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

March 18, 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-09096

Subject: MHI's Response to US-APWR DCD RAI No. 166-1784 REVISION 0

Reference: 1) "Request for Additional Information No.166-1784 Revision 0, SRP Section: 16 – TECHNICAL SPECIFICATIONS, Application Section: 16" dates February 3, 2009.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No. 166-1784 Revision 0."

Enclosed is the response to the RAI contained within Reference 1.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of 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. 166-1784 Revision 0

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

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

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Enclosure 1

UAP-HF-09096
Docket Number 52-021

Response to Request for Additional Information
No. 166-1784 Revision 0

March 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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US-APWR Design Certification

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RAI NO.:	**NO. 166-1784 REVISION 0**
SRP SECTION:	**16 - TECHNICAL SPECIFICATIONS**
APPLICATION SECTION:	**16**
DATE OF RAI ISSUE:	**2/3/2009**

QUESTION NO.: 16-158

LCO 3.3.1, RTS Instrumentation (16.3.3.1-01)

Identify the four distinct, interconnected modules of the RTS instrumentation on page B 3.3.1-3 in the US-APWR TS LCO 3.3.1 BASES, BACKGROUND section. Only three modules are identified in the BASES, though the lead sentence credits four modules.

NUREG-1431, Rev 3.1 credits four interconnected modules.

ANSWER:

NUREG-1431, Rev 3.1 credits the following four interconnected modules:

1. Field transmitters or process sensors
2. Signal Process Control and Protection System
3. SSPS
4. RTB

Above No.2 and 3 functions are integrated and performed in the RPS for the US-APWR.
The description of "the four distinct" is not correct, and the description of the DCD will be revised to incorporate the comment in QUESTION NO.16-158.

Impact on DCD

The DCD chapter 16, Page B 3.3.1-3, seventh paragraph, will be revised as follows:

The RTS instrumentation is segmented into <u>three</u> ~~four~~ distinct ...

Impact on COLA

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

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-159

LCO 3.3.1, RTS Instrumentation (16.3.3.1-02)

Clarify the phrase "Restore train to OPERABLE status" in the US-APWR TS LCO 3.3.1 BASES, APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY section. The phrase "Restore channel to OPERABLE status" is explained on Page B 3.3.1-8; however, the phrase "Restore train to OPERABLE status" is not explained, although it is actually used more frequently in the LCO.

ANSWER:

The design bases of the REQUIRED ACTION for the Channel and Train are completely same, and the explanation of the DCD will be revised to incorporate the comment in QUESTION NO.16-159.

Impact on DCD

The DCD chapter 16, Page B 3.3.1-8, second paragraph, will be revised as follows:

> In all cases where the LCO states "Restore channel <u>or train</u> to OPERABLE status", this means restore the required number of channels <u>or trains</u> to OPERABLE status. Therefore, restoration of an alternate channel <u>or train</u>, other than the failed channel <u>or train</u>, is also acceptable.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-160

LCO 3.3.1, RTS Instrumentation (16.3.3.1-04)

Justify the initial completion time of 72 hours in the US-APWR TS LCO 3.3.1, ACTIONS B.1, B.2, C.1, C.2.1, and C.2.2. NUREG-1431, Rev 3.1, TS LCO BASES establishes 48 hours as reasonable.

No basis is provided for increasing the "reasonable" completion time from 48 hours to 72 hours other than listing the variety of means available to initiate a Manual reactor trip. Justify the completion time of 72 hours.

ANSWER:

The initial completion time of 48 hours in NUREG-1431, Rev 3.1 is based on the two trains RTS configuration. When one required Manual Reactor Trip channel is inoperable, the two train system does not meet the single failure criteria for the manual reactor trip function. But, the US-APWR adopts the four trains RTS with the 2-out-of-4 configurations and the manual reactor trip function can be performed from the Manual Reactor Trip hardwired switches or from the safety VDUs. If one required Manual Reactor Trip train (hardwired) is unavailable, the system continues to meet the single failure criteria, since the manual reactor trip function can still be initiated in all three trains from the Safety VDUs. So, the tolerance to single failures for the manual reactor trip function is significantly improved from the conventional two train plant. Based on this improvement, MHI uses the initial completion time of 72 hours which is used for the four channels with the 2-out-of-4 configuration in NUREG-1431, Rev 3.1.

The PSMS reliability is analyzed by using this initial completion time of 72 hours for the Manual Reactor Trip channel, and the result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. But, the reliability of the remaining operable manual reactor trip function (including manual reactor trip from the Safety VDUs) is very high, therefore the initial completion time of 72 hours for the Manual Reactor Trip channel has no affected on the total reliability of the PSMS. So, the detail explanation and Fault Tree Analyses (FTA) of the manual reactor trip function is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.1-29, ACTIONS B.1 and B.2, and Page B 3.3.1-30, ACTIONS C.1, C.2.1 and C.2.2, each last paragraph:

The initial completion time of 72 hours is justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. The PSMS reliability analysis credits the continued compliance to the single failure criteria, since the manual reactor trip function remains fully operable from the Safety VDUs, even when one Manual Reactor Trip channel is inoperable.

Also, the detail explanation and FTA of the Manual Reactor Trip function which is including the initial completion time of 72 hours will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6A.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

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QUESTION NO.: 16-161

LCO 3.3.1, RTS Instrumentation (16.3.3.1-05)

Justify the NOTE allowing an inoperable channel in the bypassed condition for up to 12 hours while performing routine surveillance testing of the other channels based on operating experience in the US-APWR TS LCO 3.3.1 BASES, ACTIONS E.1.1, E.1.2, E.2.1, E.2.2, E.3, F.1 and F.2. For these ACTIONS, NUREG-1431, Rev 3.1, establishes the 12-hour bypass limit based on an approved topical report, WCAP-14333-P-A, Rev 1, October 1998. MHI did not provide a comparable analysis.

ANSWER:

As stated in the basis, "The 72 hours allowed to place the inoperable channel in the tripped condition is justified because the remaining three OPERABLE channels have continuous automatic self-testing (as described for COT), and continuous automatic CHANNEL CHECKS." Since automatic self-testing and automatic CHANNEL CHECKS are continuous, an additional failure that could disable this reactor trip function is immediately detectable. In conventional plants CHANNEL CHECKS are conducted only once per 12 hours and COT, which is equivalent to the continuous self-testing of the PSMS, is conducted only once per 184 days. Therefore additional failures that disable this reactor trip function can go undetected for extended time periods.

The PSMS reliability is analyzed by using this bypassed condition for up to 12 hours for the High Power Range Neutron Flux channels. Considering the continuous self-testing for the remaining operable channels, as described above, the reliability influence of this bypassed condition up to 12 hours has a negligible impact on the total reliability of the PSMS. So, the detail explanation and Fault Tree Analyses (FTA) of the bypassed condition of the High Power Range Neutron Flux functions is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The DCD chapter 16, Page 3.3.1-3, REQUIRED ACTION E, NOTE, first paragraph, will be revised as follows:

> One channel may be bypassed for up to 12 hours for surveillance testing and setpoint adjustment.

The DCD chapter 16, Page 3.3.1-4, REQUIRED ACTION F, NOTE, first paragraph, will be revised

as follows:

> For High Power Range Neutron Flux channels only, one channel may be bypassed for up to 12 hours for surveillance testing.

The following description will be added in the DCD chapter 16, Page B 3.3.1-31 ACTIONS E.1.1, E.1.2, E.2.1, E.2.2, and E.3, and Page B 3.3.1-33 ACTIONS F.1 and F.2, each last paragraph:

> One channel may be bypassed for up to 12 hours for surveillance testing and setpoint adjustment. The 12 hours bypass limit is justified in the PSMS reliability analysis, considering that the remaining operable channels have continuous self-testing. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

Also, the detail explanation and FTA of the High Power Range Neutron Flux functions which is including the bypassed condition up to 12 hours will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6A.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

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QUESTION NO.: 16-162

LCO 3.3.1, RTS Instrumentation 16.3.3.1-06)

Justify the Note that describes US-APWR TS LCO 3.3.1 Required Actions L.1 and L.2 in the BASES section. No explanation of the Note appears in the BASES section.

