MITSUBISHI HEAVY INDUSTRIES, LTD.
16-5, KONAN 2-CHOME, MINATO-KU
TOKYO, JAPAN

November 11, 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-09518

Subject: MHI's Responses to US-APWR DCD DRAFT OPEN ITEMS 16.4.6 and 16.4.11

Reference: 1) "DRAFT OPEN ITEMS 16.4.6, SRP Section: 16.4.6 – INSTRUMENTATION" dated 09/16/2009.
2) "DRAFT OPEN ITEMS 16.4.11, SRP Section: 16.4.11 – ELECTRICAL POWER SYSTEMS" dated 09/16/2009.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") documents as listed in Enclosures.

Enclosed are the responses to DRAFT OPEN ITEMS within Reference 1 and 2.

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 DRAFT OPEN ITEMS 16.4.6
2. Response to DRAFT OPEN ITEMS 16.4.11

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

D081
NRO

Contact Information

C. Keith Paulson, Senior Technical Manager
Mitsubishi Nuclear Energy Systems, Inc.
300 Oxford Drive, Suite 301
Monroeville, PA 15146
E-mail: ck_paulson@mnes-us.com
Telephone: (412) 373-6466

Enclosure 1

UAP-HF-09518, Revision 0

Response to DRAFT OPEN ITEMS 16.4.6

November 2009

RESPONSES TO DRAFT OPEN ITEMS 16.4.6

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16-1784/172 This question is related to RAI 16-1784/172.

In RAI-SRP16-CTSB-1784/172, the staff requested an explanation regarding the methodologies for obtaining allocations for signal conditioning and actuation logic response times for Reactor Trip System (RTS) Instrumentation. The APWR Bases discussion for SR 3.3.1.13, RTS RESPONSE TIME, states that the allocations for signal conditioning and actuation logic response times may be obtained from the same methodologies used to determine sensor allocation response times. The comparable Bases discussion for SR 3.3.1.16 in NUREG-1431, defines the methods for obtaining allocations for sensor response times distinctly from the methods for obtaining allocations for signal conditioning and actuation logic response times. The Bases for SR 3.3.1.16 also cites two topical reports, one that provides the basis and methodology for using allocated sensor response times (WCAP-13632-P-A), and one that provides the basis and methodology for using allocated signal conditioning and actuation logic response times (WCAP-14036-P). For the US-APWR, the applicant maintains that the same methods are used for obtaining response time allocations for all three portions of the system. The staff questions the applicant's position regarding response time allocations for RTS Instrumentation on the basis that 1) all technical references associated with the Standard Technical Specifications (STS) appear to have been removed without providing comparable replacement references, and 2) differences in the methods used by the US-APWR and STS have not been clearly delineated. In a teleconference meeting on May 26, 2009, the applicant acknowledged the staff's concerns and indicated that response time allocation issues would be appropriately addressed in a Technical Report scheduled for issuance in September 2009. This issue is identified as Open Item OI-SRP16-CTSB-1784/172.

ANSWER:

See change to DCD, below.

Impact on DCD

Following sentence will be added in the DCD Chapter 16 section 3.3.1 SR 3.3.1.13 Bases;

> MUAP-09021-P "Response Time of Safety I&C System" provides the basis and methodology for using allocated signal processing and actuation logic response times in the overall verification of the protection system channel response time. Section 4.4 of

MUAP-07005, "Safety System Digital Platform -MELTAC-" describes how response times of each individual MELTAC module are combined to determine the total digital system response time.

Impact on COLA

There are impacts on the COLA to incorporate the DCD change.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

RESPONSES TO DRAFT OPEN ITEMS 16.4.6

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16-1784/174 This question is related to RAI 16-1784/174.

In RAI-SRP16-CTSB-1784/174, the staff requested a justification for why the information associated with dynamic transfer functions in the NUREG-1431 Bases discussion for SR 3.3.1.16, REACTOR TRIP SYSTEM (RTS) RESPONSE TIME, was excluded from the comparable Bases discussion for SR 3.3.1.13 in the APWR Bases. The applicant states that Reactor Trip Breakers (RTBs) and Resistance Temperature Detectors (RTDs) are known to have aging or wear-out mechanisms that can impact response time and thus require response time measurement. Response times for other components can be affected by random failures or calibration discrepancies, which can be detected by other testing and calibration methods required by other surveillances. Consequently, response time testing is provided for RTBs and RTDs, but not for other Protection and Safety Monitoring System (PSMS) components, including digital components of the PSMS which implement dynamic transfer functions. The applicant therefore concludes that the discussion of response time testing for dynamic transfer functions is not applicable to the digital PSMS. The staff questions the applicant's position regarding the applicability of response time testing for dynamic transfer functions on the basis of insufficient information associated with other testing, calibration methods, and surveillance requirement specifics for digital PSMS instrumentation that includes dynamic transfer functions. It is not clear from the response that the justification provided warrants exclusion of the Standard Technical Specification (STS) discussion on dynamic transfer functions from the APWR Bases. In a teleconference meeting on May 26, 2009, the applicant acknowledged the staff's concerns and agreed to review the issue. This issue is identified as Open Item OI-SRP16-CTSB-1784/174.

ANSWER:

See change to DCD below.

Impact on DCD

The following will be added in the DCD Chapter 16 Section 3.3.1 SR 3.3.1.13 Bases;

> The PSMS dynamic transfer functions employ time constants that are installed as digital values and processed through digital algorithms. Therefore, the time response of the dynamic transfer functions has no potential for variation due to time or environmental drift or component aging. The COT confirms the integrity of the time constants and

algorithms through the periodic software memory integrity check. The complete PSMS response time is determined one time by analysis and confirmed one time in the factory test. The response times of analog instruments that provide input to the dynamic transfer functions are periodically checked in Surveillance 3.3.1.13, because they do have the potential for response time variation.

Impact on COLA

There are impacts on the COLA to incorporate the DCD change.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16-1784/186 This question is related to RAI 16-1784/186.

In RAI-SRP16-CTSB-1784/186, the staff requested an explanation regarding the methodologies for obtaining allocations for signal conditioning and actuation logic response times for Engineered Safety Features Actuation System (ESFAS) Instrumentation. The APWR Bases discussion for SR 3.3.2.8, ESFAS RESPONSE TIMES, states that the allocations for signal conditioning and actuation logic response times may be obtained from the same methodologies used to determine sensor allocation response times. The comparable Bases discussion for SR 3.3.2.10 in NUREG-1431, defines the methods for obtaining allocations for sensor response times distinctly from the methods for obtaining allocations for signal conditioning and actuation logic response times. The Bases for SR 3.3.2.10 also cites two topical reports, one that provides the basis and methodology for using allocated sensor response times (WCAP-13632-P-A), and one that provides the basis and methodology for using allocated signal conditioning and actuation logic response times (WCAP-14036-P). For the US-APWR, the applicant maintains that the same methods are used for obtaining response time allocations for all three portions of the system. The staff questions the applicant's position regarding response time allocations for ESFAS Instrumentation on the basis that 1) all technical references associated with the Standard Technical Specifications (STS) appear to have been removed without providing comparable replacement references, and 2) differences in the methods used by the US-APWR and STS have not been clearly delineated. In a teleconference meeting on May 26, 2009, the applicant acknowledged the staff's concerns and indicated that response time allocation issues would be appropriately addressed in a Technical Report scheduled for issuance in September 2009. This issue is identified as Open Item OI-SRP16-CTSB-1784/186.

ANSWER:

See change to DCD, below.

