REQUEST FOR ADDITIONAL INFORMATION 237-2141 REVISION Revision 1

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US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 10.02 - Turbine Generator
Application Section: Section 10.2

QUESTIONS for Balance of Plant Branch 1 (AP1000/EPR Projects) (SBPA)

10.02-1

Request for Additional Information

1. US-APWR - RAI 10.2-1

The design control document (DCD) Tier 2 Section 10.2.2.1, "General Description," provides details of the US-APWR turbine generator (T-G) system. The T-G system consists of one double flow high pressure (HP) turbine and three double flow low pressure (LP) turbines, two sets of external moisture separator re-heaters (MSRs), main generator, an exciter, associated controls and auxiliary subsystems. The HP turbine and three LP turbines are connected in tandem and operate at 188.5 rad/s (1800 rpm).

However, regarding the HP and LP turbines, the DCD is not explicit in describing whether theses turbines are designed with monoblock or shrink fit rotors. Except in, Section 10.2.3.1, "Material Selection," the DCD states, "Fully integral turbine rotors are made from ladle refined, vacuum deoxidized Ni-Mo-V alloy steel by processes that maximize the cleanliness and toughness of the steel." Therefore, the NRC staff requested the applicant to clarify whether the main turbine consists of monoblock units and describe the design of theses units. Also, the staff requested the applicant to revise the FSAR Section 10.2.2.1 to reflect any revisions that will be made in this regard.

2. US-APWR - RAI 10.2-2

Conformance to General Design Criteria (GDC) 4, "Environmental and Dynamic Effects Design Bases," as it relates to the protection of structures, systems, and components (SSCs) important to safety from the effects of turbine missiles requires that an emergency turbine over-speed protection system (with suitable redundancy and diversity) should be provided to minimize the probability of generation of the turbine missiles. Further, the Standard Review Plan (SRP), Section 10.2 Section III, "Review Procedure," Item 2.C specifies that a mechanical overspeed trip device will actuate the control, stop, and intercept valves to close at approximately 111 percent of rated speed. Furthermore, Item 2.D of the above review procedure specifies that an independent and redundant backup electric overspeed trip device should actuate to close the control, stop, and intercept valves at approximately 112 percent of the turbine rated speed.

US APWR design control document (DCD) Tier 2 Section 10.2.2.3.2.3, “Overspeed Trip Functions” describes the turbine generator (T-G) emergency overspeed trip systems, which consist of an emergency mechanical trip device and an independent emergency electrical trip device. In addition, according to DCD Table 10.2-2, “Turbine Overspeed Protection,” the mechanical overspeed trip system closes the main turbine stop and reheat valves at approximately 110 percent of rated turbine speed, and also the independent electrical overspeed trip system fully closes these valves at approximately 111 percent of rated speed based on a two-out-of-three trip logic. Based on the descriptions in the DCD, the staff finds these emergency overspeed trip devices meet the criteria specified in Items 2.C and 2.D of the SRP Section III, and also they are redundant and diverse in their design and operation.

However, it is not clear whether there is any common software that is used for both the DEH control system and emergency backup electrical overspeed trip system. Item 2.D of the SRP Section III specifies that the backup electrical overspeed trip system may use the same sensing techniques as the electro-hydraulic (i.e., DEH) control system. However, the SRP specifies that the electrical overspeed emergency system circuitry is reviewed to confirm that the control signals from the two systems are isolated from, and independent of, each other. Therefore the staff requested the applicant to provide the following additional information:

- Clarify whether any of these control systems (i.e., DEH and emergency overspeed systems) share any common components or process inputs. If so, provide an evaluation of the impact of failures of such components.

- Explain whether there is any software used for the triple processors or performing trip logic actuation. Explain the diversity and defense in-depth used to defend against a common cause failure (CCF) of the triple processor functions.

- Provide a schematic and logic diagram of all input signals to the triple processors and all outputs from the triple processors, so that staff can verify separate and redundant features that are described in the DCD.

3. <u>US-APWR - RAI 10.2-3</u>

Item 2.A, Section III, “Review Procedures” of SRP Section 10.2, specifies that the support systems, subsystems, control systems, and alarms and trips will function for all abnormal conditions, including a single failure of any component or subsystem, and will preclude an unsafe turbine overspeed. Further, the turbine overspeed control systems described in the DCD does not provide adequate information to conclude that the US-APWR T-G system meets the guidance provided in Item 2.A, as related to the single failure criteria, diversity, and defense in-depth of the T-G overspeed protection systems. Therefore the staff requested the applicant to provide the following additional information:

- Provide justification and explain how the T-G control systems meet the single failure criterion. If not, how does Mitsubishi plan to meet this criterion?

- Provide an evaluation of the T-G control systems meeting the defense in-depth design aspects to the SRP guidance as described above.

4. US-APWR - RAI 10.2-4

10 CFR 52.47(b)(1) requires that a design certification application contain the proposed inspections, tests, analyses, and acceptance criteria (ITAAC) that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations. The DCD Tier 1 Table 2.7.1.1-1, "turbine Generator Inspections, Tests, Analyses, and Acceptance Criteria," describes the ITAAC details for the US-APWR T-G system. Given that the turbine stop and control valves and moisture separator reheater stop and intercept valves are integral part of the T-G overspeed protection control systems, the ITAACs listed in the DCD Tier 1 Table 2.7.1.1-1 should identify testing of these valves to ensure that all valves will function as described in the DCD the Tier 2 Section 10.2. In order to satisfy the requirements of 10 CFR 52.47(b)(1), the staff request the applicant to provide additional ITAACs with respect to the T-G valves.