Required Actions L.1 and L.2 are preceded by a Note that allows an inoperable channel to be bypassed for up to 12 hours for surveillance testing of other channels except for Pressurizer Pressure, Pressurizer Level, and SG Water Level. NUREG-1431, Rev 3.1, justifies the 12-hour bypass allowance based on an approved topical report, WCAP- 14333-P-A, Rev 1, October 1998 (WOG STS Page B 3.3.1-42, 3rd paragraph).

ANSWER:

The 12 hour bypass is justified because the remaining two OPERABLE channels have continuous automatic self-testing (as described for COT), and continuous automatic CHANNEL CHECKS. Since automatic self-testing and automatic CHANNEL CHECKS are continuous, an additional failure that could disable this reactor trip function is immediately detectable. In conventional plants CHANNEL CHECKS are conducted only once per 12 hours and COT, which is equivalent to the continuous self-testing of the PSMS, is conducted only once per 184 days, therefore additional failures that disable this reactor trip function can go undetected for extended time periods.

The PSMS reliability is analyzed using this bypassed condition for up to 12 hours for surveillance testing of other channels except for Pressurizer Pressure, Pressurizer Level, and SG Water Level, and the result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. Considering the continuous self-testing for the remaining operable channels, as described above, the reliability influence of this bypassed condition up to 12 hours has a negligible impact on the total reliability of the PSMS. So, the detail explanation and Fault Tree Analyses (FTA) of the bypassed condition is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The DCD chapter 16, Page 3.3.1-6, REQUIRED ACTION L, NOTE, first paragraph, will be revised as follows:

Except for Pressurizer Pressure, Pressurizer Level, and SG Water Level, one channel may be

bypassed for up to 12 hours for surveillance testing.

The following description will be added in the DCD chapter 16, Page B 3.3.1-36 ACTIONS L.1 and L.2, last paragraph:

> Except for Pressurizer Pressure, Pressurizer Level, and SG Water Level, one channel may be bypassed for up to 12 hours for surveillance testing. The 12 hours bypass limit is justified in the PSMS reliability analysis, considering that the remaining operable channels have continuous self-testing. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. This bypass is not allowed for Pressurizer Pressure, Pressurizer Level, and SG Water Level because these channels are also used for control. If a failure were to occur in one of the two remaining control channels, a plant transient could occur that would require a plant trip, but a plant trip would not occur with only one remaining operable channel.

Also, the detail explanation and FTA of the other channels except for Pressurizer Pressure, Pressurizer Level, and SG Water Level which is including the bypassed condition up to 12 hours will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6A.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

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QUESTION NO.: 16-163

LCO 3.3.1, RTS Instrumentation (16.3.3.1-08)

In the US-APWR TS LCO 3.3.1 BASES, ACTIONS E.1.1, E.1.2, E.2.1, E.2.2, E.3, F.1, F.2, L.1, and L.2, justify a completion time of 72 hours for the automatic self-testing and automatic CHANNEL CHECKS. NUREG-1431, Rev 3.1, establishes the 72-hour completion time for the comparable BASES, ACTIONS D.1.1, D.1.2, D.2.1, D.2.2, D.3, E.1, E.2, K.1, and K.2 based on an approved topical report, WCAP-14333-P-A, Rev 1, October 1998. MHI did not provide a comparable analysis.

ANSWER:

As stated in the basis, "The 72 hours allowed to place the inoperable channel in the tripped condition is justified because the remaining three OPERABLE channels have automatic self-testing (as described for COT), and automatic CHANNEL CHECKS." Since automatic self-testing and automatic CHANNEL CHECKS are continuous, an additional failure that could disable this reactor trip function is immediately detectable. In conventional plants CHANNEL CHECKS are conducted only once per 12 hours and COT, which is equivalent to the continuous self-testing of the PSMS, is conducted only once per 184 days. Therefore, additional failures that disable this reactor trip function can go undetected for extended time periods.

The PSMS reliability is analyzed by using this initial completion time of 72 hours allowed to place the inoperable channel in the tripped condition, and the result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. Considering the continuous self-testing for the remaining operable channels, as described above, the reliability influence of this initial completion time of 72 hours for the inoperable channel has a negligible impact on the total reliability of the PSMS. So, the detail explanation and Fault Tree Analyses (FTA) of the initial completion time of the inoperable channel is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.1-31, ACTIONS E.1.1, E.1.2, E.2.1, E.2.2, and E.3, Page B 3.3.1-33, ACTIONS F.1 and F.2, and Page B 3.3.1-36, ACTIONS L.1 and L.2, each last paragraph:

The initial completion time of 72 hours is justified in the PSMS reliability analysis, considering that the remaining operable channels have continuous self-testing. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

Also, the detail explanation and FTA of the each trip function which is including the initial completion time of 72 hours for the inoperable channel will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6A.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

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QUESTION NO.: 16-164

LCO 3.3.1, RTS Instrumentation (16.3.3.1-09)

Justify a completion time of 24 hours in the US-APWR TS LCO 3.3.1 BASES, ACTIONS N.1 and N.2 on page B 3.3.1-38. NUREG-1431, Rev 3.1, establishes the 24-hour completion time based on a topical report, WCAP-15376, Rev 0, October 2000 (WOG STS Page B 3.3.1-46, last paragraph).

No basis is provided for the US-APWR completion time of 24 hours other than identifying that two remaining OPERABLE trains are available and that there is a low probability of an event during this interval. Describe how the completion time of 24 hours was established.

ANSWER:

The PSMS reliability is analyzed by using this initial completion time of 24 hours allowed the restore train to OPEARBLE status, and the result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. But, the reliability influence of this initial completion time of 24 hours for the restore train is negligible small to the total reliability of the PSMS.

So, the detail explanation and Fault Tree Analyses (FTA) of the initial completion time of the inoperable channel is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.1-38, ACTIONS N.1 and N.2, last paragraph:

> The initial completion time of 24 hours is justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

Also, the detail explanation and FTA of the RTB trip function which is including the initial completion time of 24 hours for the inoperable train will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6A.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

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QUESTION NO.: 16-165

LCO 3.3.1, RTS Instrumentation (16.3.3.1-10)

Explain not applying the Note associated with NUREG-1431, Rev 3.1, TS LCO 3.3.1, Required Actions P.1, and P.2 to the US-APWR TS LCO 3.3.1, Required Actions N.1, and N.2, respectively.

The NOTE states "One train may be bypassed for up to 4 hours for surveillance testing, provided the other train is OPERABLE."

ANSWER:

For conventional plants, the RTBs are arranged in a one-out-of-two configuration. Therefore, a bypass is needed when testing to avoid a reactor trip. The US-APWR adopts the four trains RTB with the 2-out-of-4 configurations without bypass breakers. The surveillance testing of the RTBs in one train can be performed without putting that train in a bypass condition. So, the NOTE states "One train may be bypassed for up to 4 hours for surveillance testing, provided the other train is OPERABLE." is not needed for the US-APWR, since no bypass is needed.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-166

LCO 3.3.1, RTS Instrumentation (16.3.3.1-11)

Justify the STAGGERED TEST BASIS frequency of 62 days with each RTB tested every 248 days, and each trip methodology ultimately tested every 744 days in the US-APWR TS LCO 3.3.1 BASES, SR 3.3.1.4 on page B 3.3.1-45. NUREG-1431, Rev 3.1, establishes the 62-day frequency based on a topical report, WCAP-15376, Rev 0, October 2000 (WOG STS Page B 3.3.1-53, top paragraph). MHI did not provide a comparable analysis.

ANSWER:

The PSMS reliability is analyzed by using this STAGGERED TEST BASIS frequency of 62 days with each RTB tested every 248 days, and each trip methodology ultimately tested every 744 days, and the result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. Based on the RTB configurations, the four RTB failures are needed to lose trip capability in normal condition.