Impact on DCD

Following sentence will be added in the DCD Chapter 16 Section 3.3.2 SR 3.3.2.8 Bases;

> <u>MUAP-09021-P "Response Time of Safety I&C System" provides the basis and methodology for using allocated signal processing and actuation logic response times in the overall verification of the protection system channel response time. Section 4.4 of</u>

MUAP-07005, "Safety System Digital Platform -MELTAC-" describes how response times of each individual MELTAC module are combined to determine the total digital system response time.

Impact on COLA

There are impacts on the COLA to incorporate the DCD change.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

RESPONSES TO DRAFT OPEN ITEMS 16.4.6

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: 16.4.6

SRP SECTION: 16.4.6 – INSTRUMENTATION

APPLICATION SECTION: 16.4.6

DATE OF OPEN ITEM ISSUE: 9/16/2009

OPEN ITEM NO. : 16-1784/188 This question is related to RAI 16-1784/188.

In RAI-SRP16-CTSB-1784/188, the staff requested a justification for why the information associated with dynamic transfer functions in the NUREG-1431 Bases discussion for SR 3.3.2.10, ENGINEERED SAFETY FEATURES ACTUATION SYSTEM (ESFAS) RESPONSE TIMES, was excluded from the comparable Bases discussion for SR 3.3.2.8 in the APWR Bases. The applicant states that Reactor Trip Breakers (RTBs) and Resistance Temperature Detectors (RTDs) are known to have aging or wear-out mechanisms that can impact response time and thus require response time measurement. Response times for other components can be affected by random failures or calibration discrepancies, which can be detected by other testing and calibration methods required by other surveillances. Consequently, response time testing is provided for RTBs and RTDs, but not for other Protection and Safety Monitoring System (PSMS) components, including digital components of the PSMS which implement dynamic transfer functions. The applicant therefore concludes that the discussion of response time testing for dynamic transfer functions is not applicable to the digital PSMS. The staff questions the applicant's position regarding the applicability of response time testing for dynamic transfer functions on the basis of insufficient information associated with other testing, calibration methods, and surveillance requirement specifics for digital PSMS instrumentation that includes dynamic transfer functions. It is not clear from the response that the justification provided warrants exclusion of the Standard Technical Specification (STS) discussion on dynamic transfer functions from the APWR Bases. In a teleconference meeting on May 26, 2009, the applicant acknowledged the staff's concerns and agreed to review the issue. This issue is identified as Open Item OI-SRP16-CTSB-1784/188.

ANSWER:

See change to DCD, below.

Impact on DCD

The following will be added in the DCD Chapter 16 Section 3.3.2 SR 3.3.2.8 Bases;

> The PSMS dynamic transfer functions employ time constants that are installed as digital values and processed through digital algorithms. Therefore, the time response of the dynamic transfer functions has no potential for variation due to time or environmental

drift or component aging. The COT confirms the integrity of the time constants and algorithms through the periodic software memory integrity check. The complete PSMS response time is determined one time by analysis and confirmed one time in the factory test. The response times of analog instruments that provide input to the dynamic transfer functions are periodically checked in Surveillance 3.3.2.8, because they do have the potential for response time variation.

Impact on COLA

There are impacts on the COLA to incorporate the DCD change.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

RESPONSES TO DRAFT OPEN ITEMS 16.4.6

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16-1784/192 This question is related to RAI 16-1784/192.

In RAI-SRP16-CTSB-1784/192, the staff requested a justification for why Condition F of LCO 3.3.3 in NUREG-1431 was not included in LCO 3.3.3 of the US-APWR GTS, as a Referenced Condition in Table 3.3.3-1 for "Reactor Vessel Water Level" and "Containment High Range Area Radiation" Post Accident Monitoring (PAM) Instrumentation. Condition F of NUREG-1431, Rev 3.1, requires the unit to "initiate action in accordance with Specification 5.6.5," which is a 14-day report. NUREG-1431 Bases B 3.3.3 for Condition F states that an alternate means of monitoring Reactor Vessel Level and Containment Area Radiation have been developed and tested for the reference unit, and that the alternate means may be temporarily installed if the normal PAM channel cannot be restored to OPERABLE status within the allotted time. If these alternate means are used, the Required Action is not to shut down the unit but rather to follow the directions of Specification 5.6.5 in the Administrative Controls of the Technical Specifications. The applicant concludes that Condition F of NUREG-1431 can be applied to both Reactor Vessel Water Level monitoring and Containment High Range Area Radiation monitoring in the APWR GTS, since they consider Pressurizer Level an alternate method of monitoring for Reactor Vessel Water Level and Containment Pressure an alternate method of monitoring for Containment High Range Area Radiation. The staff questions the applicant's position regarding the applicability of Condition F to LCO 3.3.3 of the APWR GTS, on the basis that an analysis has not been provided that 1) describes the degree to which the alternate instrumentation is equivalent to the installed PAM channels, and 2) justifies the areas in which they are not equivalent. In a teleconference meeting on May 13, 2009, the applicant acknowledged the staff's concerns and gave consideration to the development of an equivalency analysis. This issue is identified as Open Item OI-SRP16-CTSB-1784/192.

ANSWER:

As described in the Response of RAI 166-1784 QUESTION No. 16-192 revision 1, the Reactor Vessel Water Level has the alternate method of monitoring which is the Pressurizer Water Level. The Containment Area Radiation (High Range) has the alternate method of monitoring which is the Containment Pressure. Thus, Function F can be applied to those functions, and Function F is added in the Specifications and Bases. This revision was incorporated in DCD revision 2.

The Containment Pressure and Pressurizer Water Level are classified as safety related PAM variables whose design grades are equivalent to those of the Reactor Vessel Water Level and Containment High Range Area Radiation. .

The PAM function of Reactor Vessel Water Level is to monitor the coolant inventory to ensure adequate core cooling. The coolant inventory can also be monitored by the measurement of Pressurizer Water Level. Thus, the Pressurizer Water Level is the alternate method of ensuring coolant inventory for adequate core cooling.

The PAM function of Containment Area Radiation (High Range) is to avoid the release of radioactive material from containment. The release of radioactive material from containment can also be avoided by monitoring Containment Pressure and thereby maintaining containment integrity. Thus the Containment Pressure is the alternate method of Containment Area Radiation.

It is noted during considering this answer, the current description in 3.3.3 should be revised.

Impact on DCD

FUNCTION 2, 3, 10 and 16 on Table 3.3.3-1 (page 1 of 1) will be revised as follows;

2.	Reactor Coolant System (RCS) Hot Leg Temperature (Wide Range)	1 per loop [(d)]	~~F~~E
3.	RCS Cold Leg Temperature (Wide Range)	1 per loop[(d)]	~~F~~E
10.	Steam Generator Water Level (Wide Range)	1 per steam generator[(d)]	~~F~~E
16.	Emergency Feedwater Flow	1 per SG[(d)]	~~F~~E

Also, a footnote (d) of Table 3.3.1-1 (page 1 of 1) will be revised as follows;

(d) A RCS hot leg temperature wide range and a RCS cold leg temperature wide range of the same ~~train~~ loop are pair PAM functions. ASimilarly, SG water level wide range and an emergency feedwater flow of the same ~~train~~ steam generator are pair PAM functions. ~~The idea is to treat~~ Either parameters forming a pair can fulfill all PAM requirements. Therefore, only 1 per loop/SG of either parameter of the pair is required. ~~as one set and choose the number of required channels to be two, providing a basis for control.~~

Also, ACTION F.1 in Bases on page B 3.3.3-11 will be revised as follows;

At this unit, alternate means of monitoring Reactor Vessel Water Level and Containment High Area Radiation have been developed and tested. ~~Also, alternate means of the RCS Hot Leg Temperature (Wide Range) and RCS Cold Leg Temperature (Wide Range) have developed and tested. Also, alternate means of Steam Generator Water Level (Wide Range) and Emergency Feedwater Flow have been developed and tested.~~ These alternate means may be temporarily installed if the normal PAM channel cannot be restored to ~~PPERABEL~~OPERABLE status within the allotted time. If these alternate means are used, the Required Action is not to shut down the unit but rather to follow the directions of Specification 5.6.5, in the Administrative Control section of the TS. The report provided to the NRC should discuss the alternate means used, describe the degree to which the alternate means are equivalent to the installed PAM channels, justify the areas in which they are not equivalent, and provide a schedule for restoring the normal PAM channels.

