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August 21, 2009

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-09427

Subject: MHI's Response to US-APWR DCD RAI No.419

References: 1) "Request for Additional Information No. 419 Revision 0, SRP Section: 08.04 - Station Blackout," dated July, 6, 2009

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.419 Revision 0."

Enclosed are the responses to 5 RAIs 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 the submittals. His contact information is below.
Sincerely,

Y. Ogata

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

Enclosure:

1. Response to Request for Additional Information No.419 Revision 0

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-09427
Docket No. 52-021

Responses to Request for Additional Information No.419 Revision 0

August 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

8/20/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 419-3126 REVISION 0**
SRP SECTION:	**08.04 - STATION BLACKOUT**
APPLICATION SECTION:	**8.4**
DATE OF RAI ISSUE:	**7/6/2009**

QUESTION NO. : 08.04-8

In RAI-08.04-001 the staff requested additional information on whether any two, or a defined set of any two out of 4 trains are required for safe shutdown of the plant for LOOP, and LOOP and LOCA occurring simultaneously. In response to staff RAI, MHI stated that each of the four-train's 6.9 kV safety-related loads is powered from its Class 1E bus that is supplied from its respective GTG. In addition to the 6.9 kV loads, MHI stated that there are also 480 volt loads associated with each 6.9 kV train. The 480 volt loads are grouped as A1 and D1 loads. The group A1 loads support trains A and B, and group D1 loads support trains C and D. The AI loads can be supplied power from either A or B 6.9 kV Class 1E buses. The transfer of power supply from 480 volt bus A to B, or from 480 Volt B to A Class 1E buses is accomplished by manual actions by opening a normally-closed breaker and by closing a normally-open breaker. A similar arrangement exists for the 480 Volt group D1 loads that are associated with 6.9 kV trains C and D.

MHI asserts that any two out of four trains can achieve a safety function with one train out of service and with a single failure on another train. Based on the arrangement of the 480 Volt A1 and D1 loads, the US-APWR design relies on manual actions to achieve a safe shutdown of the plant using any two out of four trains. Manuals actions can be credited for meeting the SBO rule but they are not credited for design basis events and accident. During the March 12, 2009 teleconference, MHI agreed to add detail description to the DCD in future revision (Rev 2) to explain the dependencies and manual actions required for the 480 Volts loads to support the basis for the number of trains needed for safe shut down of the plant for operational and design basis events.

The staff requests that MHI docket its response confirming the above actions to resolve RAI-08.04-001

ANSWER:

A1 and D1 480V load center supply power to loads composed of 2 trains. In coping with design basis events and accident, manual switching of A1 and D1 480V load center is need when A or D train Class 1E Gas Turbine Generator is out of service due to maintenance. The manual switching is needed for maintenance and it is not needed for only compliance with a single failure criterion, so it is not need when design basis events and accident occur.
Explanation will be added in Subsection 8.3.1.1.2.1.

Impact on DCD
Subsection 8.3.1.1.2.1 will be revised as following:

Four train safety system loads are distributed on the four redundant Class 1E trains A, B, C and D. Two train safety system loads are distributed on Class 1E 480V buses A1 and D1. A1 buses are train A and can be powered from train B. Similarly, D1 buses are train D and can be powered from train C. **Prior to a maintenance outage of train A GTG, the A1 load center is manually connected to the train B Class 1E 480V load center. Similarly, prior to a maintenance outage of train D GTG, the D1 load center is manually connected to the train C Class 1E 480V load center.**

Impact on COLA
There is no impact on COLA.

Impact on PRA
There is no impact on PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

8/20/2009

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DATE OF RAI ISSUE:	**7/6/2009**

QUESTION NO. : 08.04-9

In RAI-08.04-003 the staff requested additional information and clarification on how USAPWR design met the guidance provided on SBO in the SECY 94-084 and SRP Section 8.4 for evolutionary designs. The guidance given in the SECY 94-084 recommends that the preferred method of demonstrating compliance with an SBO (10 CFR 50.63) for evolutionary designs is to have a full-capacity AAC power source of a diverse design that can power a larger complement of shutdown equipment to bring the plant to cold shutdown if needed. The description given in the US-APWR DCD (Rev 0 and Rev1) credits only one of the two AAC-GTGs to maintain the plant in hot shutdown condition during an SBO event. During the teleconference with MHI held on March 12, 2009, the staff explored the use of the second AAC-GTG during an SBO. MHI explained that USAPWR can achieve the hot shut-down condition by using only one AAC-GTG and one train Class 1 E system. Also MHI stated that the second AAC-GTG can be used as an additional back-up source to power Class 1 E system loads to achieve and to keep the plant in cold shut down condition if required.