But, the detail explanation and Fault Tree Analyses (FTA) of the RTB is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.1-44, SR 3.3.1.4, last paragraph:

> The STAGGERED TEST BASIS frequency of 62 days with each RTB tested every 248 days, and each trip methodology ultimately tested every 744 days is justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

Also, the detail explanation and FTA of the RTB to consider the test frequency of 62 days with each RTB tested every 248 days, and each trip methodology ultimately tested every 744 days will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6A.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

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QUESTION NO.: 16-167

LCO 3.3.1, RTS Instrumentation (16.3.3.1-12)

Justify the STAGGERED TEST BASIS frequency of 24 months based on the expected reliability of the Protection and Safety Monitoring System in the US-APWR TS LCO 3.3.1, SR 3.3.1.5 on page B 3.3.1-45. NUREG-1431, Rev 3.1, establishes a 92-day STAGGERED TEST BASIS frequency based on a topical report, WCAP-15376, Rev 0, October 2000 (WOG STS Page B 3.3.1-53).

SR 3.3.1.5, in the BASES of the US-APWR, indicates that the Reactor Trip System (RTS) is self-tested on a continuous basis, from the digital side of all input modules to the digital side of all output modules, and that the frequency of 24 months is justified based on the reliability of the Protection and Safety Monitoring System. The basis for this improved reliability claim should be briefly summarized and the detailed reliability analysis referenced. A comparison of the Protection and Safety Monitoring System reliability with that of a similar system in a standard plant should be made in order to justify the increased surveillance interval. Furthermore, NUREG 1431, Rev 3.1, indicates that an Actuation Logic Test should include "a continuity check of output devices." It is not clear that the self-testing performed in the US-APWR is equivalent to this and extends to the "output devices." US-APWR BASES SR 3.3.1.5 indicates that this testing extends to the "digital side of all output modules."

ANSWER:

The STAGGERED TEST frequency is not applied for the ACTUATION LOGIC TEST. The ACTUATION LOGIC TEST is conducted for each PSMS train every 24 months. With the exception of the "continuity check of output devices", the PSMS self-testing, which is conducted continuously, is equivalent to the conventional system's Actuation Logic Test, which is conducted on a 92 day STAGGERED TEST BASIS frequency. Both of these tests check for random hardware failures. The continuous self-testing in the PSMS assures random failures are immediately detected.

MHI estimates that the probability of the self-testing to detect Actuation Logic failures is 100% except the non digital side of the input and output modules as described in Reference 6 and 7. But, the conservative value, 90% probability of the self test capability, is used in the PSMS reliability analysis. And, the PSMS reliability analysis is based on that the rest 10% failure can only be found by the periodic ACTUATION LOGIC TEST and TADOT which are performed every 24 months period. So, the 90% portion of the Actuation Logic of the PSMS is continuously tested, and the test interval for only the 10% portion is increased from 92-days to 24 months.

For the RTS, the complete operability of all output devices, including the "continuity check of

output devices", is included in the TADOT for the RTBs. When an RTB's Shunt Trip or Undervoltage device is tested, the corresponding continuity between the output device and the RTB device is also tested. The TADOT overlaps with continuous self-testing. The TADOT frequency for the RTBs ensures the continuity check of each output device is conducted every 744 days. This test frequency is justified by the MTBF reliability of the PSMS output device, the redundancy between Shunt Trip and UV trip mechanisms and the 8 breaker 2-out-of-4 configuration of the RTBs.

The result of the PSMS reliability analysis, which is based on the above test descriptions and test intervals, is evaluated and confirmed in the US-APWR PRA Chapter 19.

But, the detail explanation and Fault Tree Analyses (FTA) of the PSMS to consider the test interval for the non-digital side of the PSMS is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.1-45, SR 3.3.1.5, last paragraph:

> The complete continuity check from the input device to the output device is performed by the combination of the continuous CHANNEL CHECK, the 24 month CHANNEL CALIBRATION for the non digital side of the input module, the continuous self-testing for the digital side, the 24 month COT, the 24 month ACTUATION LOGIC TEST and the 24 month TADOT for the non-digital side of the output module. The Channel CALIBRATION, COT, ACTUATION LOGIC TEST and TADOT, which are manual tests, overlap with the CHANNEL CHECK and self-testing and confirm the functioning of the self-testing.
>
> The ACTUATION LOGIC TEST interval of 24 months with the self test capability is justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

Also, the detail explanation and FTA of the test function which are performed by the digital and non digital side of the PSMS to consider the 90% self test probability and 24 months test interval will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6A.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/18/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 166-1784 REVISION 0**
SRP SECTION:	**16 - TECHNICAL SPECIFICATIONS**
APPLICATION SECTION:	**16**
DATE OF RAI ISSUE:	**2/3/2009**

QUESTION NO.: 16-168

LCO 3.3.1, RTS Instrumentation (16.3.3.1-13)

Justify the frequency of 24 months based on the expected reliability of the Protection and Safety Monitoring System in the US-APWR TS LCO 3.3.1, SR 3.3.1.7. NUREG-1431, Rev 3.1, establishes a 184-day frequency based on an approved topical report, WCAP-10271-P-A, Supplement 1, May 1986 (WOG STS Page B 3.3.1-54, last paragraph). MHI did not provide a comparable analysis.

ANSWER:

The PSMS self-testing, which is conducted continuously, is equivalent to the conventional system's COT, which is conducted every 184 days. Both of these tests check for random hardware failures. The continuous self-testing in the PSMS assures random failures are immediately detected.

The conventional system's COT also checks for setpoint drift, but there is no setpoint drift in the digital PSMS, so this check is not required. For the PSMS, setpoint drift can only occur due to sensor drift or analog input drift. Unexpected drift, which may result from random failures, is monitored through CHANNEL CHECKS, which are continuously automated. Expected drift, which commonly affects all redundant channels, is checked and corrected during CHANNEL CALIBRATION. CHANNEL CALIBRATION is conducted at a 24 month refueling interval frequency, which is consistent with conventional systems. The 24 month calibration interval is considered in the PSMS setpoint uncertainty calculations.

MHI estimates that the probability of the self test to find Digital Trip Setpoint failures is 100% except the non digital side of the input modules as described in Reference 6 and 7. But, the conservative value, 90% probability of the self test capability, is used in the PSMS reliability analysis.

And, the PSMS reliability analysis is based on that the rest 10% failure can only be found by periodic CHANNEL CALIBRATION and COT which are performed every 24 months period. The result of the PSMS reliability analysis based on the above test interval is evaluated and confirmed in the US-APWR PRA Chapter 19.

But, the detail explanation and Fault Tree Analyses (FTA) of the PSMS to consider the 90% self test probability and 24 months test interval of the digital side of the PSMS is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.1-46, SR 3.3.1.7, last paragraph:

> The completely continuity check from the input device to the output device is performed by the combination of the continuous CHANNEL CHECK, the 24 month CHANNEL CALIBRATION for the non digital sided of the input module, the continuous self-testing for the digital side, the 24 month COT, and the 24 month TADOT for the non-digital side of the output module. The Channel CALIBRATION, COT and TADOT, which are manual tests, overlap with the CHANNEL CHECK and self-testing and confirm the functioning of the self-testing.
>
> The COT interval of 24 months with the self test capability is justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

Also, the detail explanation and FTA of the test function which are performed by the digital and non digital side of the PSMS to consider the 90% self test probability and 24 months test interval will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6A.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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QUESTION NO.: 16-169

LCO 3.3.1, RTS Instrumentation (16.3.3.1-14)

Provide an explanation of the Note associated with US-APWR TS LCO 3.3.1, SR 3.3.1.7 in the BASES section. NUREG-1431, Rev 3.1, TS LCO 3.3.1, BASES, SR 3.3.1.7 includes a paragraph describing the comparable Note (WOG STS Page B 3.3.1-54). The NOTE states "Not required to be performed for source range instrumentation prior to entering MODE 3 from MODE 2 until 4 hours after entry into MODE 3." The explanation in NUREG-1431, Rev 3.1, TS LCO 3.3.1, BASES, SR 3.3.1.7 has to do with a normal shutdown proceeding without delay for testing.