Impact on COLA

There are impacts on the COLA to incorporate the DCD change.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16- 1769/209 This question is related to RAI 16-1769/209.

In RAI-SRP16-CTSB-1769/209, the staff requested an explanation for why the USAPWR GTS, Table 3.3.1-1, High Power Range Neutron Flux Rate, Positive and Negative Rate Function Allowable Values do not include Time Constants. This is a deviation from NUREG-1431. The applicant states that Allowable Values are not provided because Time Constants are digital values set in the application software and that there is no drift or adjustments for these Time Constants. The staff was unable to make a conclusive determination regarding exclusion of the Time Constants on the basis of the information provided. In a teleconference meeting on May 13, 2009, at the staff's request, the applicant agreed to review and substantiate their position. This issue has been identified as Open Item OI-SRP16-CTSB-1769/209.

ANSWER:

See response to RAI 16-1784/174

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16- 1769/220 This question is related to RAI 16-1769/220.

In RAI-SRP16-CTSB-1769/220, the staff requested a technical justification for: 1) specifying Reactor Trip System (RTS) Instrumentation Allowable Values in terms of "Channel Uncertainty Allowances" instead of specific values with inequality signs, and 2) expressing RTS Allowable Value units for various functions as "percent of span" (Functions 5, 8a, 8b, 9, 12a, 12b, 15a, 15d), "percent of rated flow" (Function 10), and "percent rated pump speed" (Function 11), in lieu of units that are function specific. These are deviations from NUREG-1431. The applicant states there is no setpoint drift for functions whose digital trip setpoint values reside within the Protection and Safety Monitoring System (PSMS) software, and that the only potential setpoint error is related to analog instrument loop uncertainties (i.e. Sensor reference accuracy, Sensor measuring and test equipment uncertainty, Sensor drift, Digital controller uncertainty). The applicant therefore concludes that the digital function Allowable Value in Table 3.3.1-1 is a maximum deviation, or two-sided OPERABILITY limit defined in terms that are pertinent to the five calibration setpoints 0%, 25%, 50%, 75% and 100% of the instrument range that can be measured during CHANNEL CALIBRATION. This approach deviates from the established convention for Allowable Values included in Standard Technical Specifications (STS) and all Tech Specs issued for operating plants. It is important to maintain consistency regarding Allowable Value convention from a human factors standpoint in order to promote uniform operations through standard operational practices and the avoidance of potential ambiguities that may result from a two-sided OPERABILITY limit. The staff finds that the response does not provide the requisite technical justification to warrant deviation from the STS. In addition, the applicant did not address the staff's request regarding Allowable Value units as described in Item 2. These issues have been identified as Open Item OI-SRP16-CTSB-1769/220.

ANSWER:

The convention for Allowable Values in the Standard Technical Specification (STS) and all Tech Specs issued for operating plants is appropriate due to the analog technology bases of these documents, and its resulting potential for variation in the trip setpoints. The US-APWR maintains this convention for analog setpoints, such as those in the DAS. However, in the PSMS, setpoints are stored as digital values that have no potential for variation. For the PSMS, the only factors that can result in variation in the trip functions reside in the uncertainties that are pertinent to the analog portion of the system. Therefore, for the PSMS it is appropriate for the Allowable Value to be expressed in terms of values that are measured during periodic testing of the analog portion of the system (ie, CHANNNEL CALIBRATION).

From a human factors standpoint it is critical that technicians understand the differences in the periodic testing methods for analog functions vs. digital functions. Having clearly distinguished testing methods, including clearly distinguished Allowable Values, reinforces this difference and reduces the potential for human performance error. For the US-APWR the Allowable Values for digital functions are measured during CHANNEL CALIBRATION; for analog functions the Allowable Values are measured during COT. The US-APWR further enhances human performance by establishing a standard CHANNEL CALIBRATION method for all instruments; the Allowable Values are measured at the same five calibration points, regardless of the PSMS trip setpoint.

Since the PSMS setpoints are stored as digital values with no drift potential, and those digital values are confirmed through the software memory integrity check, the only untested area required to confirm channel operability pertains to the accuracy of the analog input signal. When the analog input accuracy is confirmed, by reading the digital values of the five point CHANNEL CALIBRATION settings on visual display units (VDUs) driven by the same controller that executes the trip functions, the operability of the complete channel is confirmed, including the accuracy of all trip setpoints associated with that channel.

Also, as stated in the MHI letter to NRC, UAP-HF-09493, "Update of Chapter 16 of US-APWR DCD" dated October 30, 2009, MHI and Luminant have decided that the CPNPP-3 and 4 COLA Technical Specification and US-APWR DCD Technical Specification will be revised to reflect Option (3) of DC/COL-ISG-08, "Establish a PTS Section 5.5 or 5.6 Administrative Controls Program or Report". Thus all setpoints and allowable values will be under administrative control within the Setpoint Control Program. Therefore, all setpoints and allowable values are eliminated from DCD Chapter 16.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16- 1769/228 This question is related to RAI 16-1769/228.

In RAI-SRP16-CTSB-1769/228, the staff requested an explanation regarding inconsistencies between the US-APWR GTS and the WOG STS in the BACKGROUND section of the Reactor Trip System Instrumentation Bases (B 3.3.1). The inconsistencies identified are directly associated with the issue described in RAI-SRP16-CTSB-1769/220 in which the applicant considers the digital function Allowable Value in Table 3.3.1-1 to be a maximum deviation, or two-sided OPERABILITY limit defined in terms that are pertinent to the five calibration setpoints 0%, 25%, 50%, 75% and 100% of the instrument range. Determinations regarding the referenced inconsistencies are dependent upon the resolution of Open Item OI-SRP16-CTSB-1769/220. These determinations have been identified as Open Item OI-SRP16-CTSB-1769/228.

ANSWER:

Please see response to OPEN ITEM NO.:16-1769/220.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16- 1769/230 This question is related to RAI 16-1769/230.

In RAI-SRP16-CTSB-1769/230, the staff requested a technical justification explaining how the CHANNEL OPERATIONAL TEST (COT) surveillance requirement (SR 3.3.1.7) specified for Reactor Trip System (RTS) Functions 2.a, 2.b, 3.a, 3.b, 4, 5, 6, 7, 8.a, 8.b, 9, 10, 11, 12.a, 12.b, 15.a, 15.c, and 15.d in Table 3.3.1-1, ensures that those functions are adequately tested. The Channel Operational Test as originally defined in NUREG -1431, has been revised under the APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The APWR GTS Channel Operational Test for the Protection and Safety Monitoring System (PSMS) consists of a software memory integrity check. This is an adaptation of the NUREG-1431 definition, which is a verification of channel device operability based on the injection of a simulated or actual signal into the channel as close to the sensor as practicable, including the adjustment of setpoints required for operability. The applicant states that for the digital system, the continuous self-testing along with the software integrity confirmation (COT in US-APWR GTS) covers the confirmation of the setpoint and the bistable the same as in the conventional analog system (COT in WOG STS). The staff was unable to make a conclusive determination regarding the capability of the COT to adequately test the referenced functions, on the basis of the information provided and the revised definition in the US-APWR GTS. This issue has been identified as Open Item OI-SRP16-CTSB-1769/230.