In the original RAI the staff asked MHI to address why the Residual Heat Removal Pump was not included in the SBO loads that are powered by the AAC GTG during an SBO event. MHI indicated that the loads shown in the DCD are the loads needed for hot shut down as a minimum requirement of US-APWR under SBO conditions. MHI indicated during the March 12, 2009, teleconference that when the plant is moved to cold shut down, two AAC-GTGs will be used to operate any two safety trains' loads including the Residual Heat Removal Pump for keeping the plant in safe condition. Further, MHI agreed to add detail description to the DCD in future revision (Rev 2) on the use of both AAC-GTGs for SBO purposes. MHI will also provide load list for both Hot and Cold Shutdown conditions of the plant for an SBO event in future revision (Rev 2) of the DCD.

The staff requests that MHI docket its response confirming the above actions to resolve this RAI question.

ANSWER:

Description to achieve and keep cold shutdown will be added in section 8.4.
Table to show loads which achieve and keep cold shutdown will be added.

Impact on DCD
The last paragraph in subsection 8.4.1.3 will be revised as following:

~~If both AAC GTGs are running and AAC power supply from one of the AAC GTG is restored to one Class 1E bus, the other AAC GTG feeds the loads on the other non-Class 1E permanent bus.~~

Impact on COLA
Power source which achieve and keep cold shutdown become available when two AAC start and the second AAC is connected to other Class 1E bus by the way which is similar to the way of the first AAC.
Table 8.3.1-6 will be revised as Attachment A to show the load which achieve and keep Cold Shutdown during an SBO.

Impact on PRA

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

8/20/2009

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Docket No. 52-021

RAI NO.:	**NO. 419-3126 REVISION 0**
SRP SECTION:	**08.04 - STATION BLACKOUT**
APPLICATION SECTION:	**8.4**
DATE OF RAI ISSUE:	**7/6/2009**

QUESTION NO. : 08.04-10

By RAI-08.04-005, the staff asked MHI to describe how it met the Position C3.4 of RG 1.155 with regard to procedures and training to cope with station blackout. The staff requested MHI to include an interface requirement in US-APWR DCD for a COL applicant to develop and submit a summary of SBO coping procedures and training guidelines for staff review since the subject procedures are site-specific. In response to this RAI, MHI indicated the procedures and training are addressed as COL item in Chapter 13, 13.4(1) and 13.4(2) of the DCD. The staff notes that the Chapter 13, 13.4(1) and 13.4(2) of the DCD addresses Operational Programs and not the plant specific procedures and training described in Position C3.4 of RG 1.155. The applicant is requested to add a narrative in the Section 8.4 of the DCD with regard to meeting Position C3.4 of RG 1.155, and then referring the reader to the DCD chapter and section where such COL interface items are addressed. The alternative approach is to add an interface COL requirement in Chapter 8, Section 8.4 for procedures and training to cope with station blackout in accordance with the guidelines of Position C3.4 of RG 1.155.

During the March 12, 2009, teleconference, MHI agreed to add a narrative in the Section 8.4 of the upcoming revision (Rev 2) of the DCD with regard to Position C3.4 of RG 1.155 and an interface requirement for the COL applicant for meeting Position C3.4 of RG 1.155.

The staff requests that MHI docket its response confirming the above actions to resolve this RAI question.

ANSWER:

Position C.3.4 of RG 1.155 is addressed in Section 13.2 "Training" and 13.5 "Plant Procedures". Subsection 8.4.2.2 will be revised to add conformance with Regulatory Position C.3.4 of RG 1.155.

Impact on DCD

Subsection 8.4.2.2 will be revised to add new subsection after last paragraph as following:

Procedures to cope with SBO are addressed in Section 13.5 and the training is addressed in Section 13.2. These include all operator actions necessary to cope with SBO for at least the duration in accordance with Subsection 8.4.2.1.1 and to restore normal long-term core cooling/decay heat removal once ac power is restored. This meets the requirement of Regulatory Position C.3.4 of RG 1.155.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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8/20/2009

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APPLICATION SECTION:	**8.4**
DATE OF RAI ISSUE:	**7/6/2009**

QUESTION NO. : 08.04-11

By RAI-08.04-006, the staff asked MHI to addresses quality assurance and specifications as described in Position C3.5 of RG 1.155 for SBO equipment. Also, the staff requested MHI to provide an interface requirement in the US-APWR DCD for a COL applicant that references the US-APWR design certification to address the position C.3.5 of RG I.155 regarding quality assurance and specifications for SBO equipment. MHI responded to the staff query on meeting position C.3.5 of RG I.155 by stating that quality assurance of AAC-GTG will be controlled in accordance with DCD Chapter 17 and related topical report PQD-HD-19005 Revision 1.