ANSWER:

The BASES of the NOTE, SR 3.3.1.7, is same as the NUREG-1431, Rev 3.1.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.1-46, SR 3.3.1.7, last paragraph:

> The Note allows a normal shutdown to proceed without a delay for testing in MODE 2 and for a short time in MODE 3 until the RTBs are open and SR 3.3.1.7 is no longer required to be performed. If the unit is to be in MODE 3 with the RTB close for 4 hours this Surveillance must be performed prior to over 4 hours after entry into MODE 3.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

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QUESTION NO.: 16-170

LCO 3.3.1, RTS Instrumentation (16.3.3.1-16)

In the US-APWR TS LCO 3.3.1, BASES, SURVEILLANCE REQUIREMENTS, SR 3.3.1.2, the last paragraph is modified with an alternative reference to the Surveillance Frequency Control Program on page B 3.3.1-43. This alternative reference to the Surveillance Frequency Control Program should actually accompany the preceding paragraph. Correct or justify.

The statement that "control room operators periodically monitor redundant indications and alarms to detect deviations in channel outputs" is true whether the Surveillance frequency is detailed specifically in the TS BASES or in the Surveillance Frequency Control Program. This statement should remain outside of the bracketed material and not be subject to removal if the COL applicant chooses the Surveillance Frequency Control Program basis statement.

ANSWER:

The description is not correct, and the description of the DCD will be revised to incorporate the comment in QUESTION NO.16-170.

Impact on DCD

The DCD chapter 16, Page B 3.3.1-43, last paragraph, will be revised as follows:

~~In addition, control room operators periodically monitor redundant indications and alarms to detect deviations in channel outputs.~~ OR The Surveillance Frequency...] In addition, control room operators periodically monitor redundant indications and alarms to detect deviations in channel outputs.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-171

LCO 3.3.1, RTS Instrumentation (16.3.3.1-17)

In the US-APWR TS LCO 3.3.1, BASES, ACTIONS M.1 and M.2, it is noted that "Condition M applies to the ECCS actuation input and the RTS Automatic Trip Logic in MODES 1 and 2." Per Table 3.3.1-1, Reactor Trip System Instrumentation, Condition M is only associated with item 14, "ECCS Actuation," and not item 18, "Automatic Trip Logic." Correct or justify.

Also, In the US-APWR TS LCO 3.3.1, BASES, ACTIONS R.1 [and R.2], it is noted that "Condition R applies to the ECCS actuation input and the RTS Automatic Trip Logic in MODES 1 and 2." Per Table 3.3.1-1, Reactor Trip System Instrumentation, Condition R is only associated with item 18, "Automatic Trip Logic," and not item 14, "ECCS Actuation." Correct or justify.

ANSWER:

The description in the US-APWR TS LCO 3.3.1, BASES, ACTIONS M.1, M.2, R.1 and R.2, are not correct, and the description will be revised to incorporate the comment in QUESTION NO.16-171.

Impact on DCD

The DCD chapter 16, Page B 3.3.1-37, M.1 and M.2, first paragraph, will be revised as follows:

> Condition M applies to the ECCS actuation input ~~and the RTS Automatic Trip Logic in MODES 1 and 2~~.

The DCD chapter 16, Page B 3.3.1-40, R.1 [and R.2], first paragraph, will be revised as follows:

> Condition R applies to ~~the ECCS actuation input and~~ the RTS Automatic Trip Logic in MODES 1 and 2.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA.

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3/18/2009

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QUESTION NO.: 16-172

LCO 3.3.1, RTS Instrumentation (16.3.3.1-18)

Clarify the addition of "signal conditioning and actuation logic" to the phrase "Allocations for sensor, signal conditioning and actuation logic response times may be obtained from:" in the discussion of SR 3.3.1.13 on page B 3.3.1-50. The comparable phrase in the discussion of SR 3.3.1.16 on page 3.3.1-60 in NUREG-1431, Rev 3.1 does not contain "signal conditioning and actuation logic.

ANSWER:

NUREG-1431 defines the methods for obtaining allocations for sensor response times distinctly from the methods for obtaining allocations for signal processing and actuation logic response times. For the US-APWR, the same methods are used for obtaining response time allocations for all three portions of the system.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-173

LCO 3.3.1, RTS Instrumentation (16.3.3.1-19)

Justify the exclusion of the NUREG-1431, Rev 3.1 Bases discussion associated with the references to WCAP-13632-P-A and WCAP-14036-P in the US-APWR BASES discussion regarding SR 3.3.1.13 on page B 3.3.1-50. The NUREG-1431, Rev 3.1 BASES discussion regarding the comparable SR 3.3.1.16 on page B 3.3.1-60 includes references to WCAP-13632-P-A and WCAP-14036-P. These topical reports appear to provide relevant information.

ANSWER:

WCAP-13632-P-A provides response times for "specific sensors identified in the WCAP". The US-APWR may use different sensors, therefore reference to this specific WCAP is inappropriate. Sensor selection for the US-APWR is a procurement issue.

WCAP-14036-P provides response time information relevant to conventional systems. This WCAP is not applicable to the digital PSMS.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-174

LCO 3.3.1, RTS Instrumentation (16.3.3.1-20)

Justify the exclusion of the NUREG-1431, Rev 3.1 Bases discussion associated with dynamic transfer functions in the US-APWR BASES discussion regarding SR 3.3.1.13 on page B 3.3.1-49. The NUREG-1431, Rev 3.1 BASES discussion regarding the comparable SR 3.3.1.16 on page B 3.3.1-59 includes a discussion of dynamic transfer functions.

ANSWER:

As stated in B 3.3.1.13, RTBs and RTDs are known to have aging or wear-out mechanisms that can impact response time and require response time measurement.

Response time 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. Therefore, response time testing is provided for RTBs and RTDs, but response time testing is not provided for other PSMS components. These other PSMS components include the digital components of the PSMS, which implement dynamic transfer functions. Therefore, the discussion of response time testing for dynamic transfer functions is not applicable to the digital PSMS.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-175

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-02)

Identify the three primary functions of containment spray in the US-APWR TS LCO 3.3.2 BASES, APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY, Containment Spray section (Page B 3.3.2-11, 1st paragraph in section). Only two functions are identified in the BASES, though the lead sentence credits three functions. NUREG-1431, Rev 3.1 credits three primary functions of containment spray.

ANSWER:

The third function defined in NUREG-1431 "Adjusts the pH of the water in the containment recirculation sump after a large break LOCA." is provided by the static mechanism and is not applied by the Containment Spray function in the US-APWR.

So, the description is not correct, and the description of the DCD will be revised to incorporate the comment in QUESTION NO.16-175.

Impact on DCD

The DCD chapter 16, Page B 3.3.2-11, 2. Containment Spray, first paragraph, will be revised as follows:

Containment Spray provides ~~three~~ two primary functions:

Impact on COLA

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

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-176

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-03)

Clarify the US-APWR main steam line design in the US-APWR TS LCO 3.3.2 BASES, APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY, Main Steam Line Isolation section on Page B 3.3.2-18. The BASES discussion includes the statement "For units that do not have main steam line check valves, Main Steam Line Isolation also mitigates the effects of a feed line break and ensures a source of steam for the turbine driven EFW pump during a feed line break."

NUREG-1431, Rev 3.1, includes a generic statement regarding the potential use of main steam line check valves to cover multiple plant designs (WOG STS Page B 3.3.2-21, 1st paragraph). Confirm that the application of main steam line check valves for the USAPWR is a site specific decision.

ANSWER:

The US-APWR has main steam line check valves (MSCVs) so that the MSCVs can prevent to blowdown from intact SGs to faulted SG when the steam line break on the upstream of MSIV, however, the US-APWR safety analysis does not expect MSCV in the faulted SG line to mitigate the effects. The safety analysis expects the MSIVs on intact SG lines for the event mitigation and the closure of the MSIVs limits the accident to the blowdown from only the faulted SG.