ANSWER:

PSMS functions are adequately tested through the combination of all periodic manual tests (CHANNEL CALIBRATION, COT/ALT and TADOT). The CHANNEL CALIBRATION confirms that the system can accurately read all inputs, accurately convert them to engineering units, communicate the engineering values over digital data communication links and display their values on VDUs. The TADOT confirms that the controller can accurately detect all manual control commands from the VDU touch screen, communicate those commands over digital communication links and execute those commands through the control logic and output devices to manipulate the position of all plant components. Together, the CHANNEL CALIBRATION and TADOT demonstrated that the controller can correctly read and execute software instructions from both Basic Software Memory and Application Software Memory. The software memory integrity test, conducted during COT/ALT, ensures all of the Basic Software Memory, that controls all operating system function, including self-testing, is operational. The software memory integrity test also ensures that all of the Application Software Memory, that controls all function algorithms, is operational. Therefore, since the CHANNEL CALIBRATION and TADOT confirm the controllers ability to execute program instructions and the COT/ALT confirm all memory instructions, the complete operability of the system is confirmed. It is noted that the digital portion of these manual tests is also tested continuously by the PSMS self-diagnostic functions. The self-diagnostics provide a diverse test of these same digital functions.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16- 1769/231 This question is related to RAI 16-1769/231.

In RAI-SRP16-CTSB-1769/231, the staff requested a technical justification explaining how the ACTUATION LOGIC TEST (ALT) surveillance requirement (SR 3.3.1.5) specified for Reactor Trip System (RTS) Functions 14, 15.b, and 18 in Table 3.3.1-1, ensures that those functions are adequately tested. The Actuation Logic Test as originally defined in NUREG -1431, has been revised under the APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The APWR GTS Actuation Logic Test for the Protection and Safety Monitoring System (PSMS) consists of a software memory integrity check. This is an adaptation of the NUREG-1431 definition, which is a verification of required output logic for a given combination of input signals in conjunction with each possible interlock logic state required for operability of a logic circuit, including at a minimum, a continuity check of output devices. The applicant's response was to see the answer to RAI 167-1769, Question 16-230, which states that for the digital system, the continuous self-testing along with the software integrity confirmation (ALT in US-APWR GTS) covers the confirmation of the voting logic and automatic actuation signals the same as in the conventional analog system (ALT in WOG STS). The staff was unable to make a conclusive determination regarding the capability of the ALT to adequately test the referenced functions, on the basis of the information provided and the revised definition in the US-APWR GTS. This issue has been identified as Open Item OI-SRP16-CTSB-1769/231.

ANSWER:

Please see response to OPEN ITEM NO.:16-1769/230, above.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: 16.4.6

SRP SECTION: 16.4.6 – INSTRUMENTATION

APPLICATION SECTION: 16.4.6

DATE OF OPEN ITEM ISSUE: 9/16/2009

OPEN ITEM NO. : 16- 1769/232 This question is related to RAI 16-1769/232.

In RAI-SRP16-CTSB-1769/232, the staff requested a technical justification explaining how the CHANNEL CALIBRATION surveillance requirement (SR 3.3.1.9, SR 3.3.1.10, SR 3.3.1.11) for Reactor Trip System (RTS) Functions 2.a, 2.b, 3.a, 3.b, 4, 5, 6, 7, 8.a, 8.b, 9, 10, 11, 12.a, 12.b, 13.a, 13.b, 15.a, 15.c, and 15.d in Table 3.3.1-1, ensures that those functions are adequately tested. The Channel Calibration as originally defined in NUREG -1431, has been revised under the APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The APWR GTS extends the application of a Channel Calibration to binary measurements. Under this application, a Channel Calibration confirms the accuracy of the channel's state change. This is an adaptation of the NUREG-1431 definition, which consists of an adjustment, as necessary, of the channel output such that it responds within the necessary range and accuracy to known values of the parameter that the channel monitors. The applicant states that for both analog and binary measurements, the CHANNEL CALIBRATION confirms the accuracy of the channel from sensor to digital Visual Display Unit (VDU) readout as described in Topical Report, "Safety I&C System Description and Design Process," MUAP-07004 Section 4.4.2. The staff was unable to make a conclusive determination regarding the capability of the CHANNEL CALIBRATION to adequately test the referenced functions, on the basis of the information provided and the revised definition in the US-APWR GTS. This issue has been identified as Open Item OI-SRP16-CTSB-1769/232.

ANSWER:

The reactor trip system functions initiated by the parameters identified in Table 3.3.1-1 are adequately tested through the combination of all periodic manual tests (CHANNEL CALIBRATION, COT/ALT and TADOT). The CHANNEL CALIBRATION confirms that the system can accurately read all inputs, accurately convert them to engineering units, communicate the engineering values over digital data communication links and display their values on VDUs. For binary inputs, the CHANNEL CALIBRATION includes the additional confirmation of binary state change at the required setpoint. Correct digital processing of both binary states is demonstrated through the signal propagation to VDUs. The TADOT confirms that the controller can accurately process reactor trip initiation signals originating from either the input sensors or the manual reactor trip pushbuttons, and execute those commands through the control logic and output devices to manipulate the position of the reactor trip breakers. Together, the CHANNEL CALIBRATION and TADOT demonstrated that the controller can correctly read and execute software instructions from both Basic Software Memory and Application Software Memory. The software memory integrity test, conducted during COT/ALT, ensures all of the Basic Software memory, that controls all operating system function, including self-testing, is operational. The software memory integrity test also ensures that all of the Application Software memory, that controls all function algorithms, is operational. Therefore, since the CHANNEL CALIBRATION and TADOT confirms the controllers ability to execute program instructions and the COT/ALT confirm all memory instructions, the complete operability of the system is confirmed. It is noted that the digital portion of these manual tests is also tested continuously by the PSMS self-diagnostic functions. The self-diagnostics provide a diverse test of these same digital functions.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 - INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16- 1769/233 This question is related to RAI 16-1769/233.

I In RAI-SRP16-CTSB-1769/233, the staff requested a technical justification explaining how the TRIP ACTUATING DEVICE OPERATIONAL TEST (TADOT) surveillance requirement (SR 3.3.1.4, SR 3.3.1.12) for Reactor Trip System (RTS) Functions 1, 13.a, 13.b, and 17 in Table 3.3.1-1, ensures that those functions are adequately tested. The Trip Actuating Device Operational Test as originally defined in NUREG -1431, has been revised under the APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The APWR GTS Trip Actuating Device Operational Test does not include provisions for adjustment of the trip actuating device so that it actuates at the required setpoint, and is therefore typically applicable only to binary devices that are not subject to drift. This is an adaptation of the NUREG-1431 definition which states that the TADOT shall include adjustment, as necessary, of the trip actuating device. The applicant states there are two types of binary devices – those that have no drift potential and those that do have drift potential. The operability of devices that have drift potential is confirmed through CHANNEL CALIBRATION and/or RESPONSE TIME TESTING. The operability of devices that have no drift potential is confirmed through TADOT. The CHANNEL CALIBRATION confirms the accuracy of the device's binary state change with regard to its setpoint requirement and the RESPONSE TIME TEST confirms the accuracy of the devices state change with regard to its timing requirement. The TADOT confirms only the state change operability (i.e. there is no setpoint or timing accuracy information needed). The staff was unable to make a conclusive determination regarding the capability of the TADOT to adequately test the referenced functions, on the basis of the information provided and the revised definition in the US-APWR GTS. This issue has been identified as Open Item OI-SRP16-CTSB-1769/233.

