non safety-related high-speed rotating fans, the probability of missile occurrence may be statistically significant ($P_1 > 10^{-7}$). When investigating these components, the probability of impact, P_2 , is also evaluated to confirm that the product of $P_1 \times P_2$ is less than 10^{-7} . The probability of impact, P_2 , is minimized by locating a potential missile source or potential target outside the zone of postulated missile strike, by the robust building walls and slabs that are designed for applicable missile strikes, and/or the separation of the rotating equipment that is a missile source from potentially impacted SSCs. Therefore, high-speed rotating fans are not a credible missile source since the product of $P_1 \times P_2$ is less than 10^{-7} .

Refer to Subsection 3.5.1.3 for discussion of turbine and turbine rotor missiles.

3.5.1.1.3 Gas or Pressurized Cylinder Explosion

Protective measures are taken as recommended by NUREG/CR-3551 (Reference 3.5-19), including procedures, analysis, and design details, to mitigate pressurized gas cylinders/bottles from generating or becoming a missile. Design features which resist the formation of missiles from a pressurized gas cylinder/bottle include the fabrication from rolled thick-wall steel material, and a steel collar at the neck of the bottle to protect the sensitive valve and other critical parts. In addition, the pressurized cylinders are oriented vertically with the bottle pointed towards the concrete slab roof in storage racks restrained in accordance with seismic Category II requirements. Therefore, the product of the probability of occurrence, P_1 , and the probability of impacting a significant target, P_2 , is less than 10^{-7} .

Battery compartments are ventilated to prevent the concentration of hydrogen. The hydrogen supply system and gas bottles are installed in a compartment independent of safety-related structures, and ventilation is provided to prevent the concentration of hydrogen. The probability of occurrence, P_1 , for a gas explosion in battery compartments is therefore maintained less than 10^{-7} .

3.5.1.1.4 Gravitational Missiles

The COL Applicant is to have plant procedures in place prior to fuel load that specify unsecured equipment, including portable pressurized gas cylinders, located inside or outside containment and required for maintenance or undergoing maintenance is to be removed from containment prior to operation, moved to a location where it is not a potential hazard to SSCs important to safety, or seismically restrained to prevent it from becoming a missile.

3.5.1.1.4.1 Crane Drop of Heavy Loads

As defined in ASME NOG-1 (Reference 3.5-5), a critical load is any lifted load whose uncontrolled movement or release could adversely affect any safety-related SSC when such a SSC is required for plant safety or could result in potential offsite exposure in excess of 10 CFR 100 limits.

flywheel is sufficiently higher than the maximum rotating speed of the motor postulated at the plant, and the soundness of the flywheel is maintained. Therefore, the probability of missile occurrence from high-speed rotating equipment inside containment, P_1 , is less than 10^{-7} .

3.5.1.2.3 Gas or Pressurized Cylinder Explosion

Conclusions relating to statistical significance of postulated missiles due to gas or pressurized cylinder explosion also apply inside containment. By an analysis similar to that in Subsection 3.5.1.1.3, it is concluded that no items have the capability of generating potential missiles related to a gas or pressurized cylinder explosion inside the containment. Therefore, the product of the probability of occurrence, P_1 , and the probability of impacting a significant target, P_2 , is less than 10^{-7} .

3.5.1.2.4 Gravitational Missiles

Subsection 3.5.1.1.4 discusses gravitational missiles, including crane drop of heavy loads, falling objects resulting from non-seismic SSCs during seismic event, and secondary missiles caused by a falling object striking a high-energy system. Conclusions relating to statistical significance of these postulated missiles also apply to similar potential gravitational missiles inside containment. Therefore, the probability of missile occurrence, P_1 , or the product of P_1 and the probability of impacting a significant target, P_2 , is less than 10^{-7} .

~~In addition, the COL Applicant is to prepare plant procedures that specify equipment required for maintenance or undergoing maintenance is to be removed from containment prior to operation, moved to a location where it is not a potential hazard to SSCs important to safety, or seismically restrained to prevent it from becoming a missile.~~

3.5.1.3 Turbine Missiles

The two broad categories of turbine failures are referred to as design over-speed and destructive over-speed failures. Missiles resulting from design over-speed failures are the result of brittle fracture of turbine blade wheels or portions of the turbine rotor itself. Failures of this type can occur during startup or normal operation. Missiles resulting from destructive over-speed failures would be generated if the over-speed protection system malfunctions and the turbine speed increases to a point at which the low-pressure wheels or rotor undergo ductile failure.