Impact on DCD

The DCD Chapter 16, TS 3.3.2 BASES, APPLICABLE SAFETY ANALYSIS, LCO, and APPLICABILITY, 4. Steam Line Isolation, 1st paragraph will be revised as follows:

Isolation of the main steam lines provides protection in the event of an SLB inside or outside containment. Rapid isolation of the main steam lines will limit the steam break accident to the blowdown from one SG, at most. For an SLB upstream of the main steam isolation valves (MSIVs), inside or outside of containment, closure of the MSIVs limits the accident to the blowdown from only the affected SG.
For an SLB downstream of the MSIVs, closure of the MSIVs terminates the accident as soon as the main steam lines depressurize. ~~For units that do not have main steam line check valves,~~ Main Steam Line Isolation also mitigates the effects of a feed line break and ensures a source of steam for the turbine driven EFW pump during a feed line break.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-177

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-04)

Justify the initial completion time of 72 hours in the US-APWR TS LCO 3.3.2, ACTIONS B.1 and B.2. NUREG-1431, Rev 3.1, establishes 48 hours as reasonable.

No basis is provided for increasing the "reasonable" completion time from 48 hours to 72 hours other than identifying that the remaining OPERABLE trains provide protection for each function and that there is a low probability of an event during this interval. Describe the method for establishing the completion time of 72 hours.

ANSWER:

The initial completion time of 48 hours in NUREG-1431, Rev 3.1 is based on the two channel configuration of these ESFAS manual initiation functions in conventional plants. When one required Manual Initiation channel is inoperable, the two channel system does not meet the single failure criteria for the manual initiation function. But, the US-APWR adopts a 2-out-of-4 channel configuration for ESFAS manual initiation and the manual initiation function can be performed from the Manual Initiation conventional switches or from the safety VDUs. If one required Manual Initiation channel (hardwired) is unavailable, each ESFAS can be manually initiated from the remaining operable Manual Initiation channels.

In addition, the system continues to meet the single failure criteria, since the ESFAS manual initiation function can still be initiated in all three trains from the Safety VDUs. So, the tolerance to single failures in the ESFAS manual initiation function is significantly improved from the conventional two channel plant. Based on this improvement, MHI uses the initial completion time of 72 hours which is used for the four channels with the 2-out-of-4 configuration in NUREG-1431, Rev 3.1.

The PSMS reliability is analyzed by using this initial completion time of 72 hours for the ESFAS manual initiation functions, and the result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. But, the reliability of the remaining operable ESFAS manual initiation function (including EFAS manual initiation from the Safety VDUs) is very high, therefore the initial completion time of 72 hours for the ESFAS manual initiation functions have no affected on the total reliability of the PSMS.

So, the detail explanation and Fault Tree Analyses (FTA) of the ESFAS manual initiation functions are not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.2-40, ACTIONS B.1, B.2.1 and B.2.2, last paragraph:

> The initial completion time of 72 hours is justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. The PSMS reliability analysis credits the continued compliance to the single failure criteria, since the ESFAS manual initiation function remains fully operable from the Safety VDUs, even when one ESFAS manual initiation function is inoperable.

Also, the detail explanation and FTA of the ESFAS manual initiation functions which are including the initial completion time of 72 hours will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6B.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

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QUESTION NO.: 16-178

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-05)

Justify that sufficient OPERABLE trains and the low probability of an event occurring during this interval validate a completion time of 24 hours in the US-APWR, LCO 3.3.2 BASES, ACTIONS C.1, C.2.1, and C.2.2 on page B 3.3.2-40, and LCO 3.3.2 BASES, ACTIONS Q.1 and Q.2 on page B 3.3.2-49. NUREG-1431, Rev 3.1, establishes the 24-hour completion time based on an approved topical report, WCAP-14333-P-A, Rev 1, October 1998 (WOG STS Page B 3.3.2-39). MHI did not provide a comparable analysis. Note: Condition C of LCO 3.3.2 in NUREG-1431 appears to have been split into Conditions C and Q/R of LCO 3.3.2 in the APWR GTS.

Also, the APWR Bases, ACTIONS, C.1, C.2.1, and C.2.2, page B 3.3.2-41 (second paragraph), and the APWR Bases, ACTIONS, Q.1 [and Q.2], page B 3.3.2-49 (third paragraph), do not reference the specific reliability analysis assumption applicable to their respective REQUIRED ACTION NOTES. Both Bases statements merely state that "this allowance is based on the reliability analysis assumption that 4 hours is the average time required to perform train surveillance." The WOG Bases, ACTIONS, C.1, C.2.1, and C.2.2, page B 3.3.2-40 (second paragraph), specifically reference the reliability analysis assumption of WCAP-1027-P-4 as the basis of the 4 hour average time required to perform the train surveillance. Provide the specific reliability analysis assumption upon which the 4 hour average time in the APWR is based.

ANSWER:

For condition C the basis states "The Completion Time also considers that the remaining OPERABLE trains each have automatic self-testing." Since automatic self-testing is continuous, an additional failure that could disable these ESFAS functions is immediately detectable. In conventional plants, Actuation Logic Tests are conducted only once per 92 days on a STAGGERED TEST BASIS, therefore additional failures that disable these ESFAS functions can go undetected for extended time periods.

The reliability analysis assumption of WCAP-1027-P-4 is simply a stated assumption (ie. 4 hours is the average time required to perform train surveillance). This is also a stated assumption in the reliability analysis for the US-APWR. Based on MHI's nuclear experience in Japan, 4 hours is a reasonable number.

The PSMS reliability is analyzed by using the bypassed condition for up to 4 hours and the initial completion time of 24 hours allowed the restore train to OPEARBLE status, and the result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. But, the

reliability influence of the bypassed condition for up to 4 hours and the initial completion time of 24 hours for the restore train are negligible small to the total reliability of the PSMS, because of the automatic self-testing is continuously performed and an additional failure that could disable these ESFAS functions is immediately detectable.

So, the detail explanation and Fault Tree Analyses (FTA) of the bypassed condition and the initial completion time of the inoperable channel is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.2-41, ACTIONS C.1, C.2.1 and C.2.2, last paragraph:

> The bypassed condition for up to 4 hours and the initial completion time of 24 hours are justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

The following description will be added in the DCD chapter 16, Page B 3.3.2-49, ACTIONS Q.1 [and Q.2], last paragraph:

> The bypassed condition for up to 4 hours and the initial completion time of 24 hours are justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

Also, the detail explanation and FTA of the ESFAS Actuation Logic and Actuation Outputs function which is including the bypassed condition for up to 4 hours and the initial completion time of 24 hours for the inoperable train will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6B.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

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QUESTION NO.: 16-179

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-06)

Justify the NOTE allowing an inoperable channel in the bypassed condition for up to 12 hours while performing routine surveillance testing of the other channels in the USAPWR TS LCO 3.3.2 BASES, ACTIONS D.1, D.2.1, and D.2.2 on page B 3.3.2-42.
NUREG-1431, Rev 3.1, establishes the 12-hour bypass limit based on an approved topical report, WCAP-14333-P-A, Rev 1, October 1998 (WOG STS Page B 3.3.2-41). MHI did not provide a comparable analysis.

The US-APWR BASES indicates that ACTIONS D.1, D.2.1, and D.2.2 apply to numerous functions listed on page B 3.3.2-41. The REQUIRED ACTION NOTE is limited to "Containment Pressure" and "Main Steam Line Pressure." The justification for the Note should include a discussion concerning the limitation of applicable functions.

Also, explain not applying the Reviewers Note associated with NUREG-1431, Rev 3.1, TS LCO 3.3.2, Required Actions D.1, D.2.1, D.2.2, E.1, E.2.1, and E.2.2 to the USAPWR TS LCO 3.3.2, Required Actions D.1, D.2.1, D.2.2, E.1, E.2.1, and E.2.2.