ANSWER:

The same tests required by NUREG-1431 are also required for the US-APWR. However, for human factors consistency, and thereby to avoid human performance error, TADOT has been limited to tests that require only confirmation of signal propagation, without accuracy confirmation (eg. tests of conventional manual Reactor Trip pushbutton inputs, or tests of PSMS actuation outputs). Periodic tests that required accuracy confirmation have been included in CHANNEL CALIBRATION (eg. accuracy at the five calibration points for analog process measurements, or accuracy at the transition setpoint for binary process measurements) or RESPONSE TIME TEST (eg. accuracy of the undervoltage and shunt trip response time for RTBs). Therefore, although the tests are indentified differently than in NUREG-1431, the same tests are conducted.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16- 1769/238 This question is related to RAI 16-1769/233.

In RAI-SRP16-CTSB-1769/238, the staff requested an explanation regarding an inconsistency between the US-APWR GTS and the WOG STS in the APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY section of the Reactor Trip System Instrumentation Bases (B 3.3.1). The inconsistency identified is directly associated with the issue described in RAI-SRP16-CTSB-1769/220 in which the applicant considers the digital function Allowable Value in Table 3.3.1-1 to be a maximum deviation, or two-sided OPERABILITY limit defined in terms that are pertinent to the five calibration setpoints 0%, 25%, 50%, 75% and 100% of the instrument range. Determination regarding the referenced inconsistency is dependent upon the resolution of Open Item OI-SRP16-CTSB-1769/220. This determination has been identified as Open Item OI-SRP16-CTSB-1769/238.

ANSWER:

Please see response to OPEN ITEM NO.:16-1769/220.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.:	**16.4.6**
SRP SECTION:	**16.4.6 – INSTRUMENTATION**
APPLICATION SECTION:	**16.4.6**
DATE OF OPEN ITEM ISSUE:	**9/16/2009**

OPEN ITEM NO. : 16- 1769/241 This question is related to RAI 16-1769/241.

In RAI-SRP16-CTSB-1769/241, the staff requested an explanation for why the USAPWR GTS, Table 3.3.2-1, Function 1.e, 4.d (1), and 4.d (2) Allowable Values do not include Time Constants used in the lead/lag controller. This is a deviation from NUREG-1431. The applicant states that Allowable Values are not provided because Time Constants are digital values set in the application software and that there is no drift or adjustments for these Time Constants. The staff was unable to make a conclusive determination regarding exclusion of the Time Constants on the basis of the information provided. In a teleconference meeting on May 13, 2009, at the staff's request, the applicant agreed to review and substantiate their position. This issue has been identified as Open Item OI-SRP16-CTSB-1769/241.

ANSWER:

Please see response to OPEN ITEM NO.:16-1784/174.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16- 1769/242 This question is related to RAI 16-1769/242.

In RAI-SRP16-CTSB-1769/242, the staff requested a technical justification for: 1) specifying Engineered Safety Feature Actuation System (ESFAS) Instrumentation Allowable Values in terms of "Channel Uncertainty Allowances" instead of specific values with inequality signs, and 2) expressing ESFAS Allowable Value units as "percent of span" for Functions 1.c, 1.d, 1.e, 2.c, 4.c, 4.d(1), 4.d(2), 5A.a, 5B.c, 6.c, 6.e, 7.c, 7.d, 8.c, 9.c, 11.b, 12.e, 13.c(1), 13.c(2), 13.c(3), and ESFAS Trip Setpoint units as "percent of span" for Functions 5B.c, 6.c, 7.c, 8.c, 9.c, in lieu of units that are function specific. These are deviations from NUREG-1431. The applicant's response was to see the answer to RAI 1769, Question 16-220. The staff finds that the response to Question 16-220 does not provide the requisite technical justification to warrant deviation from the Standard Technical Specifications (STS). In addition, the applicant did not address the staff's request regarding ESFAS Allowable Value and Trip Setpoint units as described in Item 2. These issues have been identified as Open Item OI-SRP16-CTSB-1769/242.

ANSWER:

Please see response to OPEN ITEM NO.:16-1769/220.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16- 1769/270 This question is related to RAI 16-1769/270.

In RAI-SRP16-CTSB-1769/270, the staff requested a technical justification explaining how the CHANNEL OPERATIONAL TEST (COT) surveillance requirement (SR 3.3.2.3) specified for Engineered Safety Feature Actuation System (ESFAS) Instrumentation Functions 1.c, 1.d, 1.e, 2.c, 4.c, 4.d(1), 4.d(2), 5A.a, 5B.c, 6.c, 7.c, 7.d, 8.c, 9.c, 11.b, 12.e, 13.c(1), 13.c(2), and 13.c(3) in Table 3.3.2-1, ensures that those functions are adequately tested. The Channel Operational Test as originally defined in NUREG -1431, has been revised under the APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The APWR GTS Channel Operational Test for the Protection and Safety Monitoring System (PSMS) consists of a software memory integrity check. This is an adaptation of the NUREG-1431 definition, which is a verification of channel device operability based on the injection of a simulated or actual signal into the channel as close to the sensor as practicable, including the adjustment of setpoints required for operability. The applicant's response was to see the answer to RAI 167-1769, Question 16-230, which states that for the digital system, the continuous self-testing along with the software integrity confirmation (COT in US-APWR GTS) covers the confirmation of the setpoint and the bistable the same as in the conventional analog system (COT in WOG STS). The staff was unable to make a conclusive determination regarding the capability of the COT to adequately test the referenced functions, on the basis of the information provided and the revised definition in the USAPWR GTS. This issue has been identified as Open Item OI-SRP16-CTSB-1769/270.

ANSWER:

Please see response to OPEN ITEM NO.:16-1769/230.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.:	**16.4.6**
SRP SECTION:	**16.4.6 – INSTRUMENTATION**
APPLICATION SECTION:	**16.4.6**
DATE OF OPEN ITEM ISSUE:	**9/16/2009**

OPEN ITEM NO. : 16- 1769/271 This question is related to RAI 16-1769/271.

In RAI-SRP16-CTSB-1769/271, the staff requested a technical justification explaining how the ACTUATION LOGIC TEST (ALT) surveillance requirement (SR 3.3.2.2) specified for Engineered Safety Feature Actuation System (ESFAS) Instrumentation Functions 1.b, 2.b, 3.a (2), 3.b (2), 4.b, 5B.b, 6.b, 7.b, 8.b, 9.a, 12.c, and 13.b in Table 3.3.2-1, ensures that those functions are adequately tested. The Actuation Logic Test as originally defined in NUREG -1431, has been revised under the APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The APWR GTS Actuation Logic Test for the Protection and Safety Monitoring System (PSMS) consists of a software memory integrity check. This is an adaptation of the NUREG-1431 definition, which is a verification of required output logic for a given combination of input signals in conjunction with each possible interlock logic state required for operability of a logic circuit, including at a minimum, a continuity check of output devices. The applicant's response was to see the answer to RAI 167-1769, Question 16-230, which states that for the digital system, the continuous self-testing along with the software integrity confirmation (ALT in US-APWR GTS) covers the confirmation of the voting logic and automatic actuation signals the same as in the conventional analog system (ALT in WOG STS). The staff was unable to make a conclusive determination regarding the capability of the ALT to adequately test the referenced functions, on the basis of the information provided and the revised definition in the US-APWR GTS. This issue has been identified as Open Item OI-SRP16-CTSB-1769/271.