3.5.1.3.1 Geometry

As defined by "Protection Against Low-Trajectory Turbine Missiles", RG 1.115, Rev. 1 (Reference 3.5-6), current evidence suggests low trajectory turbine missile strikes are concentrated within an area bounded by lines inclined at 25 degrees to the turbine wheel planes and passing through the end wheels of the low pressure stages.

The T/G is located south of the nuclear island with its shaft oriented along the north-south axis. In this orientation, the potential for low trajectory turbine missiles to impact safety-related SSCs within the same unit is minimized since safety-related SSCs are

3.5.4 Combined License Information

- COL 3.5(1) *The COL Applicant is to ~~prepare~~ have plant procedures in place prior to fuel load that specify unsecured equipment, including portable pressurized gas cylinders, located inside or outside containment and required for maintenance or undergoing maintenance is to be removed from containment prior to operation, moved to a location where it is not a potential hazard to SSCs important to safety, or seismically restrained to prevent it from becoming a missile.*
- COL 3.5(2) *The COL Applicant is to commit to actions to maintain P_1 within this acceptable limit as provided by turbine and rotor design features, material specifications and recommended inspections during preservice and inservice periods based on Technical Report, MUAP-070028-NP, Probability of Missile Generation From Low Pressure Turbines.*
- COL 3.5(3) *As described in DCD, Section 2.2, the COL Applicant is to establish the presence of potential hazards, except aircraft, which is reviewed in Subsection 3.5.1.6, and the effects of potential accidents in the vicinity of the site.*
- COL 3.5(4) *It is the responsibility of the COL Applicant to verify the site interface parameters with respect to aircraft crashes and air transportation accidents as described in Section 2.2.*
- COL 3.5(5) *The COL Applicant is responsible to evaluate site-specific hazards for external events that may produce missiles more energetic than tornado missiles, and assure that the design of seismic category I and II structures meet these loads.*
- COL 3.5(6) *The COL Applicant is responsible to assess the orientation of the T/G of this and other unit(s) at multi-unit site for the probability of missile generation using the evaluation of Subsection 3.5.1.3.2.*

3.5.5 References

- 3.5-1 Domestic Licensing of Production and Utilization Facilities. Title 10 Code of Federal Regulations Part 50, U.S. Nuclear Regulatory Commission, Washington, DC.
- 3.5-2 Reactor Site Criteria. Title 10 Code of Federal Regulations Part 100, U.S. Nuclear Regulatory Commission, Washington, DC.
- 3.5-3 Rules for Construction of Nuclear Facility Components, American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code Section III, 2001 Edition through the 2003 Addenda.
- 3.5-4 Rules for Construction of Nuclear Facility Components, American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code Section XI, 2001 Edition through the 2003 Addenda.

Table 1.8-2 Compilation of All Combined License Applicant Items
for Chapters 1-19 (sheet 4 of 44)

COL ITEM NO.	COL ITEM
COL 3.4(3)	<i>Site-specific flooding hazards from engineered features, such as from cooling water system piping, is to be addressed by the COL Applicant.</i>
COL 3.4(4)	<i>The COL Applicant is to address any additional measures below grade to protect against exterior flooding and the intrusion of ground water into seismic category I buildings and structures.</i>
COL 3.4(5)	<i>The COL Applicant is to identify and design, if necessary, any site-specific flood protection measures such as levees, seawalls, floodwalls, site bulkheads, revetments, or breakwaters per the guidelines of RG 1.102 (Reference 3.4-3), or dewatering system if the plant is not built above the DBFL.</i>
COL 3.4(6)	<i>The COL Applicant is to identify any site-specific physical models used to predict prototype performance of hydraulic structures and systems.</i>
COL 3.5(1)	<i>The COL Applicant is to prepare <u>have</u> plant procedures <u>in place prior to fuel load</u> that specify <u>unsecured equipment, including portable pressurized gas cylinders, located inside or outside containment and required for maintenance or undergoing maintenance</u> is to be removed from containment prior to operation, moved to a location where it is not a potential hazard to SSCs important to safety, or seismically restrained to prevent it from becoming a missile.</i>
COL 3.5(2)	<i>The COL Applicant is to commit to actions to maintain P_1 within this acceptable limit as provided by turbine and rotor design features, material specifications and recommended inspections during preservice and inservice periods based on Technical Report, MUAP-070028-NP, Probability of Missile Generation From Low Pressure Turbines.</i>
COL 3.5(3)	<i>As described in DCD, Section 2.2, the COL Applicant is to establish the presence of potential hazards, except aircraft, which is reviewed in Subsection 3.5.1.6, and the effects of potential accidents in the vicinity of the site.</i>
COL 3.5(4)	<i>It is the responsibility of the COL Applicant to verify the site interface parameters with respect to aircraft crashes and air transportation accidents as described in Section 2.2.</i>