The NOTE referred to by the REVIEWER'S NOTE states that "one channel may be bypassed for up to 12 hours for surveillance testing" for plants with installed bypass test capability. The absence of this NOTE would seem to imply that the APWR does not have installed bypass test capability.

ANSWER:

The 12 hour bypass is justified because the remaining two OPERABLE channels have continuous automatic self-testing (as described for COT), and continuous automatic CHANNEL CHECKS. Since automatic self-testing and automatic CHANNEL CHECKS are continuous, an additional failure that could disable this ESFAS function is immediately detectable. In conventional plants CHANNEL CHECKS are conducted only once per 12 hours and COT, which is equivalent to the continuous self-testing of the PSMS, is conducted only once per 184 days, therefore additional failures that disable this reactor trip function can go undetected for extended time periods.

The PSMS reliability is analyzed by using this bypassed condition for up to 12 hours for surveillance testing of the Containment Pressure function and the Main Steam Line Pressure function and the result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. Considering the continuous self-testing for the remaining operable

channels, as described above, the reliability influence of this bypassed condition up to 12 hours has a negligible impact on the total reliability of the PSMS. So, the detail explanation and Fault Tree Analyses (FTA) of the bypassed condition is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

The REQUIRED ACTION NOTE is limited to the Containment Pressure function and the Main Steam Line Pressure function because these two functions have no interaction between the PSMS and the PCMS. If two channels of these functions are bypassed at the same time (ie. one in continuous bypass, one in temporary bypass per this note, to allow testing other channels) a single failure will prevent protective action for postulated accidents, but it will not result in a plant transient that would require protective action. Two channels of other functions that are shared between PSMS and PCMS cannot be bypassed, because with only two operable channels the signal selector function in the PCMS can not distinguish a single failure. Therefore, a single failure could result in a plant transient (initiated by the PCMS) that would require protective action. But that same single failure would prevent protection from the PSMS.

Also, the US-APWR has installed bypass test capability, so the NOTE will be revised based on the REVIEWER'S NOTE states to incorporate the comment in QUESTION NO.16-176.

Impact on DCD

The DCD chapter 16, Page 3.3.2-2, REQUIRED ACTION D, NOTE, first paragraph, will be revised as follows:

> For Containment Pressure and Main Steam Line Pressure, one channel may be bypassed for up to 12 hours for surveillance testing.

The following description will be added in the DCD chapter 16, Page B 3.3.2-42 ACTIONS D.1, D.2.1 and D.2.3, last paragraph:

> For Containment Pressure and Main Steam Line Pressure, one channel may be bypassed for up to 12 hours for surveillance testing. The 12 hours bypass limit is justified in the PSMS reliability analysis, considering that the remaining operable channels have continuous self-testing. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. This bypass is not allowed for the other functions because these channels are also used for control. If a failure were to occur in one of the two remaining control channels, a plant transient could occur that would require a plant trip, but a plant trip would not occur with only one remaining operable channel.

Also, the detail explanation and FTA of the Containment Pressure and Main Steam Line Pressure functions which are including the bypassed condition up to 12 hours will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6B.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

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QUESTION NO.: 16-180

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-07)

Justify the nature of these Functions, the available redundancy, and the low probability of an event occurring during this interval validate a completion time of 72 hours in the US-APWR TS LCO 3.3.2 BASES, ACTIONS F.1, F.2.1, and F.2.2 on page B 3.3.2-43.
NUREG-1431, Rev 3.1, establishes a shorter 48-hour completion time based on the same statement (WOG STS Page B 3.3.2-43).

ANSWER:

For the manual initiation functions, the initial completion time of 48 hours in NUREG-1431, Rev 3.1 is based on the two channel configuration of these ESFAS manual initiation functions in conventional plants. When one required Manual Initiation channel is inoperable, the two channel system does not meet the single failure criteria for the manual initiation function. But, the US-APWR adopts a 2-out-of-4 channel configuration for ESFAS manual initiations and the manual initiation functions can be performed from the Manual Initiation conventional switches or from the safety VDUs. If one required Manual Initiation channel (hardwired) is unavailable, each ESFAS can be manually initiated from the remaining operable Manual Initiation channels. In addition, the system continues to meet the single failure criteria, since the ESFAS manual initiation function can still be initiated in all three trains from the Safety VDUs.

So, the tolerance to single failures in the ESFAS manual initiation function is significantly improved from the conventional two channel plant. Based on this improvement, MHI uses the initial completion time of 72 hours which is used for the four channels with the 2-out-of-4 configuration in NUREG-1431, Rev 3.1.

Item 6e of Table 3.3.2-1 will be changed to "2 per bus for each EFW train", since the single failure criteria can be met with failure of an entire EFW train. The 72 hour completion time is consistent with the completion time for restoring a completely inoperable EFW train (Condition J).

The PSMS reliability is analyzed by using this initial completion time of 72 hours for the ESFAS manual initiation functions, LOOP initiation of EFW and the P-4 interlock, and the result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. But, the reliability of the remaining operable ESFAS functions is very high, therefore the initial completion time of 72 hours for these ESFAS functions has no affected on the total reliability of the PSMS. So, the detail explanation and Fault Tree Analyses (FTA) of these ESFAS functions is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.2-43, ACTIONS F.1, F.2.1 and F.2.2, last paragraph:

> The initial completion time of 72 hours is justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. For the manual initiation functions, the PSMS reliability analysis credits the continued compliance to the single failure criteria, since the ESFAS manual initiation function remains fully operable from the Safety VDUs, even when one ESFAS manual initiation function is inoperable.

Also, the detail explanation and FTA of the ESFAS manual initiation functions, LOOP initiation of EFW and the P-4 interlock, which include the initial completion time of 72 hours, will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6B.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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QUESTION NO.: 16-181

3.3.2, ESFAS Instrumentation (16.3.3.2-08)

Justify the frequency of 24 months based on the expected reliability of the Protection and Safety Monitoring System in the US-APWR TS LCO 3.3.2 BASES, SR 3.3.2.3 on page B 3.3.2-52. NUREG-1431, Rev 3.1, establishes a 184-day frequency for LCO 3.3.2, SR 3.3.2.5, based on topical report, WCAP-15376, Rev 0, October 2000 (WOG STS Page B 3.3.2-50), and a 92-day frequency for LCO 3.3.7, SR 3.3.7.2, based on "the known reliability of the monitoring equipment" and the fact that the Frequency has "been shown to be acceptable through operating experience" (WOG STS Page B 3.3.7-6).

Note that the WOG STS, LCO 3.3.7, has been incorporated into the APWR GTS, LCO 3.3.2. MHI did not provide a comparable analysis.

ANSWER:

The PSMS self-testing, which is conducted continuously, is equivalent to the conventional system's COT, which is conducted every 184 days. Both of these tests check for random hardware failures. The continuous self-testing in the PSMS assures random failures are immediately detected.

The conventional system's COT also checks for setpoint drift, but there is no setpoint drift in the digital PSMS, so this check is not required. For the PSMS, setpoint drift can only occur due to sensor drift or analog input drift. Unexpected drift, which may result from random failures, is monitored through CHANNEL CHECKS, which are continuously automated. Expected drift, which commonly affects all redundant channels, is checked and corrected during CHANNEL CALIBRATION. CHANNEL CALIBRATION is conducted at a 24 month refueling interval frequency, which is consistent with conventional systems. The 24 month calibration interval is considered in the PSMS setpoint uncertainty calculations.

MHI estimates that the probability of the self test to find Digital Trip Setpoint failures is 100% except the non digital side of the input modules as described in Reference 6 and 7. But, the conservative value, 90% probability of the self test capability, is used in the PSMS reliability analysis. And, the PSMS reliability analysis is based on that the rest 10% failure can only be found by the periodic CHANNEL CALIBRATION and COT which is performed every 24 months period. The result of the PSMS reliability analysis based on the above test interval is evaluated and confirmed in the US-APWR PRA Chapter 19.