ANSWER:

Please see response to OPEN ITEM NO.:16-1769/230.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16- 1769/272 This question is related to RAI 16-1769/272.

In RAI-SRP16-CTSB-1769/272, the staff requested a technical justification explaining how the CHANNEL CALIBRATION surveillance requirement (SR 3.3.2.7) for Engineered Safety Feature Actuation System (ESFAS) Instrumentation Functions 1.c, 1.d, 1.e, 2.c, 4.c, 4.d(1), 4.d(2), 5A.a, 5B.c, 6.c, 6.e, 7.c, 7.d, 8.c, 9.c, 11.b, 13.e, 13.c(1), 13.c(2), and 13.c(3) in Table 3.3.2-1, ensures that those functions are adequately tested. The Channel Calibration as originally defined in NUREG -1431, has been revised under the APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The APWR GTS extends the application of a Channel Calibration to binary measurements. Under this application, a Channel Calibration confirms the accuracy of the channel's state change. This is an adaptation of the NUREG-1431 definition, which consists of an adjustment, as necessary, of the channel output such that it responds within the necessary range and accuracy to known values of the parameter that the channel monitors. The applicant's response was to see the answer to RAI 167-1769, Question 16-232, which states that for both analog and binary measurements, the CHANNEL CALIBRATION confirms the accuracy of the channel from sensor to digital Visual Display Unit (VDU) readout as described in Topical Report, "Safety I&C System Description and Design Process," MUAP-07004 Section 4.4.2. The staff was unable to make a conclusive determination regarding the capability of the CHANNEL CALIBRATION to adequately test the referenced functions, on the basis of the information provided and the revised definition in the US-APWR GTS. This issue has been identified as Open Item OI-SRP16-CTSB-1769/272.

ANSWER:

Please see response to OPEN ITEM NO.:16-1769/232.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16- 1769/273 This question is related to RAI 16-1769/273.

In RAI-SRP16-CTSB-1769/273, the staff requested a technical justification explaining how the TRIP ACTUATING DEVICE OPERATIONAL TEST (TADOT) surveillance requirement (SR 3.3.2.4, SR 3.3.2.5, SR 3.3.2.6, SR 3.3.2.9) for Engineered Safety Feature Actuation System (ESFAS) Instrumentation Functions 1.a, 1.b, 2.a, 2.b, 3.a(1), 3.a(2), 3.b(2), 4.a, 4.b, 5B.a, 5B.b, 6.a, 6.b, 6.e, 6.f, 7.a, 7.b, 8.a, 8.b, 9.a, 11.a, 12.c, 13.a, and 13.b in Table 3.3.2-1, ensures that those functions are adequately tested. The Trip Actuating Device Operational Test as originally defined in NUREG -1431, has been revised under the APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The APWR GTS Trip Actuating Device Operational Test does not include provisions for adjustment of the trip actuating device so that it actuates at the required setpoint, and is therefore typically applicable only to binary devices that are not subject to drift. This is an adaptation of the NUREG-1431 definition which states that the TADOT shall include adjustment, as necessary, of the trip actuating device. The applicant's response was to see the answer to RAI 167-1769, Question 16-233, which states that there are two types of binary devices – those that have no drift potential and those that do have drift potential. The operability of devices that have drift potential is confirmed through CHANNEL CALIBRATION and/or RESPONSE TIME TESTING. The operability of devices that have no drift potential is confirmed through TADOT. The CHANNEL CALIBRATION confirms the accuracy of the device's binary state change with regard to its setpoint requirement and the RESPONSE TIME TEST confirms the accuracy of the devices state change with regard to its timing requirement. The TADOT confirms only the state change operability (i.e. there is no setpoint or timing accuracy information needed). The staff was unable to make a conclusive determination regarding the capability of the TADOT to adequately test the referenced functions, on the basis of the information provided and the revised definition in the US-APWR GTS. This issue has been identified as Open Item OI-SRP16-CTSB-1769/273.

ANSWER:

Please see response to OPEN ITEM NO.:16-1769/233.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.:	**16.4.6**
SRP SECTION:	**16.4.6 – INSTRUMENTATION**
APPLICATION SECTION:	**16.4.6**
DATE OF OPEN ITEM ISSUE:	**9/16/2009**

OPEN ITEM NO. : 16- 1769/274 This question is related to RAI 16-1769/274.

In RAI-SRP16-CTSB-1769/274, the staff requested an explanation regarding inconsistencies between the US-APWR GTS and the WOG STS in the BACKGROUND section of the Engineered Safety Feature Actuation System Instrumentation Bases (B 3.3.2). The inconsistencies identified are directly associated with the issue described in RAI-SRP16-CTSB-1769/242 in which the applicant considers the digital function Allowable Value in Table 3.3.2-1 to be a maximum deviation, or two-sided OPERABILITY limit defined in terms that are pertinent to the five calibration setpoints 0%, 25%, 50%, 75% and 100% of the instrument range. Determinations regarding the referenced inconsistencies are dependent upon the resolution of Open Item OI-SRP16-CTSB-1769/242. These determinations have been identified as Open Item OI-SRP16-CTSB-1769/274.

ANSWER:

Please see response to OPEN ITEM NO.:16-1769/220.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16- 1769/275 This question is related to RAI 16-1769/275.

In RAI-SRP16-CTSB-1769/275, the staff requested an explanation regarding an inconsistency between the US-APWR GTS and the WOG STS in the APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY section of the Engineered Safety Feature Actuation System Instrumentation Bases (B 3.3.2). The inconsistency identified is directly associated with the issue described in RAI-SRP16-CTSB-1769/242 in which the applicant considers the digital function Allowable Value in Table 3.3.2-1 to be a maximum deviation, or two-sided OPERABILITY limit defined in terms that are pertinent to the five calibration setpoints 0%, 25%, 50%, 75% and 100% of the instrument range. Determination regarding the referenced inconsistency is dependent upon the resolution of Open Item OI-SRP16-CTSB-1769/242. This determination has been identified as Open Item OI-SRP16-CTSB-1769/275.

ANSWER:

Please see response to OPEN ITEM NO.:16-1769/220.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16- 1769/282 This question is related to RAI 16-1769/282.

In RAI-SRP16-CTSB-1769/282, the staff requested an explanation regarding the implementation of Condition C in LCO 3.3.3 for Post Accident Monitoring (PAM) Functions 2, 3, 10 and 16 in Table 3.3.3-1. Condition C states "One or more Functions with two required channels inoperable." Table 3.3.3-1 "Required Channels" column only specifies "1 per loop" for Functions 2 and 3, and "1 per steam generator" for Functions 10 and 16. Comparable functions in the WOG STS, Table 3.3.3-1, specify "2 per loop" and "2 per steam generator" in the "Required Channels" column. The applicant states that since there are four loops and four steam generators, there are four required channels for each of these parameters. Reactor Coolant System (RCS) Cold Leg Temperature Wide Range (Function 2) is used in conjunction with RCS Hot Leg Temperature Wide Range (Function 3) to verify unit conditions necessary to establish natural circulation in the RCS. RCS Hot Leg Temperature Wide Range and RCS Cold Leg Temperature Wide Range of the same train form a pair PAM function. Similarly, Steam Generator Water Level Wide Range (Function 10) and Emergency Feedwater Flow (Function 16) of the same train make up a pair PAM function as well. Revisions include the addition of a NOTE to Table 3.3.3-1 describing the pair PAM functions and dedicated NOTES to Conditions A and C providing implementation guidance with respect to Functions 2, 3, 10 and 16. The staff questions the applicant's position regarding pair PAM functions on the basis of what appears to be a change of intent regarding implementation of the functional concept within the confines of LCO 3.3.3, and the introduction of potential ambiguities. In a teleconference meeting on May 13, 2009, the applicant acknowledged the staff's concerns and agreed to reexamine their approach. This issue is identified as Open Item OI-SRP16-CTSB-1769/282.