During the March 12, 2009, teleconference, MHI agreed to add a narrative in the Section 8.4 of the upcoming revision (Rev 2) of the DCD with regard to Position C3.5 of RG 1.155 and an interface requirement for the COL applicant for meeting Position C3.5 of RG 1.155.

The staff requests that MHI docket its response confirming the above actions to resolve this RAI question.

ANSWER:

Subsection 8.4.2.2 will be revised to add conformance with Regulatory Position C.3.5 of RG 1.155. And Subsection 8.4.4 will be revised to add the reference.

Impact on DCD

Subsection 8.4.2.2 will be revised to add new subsection after last paragraph as following:

The quality assurance of AAC GTG is controlled in accordance with DCD Chapter 17 and related topical report PQD-HD-19005 Revision 2 (Reference 8.4-3). This meets the requirements of Regulatory Position C.3.5 of RG 1.155.

Subsection 8.4.4 will be revised to add as following:

8.4-3 Quality Assurance Program (QAP) Description For Design Certification of the US-APWR, PQD-HD-19005 Revision 2, December 2008.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

8/20/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 419-3126 REVISION 0**
SRP SECTION:	**08.04 - STATION BLACKOUT**
APPLICATION SECTION:	**8.4**
DATE OF RAI ISSUE:	**7/6/2009**

QUESTION NO. : 08.04-12

By RAI-08.04-007, the staff asked MHI to provide additional information on the systems and equipment required for coping for 1 hour without ac power for the following:

a. The staff asked MHI to provide additional information on RCS inventory taking into consideration shrinkage, leakage from pump seals, and inventory loss from letdown or other normally open lines. MHI responded by stating that the RCS is not in shrinkage condition, because plant is operated with keeping the RCS temperature during SBO. The seal return line is closed, and leakage of pump will not occur. Also letdown line and any other lines are closed, any inventory loss does not occur during SBO condition.

During the March 12, 2009, teleconference MHI stated that the wording "leakage of pump will not occur" stated in its response is not appropriate. It should be stated "leakage of pump will be limited". There is small leakage through RCP No.2 seal which is expected to be approximately 0.2 gpm (40 litters) per hour under SBO condition.

This leakage is very small compared to RCS inventory and no significant inventory loss will occur during SBO.

Based on MHI's revised statements on the issue of RCS inventory during the March 12, 2009 Teleconference, MHI is requested to provide the following information and clarification regarding the RCS inventory and core coverage.

1) Provide detailed description of the reactor coolant pump (RCP) seal return system and explain how the RCP seal leak flow at lower pressure could return to the reactor at higher pressure to avoid loss of reactor coolant inventory during a station blackout (SBO) event.

2) Perform an SBO coping analysis to demonstrate that reactor core will remain covered during the SBO time period assuming loss of coolant inventory by (a) steaming from the reactor through safety relief valves to carry out decay heat from the core, (b) assuming maximum RCS unidentified leakage defined in technical specifications, and (c) appropriate amount of RCP seal leakage (at 25 gpm per pump per NUMARC 87-00, 2.5.2) unless justified in item 1 above.

ANSWER:

1) As described in Section 5.4.1.4.9, the leakage from the RCP is controlled by three shaft seals arranged in series. Normally, the seal injection water is supplied and the seal injection inside the pump is separated into two directions. One injection flows down to cool the bearing and enters the RCS, while the other injection flows up the shaft through the seals. After passing through the No. 1 seal, most of the flow leaves the pump via the No. 1 seal leak-off line. Minimal flow passes through the No. 2 seal to its leak-off line. The No. 1 seal leak-off is routed to the volume control tank and the No. 2 and 3 seal leak-offs are routed to the containment vessel reactor coolant drain tank (CVDT).

   After SBO occurs, when the seal injection to the RCPs stops, the isolation valves on the No. 1 seal leak-off line of each RCP are closed by the undervoltage signal. Thus, the No. 2 seal leak-off is the only pathway for reactor coolant leakage through the RCPs. The leakage through the No.2 seal is limited and is expected to be approximately 0.2 gpm per RCP under SBO condition.

   MHI will revise DCD Section 8.4.2.1.2 "Station Blackout Coping Analysis" as shown in the "Impact on DCD" section below.