But, the detail explanation and Fault Tree Analyses (FTA) of the PSMS to consider the 90% self

test probability and 24 months test interval of the digital side of the PSMS is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.2-52, SR 3.3.1.7, last paragraph:

> The complete continuity check from the input device to the output device is performed by the combination of the continuous CHANNEL CHECK, the 24 month CHANNEL CALIBRATION for the non digital sided of the input module, the continuous self-testing for the digital side, the 24 month COT and the 24 month TADOT for the non-digital side of the output module. The Channel CALIBRATION, COT and TADOT, which are manual tests, overlap with the CHANNEL CHECK and self-testing and confirm the functioning of the self-testing.
>
> The COT interval of 24 months with the self test capability is justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

Also, the detail explanation and FTA of the test functions which are performed on the digital and non digital side of the PSMS to consider the 90% self test probability and 24 months test interval will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6B.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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QUESTION NO.: 16-182

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-09)

Clarify the explanation of the Note that the turbine driven EFW pump is tested within 24 hours after reaching 1000 psig in the SGs in the US-APWR TS LCO 3.3.2 BASES, SR 3.3.2.8 on page B 3.3.2-56. It is not clear if both turbine driven EFW pumps are required to be tested within 24 hours after reaching 1000 psig in the SGs

Misinterpretation of the TS requirement could cause confusion for the operating staff and create unnecessary opportunities to operate the plant outside LCO boundaries.

ANSWER:

The description is not correct, and the description of the DCD will be revised to incorporate the comment in QUESTION NO.16-162.

Impact on DCD

The DCD chapter 16, Page B 3.3.2-56, SR 3.3.2.8, last paragraph, will be revised as follows:

> This SR is modified by a Note that clarifies that the tests for the turbine driven EFW pumps are ~~is~~ conducted within 24 hours after reaching 1000 psig in the SGs.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-183

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-10)

Clarify the note that Required Action Q.2 is not applicable in MODE 4 in the US-APWR TS LCO 3.3.2 BASES, ACTIONS Q.1 [and Q.2] on page B 3.3.2-49.

The Condition R BASES state that "if the train cannot be restored to OPERABLE status, the unit must be placed in a MODE in which the LCO [Condition Q] does not apply."
Condition R requires that the plant be placed in Mode 5 within 36 hours if the completion time for Condition Q is not met. If Required Action Q.2 does not apply in Mode 4, the Condition R BASES imply that once the plant reaches Mode 4, the LCO Action Statement could be exited, if Condition R were entered from Required Action Q.2. This requires further clarification to avoid operator confusion regarding the desired end state of the plant.

ANSWER:

The LCO is correct as written. If the plant is in Mode 1, 2 or 3 when the inoperable condition occurs, the Required Actions of Q1, R1 and R2 apply or the Required Action of Q.2 "Risk Informed Tech Specs" can be applied. However, if the plant is in Mode 4, the Required Action of Q.2 "Risk Informed Tech Specs" cannot be applied.

If the plant is in Mode 4 and the Completion Time for Condition Q.1 is not met, the plant must be in Mode 5 within 36 hours.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-184

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-11)

In the US-APWR TS LCO 3.3.2 BASES, ACTIONS D.1, D.2.1, D.2.2, E.1, E.2.1, E.2.2, and K.1, justify the completion time of 72 hours for the automatic self-testing and automatic CHANNEL CHECKS. NUREG-1431, Rev 3.1, establishes the 72-hour completion time for the comparable BASES, ACTIONS D.1, D.2.1, and D.2.2 based on an approved topical report, WCAP-14333-P-A, Rev 1, October 1998 (WOG STS Page B 3.3.2-41). MHI did not provide a comparable analysis

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ANSWER:

As stated in the basis, "The 72 hours allowed to place the inoperable channel in the tripped condition is justified because the remaining three OPERABLE channels have continuous automatic self-testing (as described for COT), and continuous automatic CHANNEL CHECKS." Since automatic self-testing (COT) and automatic CHANNEL CHECKS are continuous, an additional failure that could disable this ESFAS function is immediately detectable. In conventional plants CHANNEL CHECKS are conducted only once per 12 hours and COT, which is equivalent to the continuous self-testing of the PSMS, is conducted only once per 184 days. Therefore, additional failures that disable this ESFAS function can go undetected for extended time periods.

The PSMS reliability is analyzed by using this initial completion time of 72 hours allowed to place the inoperable channel in the tripped condition, and the result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. Considering the continuous self-testing for the remaining operable channels, as described above, the reliability influence of this initial completion time of 72 hours for the inoperable channel has a negligible impact on the total reliability of the PSMS. So, the detail explanation and Fault Tree Analyses (FTA) of the initial completion time of the inoperable channel is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.2-41, ACTIONS D.1, D.2.1, and D.2.2, and E.3, Page B 3.3.2-42, ACTIONS E.1, E.2.1, and E.2.2, and Page B 3.3.2-46, ACTIONS K.1, each last paragraph:

The initial completion time of 72 hours is justified in the PSMS reliability analysis, considering

that the remaining operable channels have continuous self-testing. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

Also, the detail explanation and FTA of the each trip function which is including the initial completion time of 72 hours for the inoperable channel will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6B.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

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QUESTION NO.: 16-185

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-12)

Include "Manual Initiation of Emergency Feedwater Actuation" in the list of applicable functions for Condition F in the US-APWR TS LCO 3.3.2 BASES on page B 3.3.2-43. "Emergency Feedwater Actuation" is listed as Function 6.a (Manual Initiation) on Table 3.3.2-1 and is associated with Condition F.

The descriptions of the functions on page B 3.3.2-43 are inadequate. All functions listed, with the exception "Loss of Offsite Power" and P-4 Interlock, are Manual Initiations associated with the referenced function. This information is pertinent and should be addressed along with the inclusion of "Manual Initiation of Emergency Feedwater Actuation."

ANSWER:

The descriptions of the functions on page B 3.3.2-43 are inadequate, and the description of the DCD will be revised to incorporate the comment in QUESTION NO.16-185.

Impact on DCD

The DCD chapter 16, Page B 3.3.2-43, ACTIONS F.1, F.2.1, and F.2.2, first paragraph, will be revised as follows:

Condition F applies to:
- Loss of Offsite Power, and
- P-4 Interlock.

<u>Condition F also applies to the manual initiation for:</u>
- Main Steam Line Isolation,
- Main Feed Water Isolation,
- <u>Emergency Feedwater Actuation,</u>
- Emergency Feedwater Isolation, and
- CVCS Isolation.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-186

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-13)

Clarify the addition of "signal conditioning and actuation logic" to the phrase "Allocations for sensor, signal conditioning and actuation logic response times may be obtained from:" in the discussion of SR 3.3.2.8 on page B 3.3.2-55. The comparable phrase in the discussion of SR 3.3.2.10 on page 3.3.2-53 in NUREG-1431, Rev 3.1 does not contain "signal conditioning and actuation logic."

Also, clarify the reference to "equipment in both trains" in the discussion of SR 3.3.2.8 on page B 3.3.2-55 (second paragraph). The APWR FSAR, Section 7.3.1.1, ESF System Level Logic, page 7.3-2, states that "there are four trains for the ESF system in the USAPWR."

ANSWER:

NUREG-1431 defines the methods for obtaining allocations for sensor response times distinctly from the methods for obtaining allocations for signal processing and actuation logic response times. For the US-APWR, the same methods are used for obtaining response time allocations for all three portions of the system.

The description of "equipment in both trains" in the discussion of SR 3.3.2.8 on page B 3.3.2-55 is not correct, and the description of the DCD will be revised to incorporate the comment in QUESTION NO.16-186.

Impact on DCD

The DCD chapter 16, Page B 3.3.2-55, SR 3.3.2.8, Second paragraph, will be revised as follows:

... the equipment in <u>all</u> ~~both~~ trains reaches the required ...

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-187

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-14)

Justify the exclusion of the NUREG-1431, Rev 3.1 Bases discussion associated with the references to WCAP-13632-P-A and WCAP-14036-P in the US-APWR BASES discussion regarding SR 3.3.2.8 on page B 3.3.2-55. The NUREG-1431, Rev 3.1 BASES discussion regarding the comparable SR 3.3.2.10 on page B 3.3.2-53 includes references to WCAP-13632-P-A and WCAP-14036-P. These topical reports appear to provide relevant information.