ANSWER:

The PAM function of RCS Hot Leg and Cold Leg Temperature Wide Range is to monitor the core cooling condition. There will be little temperature deviation between the Hot Leg and Cold Leg after an accident and reactor shutdown Thus, Hot Leg and Cold Leg Temperatures can be defined as equivalent parameters to monitor the trend of core cooling. Thus, Hot Leg and Cold Leg Temperature of the same loop are pair PAM functions credited for compliance with the single failure criteria. Therefore, only one of each channel of Hot Leg Temperature and Cold Leg Temperature are required in each loop, since with a failure of either channel adequate core cooling can still be monitored.

The PAM function of Steam Generator Water Level Wide Range and Emergency Feedwater Flow is to monitor heat removal capability of the Steam Generators. Since during accident or shutdown conditions, SG water level is directly attributed to emergency feedwater flow, either provides an indication of SG heat removal capability. Thus the SG Water Level Wide Range and EFW Flow can be defined as equivalent parameters to monitor the heat removal capability of the secondary. Thus, the SG Water Level and EFW Flow of same loop are pair PAM functions credited for compliance with the single failure criteria. Therefore, only one of each channel of SG Water Level and EFW Flow are required in each loop, since with a failure of either channel adequate heat remove capability can still be monitored.

Impact on DCD

Following description will be revised in the DCD Chapter 16 Section 3.3.3 Bases B 3.3.3-4;
2,3. Reactor Coolant System (RCS) Hot and Cold Leg Temperatures

RCS Hot and Cold Leg Temperatures are provided for verification of core cooling and long term surveillance.

In addition, RCS cold leg temperature is used in conjunction with RCS hot leg temperature to verify the unit conditions necessary to establish natural circulation in the RCS.

The PAM function of RCS Hot Leg and Cold Leg Temperature Wide Range is to monitor the core cooling condition. There will be little temperature deviation between the Hot Leg and Cold Leg after an accident and reactor shutdown. Thus, Hot Leg and Cold Leg Temperatures can be defined as equivalent parameters to monitor the trend of core cooling. Thus, Hot Leg and Cold Leg Temperature of the same loop are pair PAM functions credited for compliance with the single failure criteria. Therefore, only one of each channel of Hot Leg Temperature and Cold Leg Temperature are required in each loop, since with a failure of either channel adequate core cooling can still be monitored.

Following description will be revised in the DCD Chapter 16 Section 3.3.3 Bases B 3.3.3-4;

10,11. Steam Generator Water Level (Wide Range and Narrow Range)

SG Water Level is provided to monitor operation of decay heat removal via the SGs. The indication of SG level is the extended startup range level instrumentation. The extended startup range level covers a span above the lower tubesheet.

SG Water Level (Wide Range) is used to:

· identify the faulted SG following a tube rupture,

· verify that the intact SGs are an adequate heat sink for the reactor,

· determine the nature of the accident in progress (e.g., verify an SGTR), and

· verify unit conditions for termination of SI during secondary unit HELBs outside containment.

Operator action is based on the control room indication of SG level. The RCS response during a design basis small break LOCA depends on the break size. For a certain range of break sizes, the boiler condenser mode of heat transfer is necessary to remove decay heat. Extended startup range level is a Type A variable because the operator must manually raise and control SG level to establish boiler condenser heat transfer. Operator action is initiated on a loss of subcooled margin. Feedwater flow is increased until the indicated extended startup range level reaches the boiler condenser setpoint. This function is an alternate mean with EFW Flow.

The PAM function of Steam Generator Water Level Wide Range and Emergency Feedwater Flow is to monitor heat removal capability of the Steam Generators. Since during accident or shutdown conditions, SG water level is directly attributed to emergency feedwater flow, either provides an indication of SG heat removal capability. Thus the SG Water Level Wide Range and EFW Flow can be defined as equivalent parameters to monitor the heat removal capability of the secondary. Thus, the SG Water Level and EFW Flow of same loop are pair PAM functions credited for compliance with the single failure criteria. Therefore, only one of each channel of SG Water Level and EFW Flow are required in each loop, since with a failure of either channel adequate heat remove capability can still be monitored.

Impact on COLA

There are impacts on the COLA to incorporate the DCD change.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

11/10/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.6**

SRP SECTION: **16.4.6 – INSTRUMENTATION**

APPLICATION SECTION: **16.4.6**

DATE OF OPEN ITEM ISSUE: **9/16/2009**

OPEN ITEM NO. : 16- 1769/290 This question is related to RAI 16-1769/290.

In RAI-SRP16-CTSB-1769/290, the staff requested a technical justification explaining how the TRIP ACTUATING DEVICE OPERATIONAL TEST (TADOT) surveillance requirement (SR 3.3.5.2) for the LOP Class 1E GTG Start Instrumentation Functions, ensures that the undervoltage (UV) relays are adequately tested. The Trip Actuating Device Operational Test as originally defined in NUREG -1431, has been revised under the APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The APWR GTS Trip Actuating Device Operational Test does not include provisions for adjustment of the trip actuating device so that it actuates at the required setpoint. This is a change from the NUREG-1431 definition which states that the TADOT shall include adjustment, as necessary, of the trip actuating device. The TADOT specified in accordance with SR 3.3.5.2 for both the APWR GTS and WOG STS, has a 31-day Surveillance Frequency. Under the WOG STS, undervoltage relay trip setpoints are checked and any necessary adjustments made every 31 days during performance of a TADOT. For the APWR GTS, the undervoltage relay is confirmed to actuate for gross loss of voltage conditions every 31 days during performance of a TADOT, and undervoltage relay trip setpoints/time delays are verified and any necessary adjustments made every 24-months during performance of a CHANNEL CALIBRATION. The applicant states that TADOT SR 3.3.5.2 confirms UV relay operation with reasonable accuracy based on technician judgment and that checking the setpoint accuracy more frequently than 24 months is unnecessary because the total channel uncertainty, including setpoint drift over the 24 month calibration interval, is included in determination of the Nominal Setpoint and Allowable Value. The staff was unable to make a conclusive determination regarding the capability of the TADOT to adequately test the LOP undervoltage relays, on the basis of the information provided and the revised definition in the US-APWR GTS. This issue has been identified as Open Item OISRP16-CTSB-1769/290.

ANSWER:

The US-APWR Instrument Setpoint Methodology Technical Report, MUAP-09022 defines the undervoltage relay trip setpoints based on the total instrument loop uncertainty, which includes the instrument drift between the 24 month CHANNEL CALIBRATION intervals. This is the same bases that is used for the 24 month CHANNEL CALIBRATION interval for all PSMS instruments.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's response to the NRC's open item.

Enclosure 2

UAP-HF-09518, Revision 0

Response to DRAFT OPEN ITEMS 16.4.11

October 2009

RESPONSES TO DRAFT OPEN ITEMS 16.4.11

10/30/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.11**

SRP SECTION: **16.4.11 – ELECTRICAL POWER SYSTEMS**

APPLICATION SECTION: **16.4.11**

DATE OF OPEN ITEM ISSUE: **09/16/2009**

OPEN ITEM NO. : 16-134-1825/26 This question is related to RAI 16-134-1825/26.