2) Until AAC GTG restores power to the Class 1E power system within one hour after SBO occurs, the loss of coolant inventory with regard to item (a), (b) and (c) stated in the question are assumed as the following;

   (a) By steaming through the main steam relief valves, the decay heat of the core is removed and the plant is kept in a condition similar to hot shut down. This steaming is performed in the secondary system and relief through the valves around the pressurizer in the RCS will not occur. Therefore, it does not result in the loss of coolant inventory in the RCS.
   (b) The maximum RCS unidentified leakage defined in the technical specifications is 0.5 gpm and the loss of coolant inventory within 1 hour is expected not to exceed 30 gallons. (Note that since the DCD Rev. 1 was issued, RCS unidentified leakage limit in technical specifications has changed to 0.5 gpm. The change was described to the NRC in RAI No. 217-2025, Revision 1, Question No 3.6.3-15, which was submitted by MHI letter UAP-HF-09103, dated March 24, 2009.)
   (c) The leakage of reactor coolant through the seals of each RCP is assumed to be 0.2 gpm as described in the response to question 1) above. Therefore the total loss of coolant inventory within 1 hour from the seals on all four RCPs is expected to be 48 gallons.

   Based on these assumptions, the total amount of the inventory loss during the first hour after SBO is assumed to be 78 gallons, which corresponds to approximately 10.4 ft^3 at standard condition. This amount is small compared to RCS coolant inventory. The normal operating water volume of the pressurizer is approximately 1,300 ft^3 (which is 45% of the free internal vessel volume of the pressurizer). Thus, the water in the pressurizer is maintained and the reactor core will remain covered during the SBO time period.

   After AAC GTG has restored power to the Class 1E power system, the coolant inventory will be maintained by supplying water by auxiliary system equipment.

Impact on DCD

The following changes will be made to the Tier 2 DCD, Section 8.4.2.1.2, item 2.(1):

<u>Chapter 8 (Section 8.4.2.1.2, item 2.(1))</u>

(1) Core and reactor coolant system (RCS) condition

Until AAC GTG restores the Class 1E power system within one hour after SBO occurs, all pumps and fans cannot be operated. However, during this time, the plant is in a condition similar to hot shut down. Turbine driven (T/D) emergency feedwater (EFW) pump and, main steam relief valve remove the decay heat of the core through natural circulation of the reactor coolant and the core and the RCS are kept in a safe mode. **After SBO occurs, the isolation valves on No. 1 seal leak-off line of each RCP are closed by the undervoltage signal. The leakage through the No.2 seal is limited and minimal. Thus, the reactor core will remain covered.**

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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

Table 8.3.1-6 Electrical Load Distribution - AAC GTG Loading (SBO Condition)

AAC GTG

Bus	Load	Quantity Installed	Rated Output [kW]	Load Input [kW]	Efficiency [%]	Power Factor [%]	Load Factor [%]	SBO							
								Hot Standby				Cold Shutdown			
								A or B AAC GTG				A and B AAC GTG			
								Quantity	[kW]	[kVAR]	[kVA]	Quantity	[kW]	[kVAR]	[kVA]
Class 1E Bus	Component Cooling Water Pump	1	610	644	90	85	95	1	644	400	758	1	644	400	758
	Essential Service Water Pump	1	720	760	90	85	95	1	760	473	895	1	760	473	895
	Containment Spray/Residual Heat Removal Pump	1	400	422	90	85	95	0	-	-	-	1	422	263	497
	Charging Pump	1	820	866	90	85	95	1	866	537	1019	1	866	537	1019
	Class 1E Electrical Room Air Handling Unit Fan	1	80	89	85	80	95	1	89	68	112	1	89	68	112
	Essential Chiller Unit	1	290	324	85	80	95	1	324	243	405	1	324	243	405
	Class 1E Electrical Room Air Handling Unit Electrical Heater	1	250	250	100	100	100	0	-	-	-	0	-	-	-
	Pressurizer Heater	1	562	562	100	100	100	0	-	-	-	0	-	-	-
	Motor Control Center	2						2	400	249	471	2	500	311	589
	Subtotal								3083	1970	3660		3605	2295	4275
	~~Motor Control Center~~ AAC Supporting Equipment	~~2~~ -						~~2~~ -	~~2080~~	~~1580~~	~~25100~~	-	80	60	100
	~~Subtotal~~								~~200~~	~~150~~	~~250~~				
Total									~~328~~163	~~212~~030	~~391~~760		3685	2355	4375