In RAI-SRP-16-CTSB-134-1825 Question 16-26 (EEB RAI 16-2), the staff asked the applicant to provide justification why there is no required action equivalent to the STS NUREG-1431 LCO 3.8.1 REQUIRED ACTION A.2 for the LCO 3.8.1 CONDITION A in the US-APWR TS to provide assurance that an event with a coincident single failure will not result in a complete loss of redundant required safety functions associated with critical two-train safety loads.

The applicant responded that the "condition that one required feature composed of four trains becomes inoperable during the existence of Condition A, furthermore if a single failure of one GTG is caused, features in redundant three trains would keep their one hundred and fifty percent capacity which satisfies the required function," and therefore the Required Action to declare required feature inoperable was not required.

The STS LCO 3.8.1 Condition A requires a cross check among the redundant safety divisions to determine how many trains of a given system are unavailable. The applicant did not include this cross check; therefore the staff believes Required Action A.2 should be added. This is an open item, OI-SRP-16-CTSB- 134-1825 Question 16-26 (EEB RAI 16-2).

ANSWER:

MHI agrees LCO 3.8.1 Condition A includes requirement of a cross check among the redundant safety divisions to determine how many trains of a given system are unavailable.

Impact on DCD

Required Action of LCO 3.8.1 Condition A will be revised to add required action corresponding to the STS LCO 3.8.1 RERUIRED ACTION A.2 as below:

Spec

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One required offsite circuit inoperable.	A.1	Perform SR 3.8.1.1 for required OPERABLE offsite circuit.	1 hour AND Once per 8 hours thereafter
	AND		
	A.2	**Declare required feature(s) with no offsite power available inoperable when its redundant required feature(s) is inoperable.**	**24 hours from discovery of no offsite power to one train concurrent with inoperability of redundant required feature(s)**
	AND		
	A.~~2~~3.1	Restore required offsite circuit to OPERABLE status.	72 hours
	[OR		
	A.~~2~~3.2	-----------NOTE-------------- This Required Action is not applicable in MODE 4. ----------------------------------- Apply the requirements of Specification 5.5.18.	72 hours]

Bases

A.2

Required Action A.2, which only applies if the train cannot be powered from an offsite source, is intended to provide assurance that an event coincident with a single failure of the

associated Class 1E GTG will not result in a complete loss of safety function of critical redundant required features. These features are powered from the redundant AC electrical power train. This includes motor driven emergency feedwater pumps. Two train systems, such as turbine driven auxiliary feedwater pumps, may not be included.

The Completion Time for Required Action A.2 is intended to allow the operator time to evaluate and repair any discovered inoperabilities. This Completion Time also allows for an exception to the normal "time zero" for beginning the allowed outage time "clock." In this Required Action, the Completion Time only begins on discovery that both:

a. One required train has no offsite power supplying it loads and

b. A required feature on the other train (Train A, B, C or D) is inoperable.

If at any time during the existence of Condition A (one offsite circuit inoperable) a redundant required feature subsequently becomes inoperable, this Completion Time begins to be tracked.

Discovering no offsite power to one required train of the onsite Class 1E Electrical Power Distribution System coincident with one or more inoperable required support or supported features, or both, that are associated with the other train that has offsite power, results in starting the Completion Times for the Required Action. Twenty-four hours is acceptable because it minimizes risk while allowing time for restoration before subjecting the unit to transients associated with shutdown.

The remaining OPERABLE offsite circuit and Class 1E GTGs are adequate to supply electrical power to the onsite Class 1E Distribution System. The 24 hour Completion Time takes into account the component OPERABILITY of the redundant counterpart to the inoperable required feature. Additionally, the 24 hour Completion Time takes into account the capacity and capability of the remaining AC sources, a reasonable time for repairs, and the low probability of a DBA occurring during this period.

Impact on COLA

There is impact on the COLA to incorporate the DCD change.

Impact on PRA

There is no impact on PRA.

10/30/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.: **16.4.11**

SRP SECTION: **16.4.11 – ELECTRICAL POWER SYSTEMS**

APPLICATION SECTION: **16.4.11**

DATE OF OPEN ITEM ISSUE: **09/16/2009**

OPEN ITEM NO. : 16-134-1825/27 This question is related to RAI 16-134-1825/27.

In RAI-SRP-16-CTSB-134-1825 Question 16-27, the staff asked the applicant to provide justification for the performance frequency of 24 months for the automatic and manual bus transfer surveillance test SR 3.8.1 and US-APWR Class 1E GTG refueling cycle surveillance tests SR 3.8.1.8 through SR 3.8.1.18. The industry operating experience with DGs may not directly translate over for GTGs. The applicant based the Class 1E GTG reliability performance and SR frequency on operating experience of non-nuclear GTGs, presented in Technical Report MUAP-07024. This is an open item, OI-16-CTSB-134-1825 Question 16-134-1825/27.

ANSWER:

As a part of Qualification test, MHI conducts reliability test for 150 starting of gas turbine generator. Based on that test result, reliability of the gas turbine generator is equivalent or beyond the reliability of DGs.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

RESPONSES TO DRAFT OPEN ITEMS 16.4.11

10/30/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

OPEN ITEM NO.:	**16.4.11**
SRP SECTION:	**16.4.11 – ELECTRICAL POWER SYSTEMS**
APPLICATION SECTION:	**16.4.11**
DATE OF OPEN ITEM ISSUE:	**09/16/2009**

OPEN ITEM NO. : 16-72-853 This question is related to RAI 16-72-853.

In RAI No 72-853 Question 16-8 (EEB), the staff asked the applicant to confirm that 0.9 is the designed load power factor that the CTG will experience during accident loading.

The applicant responded that the load power factor does not exceed 0.9. In chapter 8, Table 8.3.1.4 the average of load power factors during accident loading is approximately 0.85. Therefore, the applicant described load power factor ≤ 0.9 in DCD TS surveillance requirement (SR) 3.8.1.9.

Given that the accident loading is roughly 0.85 power factor, the staff recommends that 0.9 be used as an upper bound, but that a statement be added that the loading should be as close to 0.85 as is practical. This is an OPEN ITEM, OI-SRP-16.3.8-EEB-08.

ANSWER:

MHI agrees that 0.9 be used as an upper bound, and that a statement will be added that the loading should be as close to 0.85 as is practical.

Impact on DCD

The fifth paragraph of SR 3.8.1.8 will be revised as below:

Note 2 ensures that the Class 1E GTG is tested under load conditions that are as close to design basis conditions as possible. When synchronized with offsite power, testing should be performed at a power factor of ≤ 0.9. This power factor ~~is representative of the actual inductive loading a~~ **should be maintained as close as practicable to actual power factor which** Class 1E GTG would see under design basis accident conditions**, such as 0.85**. Under certain conditions, however, Note 2 allows the Surveillance to be conducted at a power factor other than ≤ 0.9. These conditions occur when grid voltage is high, and the additional field excitation needed to get the power factor to ≤ 0.9 results in voltages on the emergency busses that are too high. Under these conditions, the power factor should be maintained as close as practicable to 0.9 while still maintaining acceptable voltage limits on the emergency busses. In other circumstances, the grid voltage may be such that the Class 1E GTG excitation levels needed to obtain a power factor of 0.9 may not cause unacceptable voltages on the emergency busses, but the excitation levels are in excess of those recommended for the Class 1E GTG. In such cases, the power factor shall be maintained as close as practicable to 0.9 without exceeding the Class 1E GTG excitation limits.

Impact on COLA

There is impact on the COLA to incorporate the DCD change.

Impact on PRA

There is no impact on PRA.