ANSWER:

WCAP-13632-P-A provides response times for "specific sensors identified in the WCAP". The US-APWR may use different sensors, therefore reference to this specific WCAP is inappropriate. Sensor selection for the US-APWR is a procurement issue.

WCAP-14036-P provides response time information relevant to conventional systems. This WCAP is not applicable to the digital PSMS.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-188

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-15)

Justify the exclusion of the NUREG-1431, Rev 3.1 Bases discussion associated with dynamic transfer functions in the US-APWR BASES discussion regarding SR 3.3.2.8 on page B 3.3.2-55. The NUREG-1431, Rev 3.1 BASES discussion regarding the comparable SR 3.3.2.10 on page B 3.3.2-53 includes a discussion of dynamic transfer functions.

ANSWER:

As stated in B 3.3.2.8, Electro-mechanical components in the ESFAS have aging or wear-out mechanisms that can impact response time and require response time measurement.

Response time 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. Therefore, response time testing is provided for Electro-mechanical components in the ESFAS, but response time testing is not provided for other PSMS components. These other PSMS components include the digital components of the PSMS, which implement dynamic transfer functions. Therefore, the discussion of response time testing for dynamic transfer functions is not applicable to the digital PSMS.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-189

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-16)

Justify the completion time of 24 hours accounts for sufficient OPERABLE trains and the low probability of an event occurring during this interval in the US-APWR, LCO 3.3.2 BASES, ACTIONS G.1, G.2.1 and G.2.2 on page B 3.3.2-44, and LCO 3.3.2 BASES, ACTIONS S.1 and S.2 on page B 3.3.2-50. NUREG-1431, Rev 3.1, establishes the 24-hour completion time based on an approved topical report, WCAP-14333-P-A, Rev 1, October 1998 (WOG STS Page B 3.3.2-44). MHI did not provide a comparable analysis. Note: Condition G of LCO 3.3.2 in NUREG-1431 appears to have been split into Conditions G and S/T of LCO 3.3.2 in the APWR GTS.

Also, the APWR Bases, ACTIONS, G.1, G.2.1, and G.2.2, page B 3.3.2-44 (last paragraph), and the APWR Bases, ACTIONS, S.1 [and S.2], page B 3.3.2-50 (third paragraph), do not reference the specific reliability analysis assumption applicable to their respective REQUIRED ACTION NOTES. Both Bases statements merely state that "this allowance is based on the assumption that 4 hours is the average time required to perform train surveillance." The WOG Bases, ACTIONS, G.1, G.2.1, and G.2.2, page B 3.3.2-44 (second paragraph), specifically reference the reliability analysis assumption of WCAP-1027-P-4 as the basis of the 4 hour average time required to perform the surveillance. Provide the specific reliability analysis assumption upon which the 4 hour average time in the APWR is based.

ANSWER:

For the 24 hour completion time of Conditions G and S, the basis states "The Completion Time also considers that the remaining OPERABLE trains each have continuous self-testing." Continuous automatic self-testing ensures that an additional failure that could disable these ESFAS functions is immediately detectable. In conventional plants, Actuation Logic Tests are conducted only once per 92 days on a STAGGERED TEST BASIS, therefore additional failures that disable these ESFAS functions can go undetected for extended time periods.

The reliability analysis assumption of WCAP-1027-P-4 is simply a stated assumption (i.e. 4 hours is the average time required to perform train surveillance). This is also a stated assumption in the reliability analysis for the US-APWR. Based on MHI's nuclear experience in Japan, 4 hours is a reasonable number.

The PSMS reliability is analyzed by using the bypassed condition for up to 4 hours and the initial

completion time of 24 hours allowed the restore train to OPEARBLE status, and the result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. But, the reliability influence of the bypassed condition for up to 4 hours and the initial completion time of 24 hours for the restore train are negligible small to the total reliability of the PSMS, because of the automatic self-testing is continuously performed and an additional failure that could disable these ESFAS functions is immediately detectable.

So, the detail explanation and Fault Tree Analyses (FTA) of the bypassed condition and the initial completion time of the inoperable channel is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.2-44, ACTIONS G.1, G.2.1, and G.2.2, last paragraph:

> The bypassed condition for up to 4 hours and the initial completion time of 24 hours are justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

The following description will be added in the DCD chapter 16, Page B 3.3.2-50, ACTIONS S.1 [and S.2], last paragraph:

> The bypassed condition for up to 4 hours and the initial completion time of 24 hours are justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

Also, the detail explanation and FTA of the ESFAS Actuation Logic and Actuation Outputs function which is including the bypassed condition for up to 4 hours and the initial completion time of 24 hours for the inoperable train will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6B.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

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QUESTION NO.: 16-190

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-17)

Justify the completion time of 72 hours accounts for sufficient OPERABLE trains, the low probability of an event occurring during this interval, and continuous self-testing on the remaining OPERABLE trains, in the US-APWR, LCO 3.3.2 BASES, ACTIONS J.1 and J.2 on page B 3.3.2-46. Condition J of LCO 3.3.2 in the APWR GTS, applies to the "Actuation Logic and Actuation Outputs" for the "Emergency Feedwater Actuation Function" only, and appears to have originally been part of Condition G of LCO 3.3.2 in NUREG-1431, Rev 3.1. NUREG-1431, Rev 3.1, establishes the 24-hour completion time for Condition G based on an approved topical report, WCAP-14333-P-A, Rev 1, October 1998 (WOG STS Page B 3.3.2-44). MHI did not provide a comparable analysis.

Also, the APWR Bases, ACTIONS, J.1 and J.2, page B 3.3.2-46 (second paragraph), does not reference the specific reliability analysis assumption applicable to the REQUIRED ACTION NOTE of Condition J. The Bases statement merely states that "this allowance is based on the assumption that 4 hours is the average time required to perform channel surveillance." The WOG Bases, ACTIONS, G.1, G.2.1, and G.2.2, page B 3.3.2-44 (second paragraph), specifically reference the reliability analysis assumption of WCAP-1027-P-4 as the basis of the 4 hour average time required to perform the surveillance. Provide the specific reliability analysis assumption upon which the 4 hour average time in the APWR is based.

ANSWER:

For the completion time of 72 hours of Condition J, the basis states "The Completion Time also considers that the remaining OPERABLE trains each have continuous self-testing." Continuous automatic self-testing ensures that an additional failure that could disable these ESFAS functions is immediately detectable. In conventional plants, Actuation Logic Tests are conducted only once per 92 days on a STAGGERED TEST BASIS, therefore additional failures that disable these ESFAS functions can go undetected for extended time periods.

The reliability analysis assumption of WCAP-1027-P-4 is simply a stated assumption (ie. 4 hours is the average time required to perform train surveillance). This is also a stated assumption in the reliability analysis for the US-APWR. Based on MHI's nuclear experience in Japan, 4 hours is a reasonable number.

The PSMS reliability is analyzed by using the bypassed condition for up to 4 hours and the initial

completion time of 72 hours allowed the restore train to OPEARBLE status, and the result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19. But, the reliability influence of the bypassed condition for up to 4 hours and the initial completion time of 72 hours for the restore train are negligible small to the total reliability of the PSMS, because of the automatic self-testing is continuously performed and an additional failure that could disable these ESFAS functions is immediately detectable.

So, the detail explanation and Fault Tree Analyses (FTA) of the bypassed condition and the initial completion time of the inoperable channel is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.2-46, ACTIONS J.1, [J.2], last paragraph:

> The bypassed condition for up to 4 hours and the initial completion time of 24 hours are justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

Also, the detail explanation and FTA of the ESFAS Actuation Logic and Actuation Outputs function which is including the bypassed condition for up to 4 hours and the initial completion time of 24 hours for the inoperable train will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6B.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/18/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 166-1784 REVISION 0**
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QUESTION NO.: 16-191

LCO 3.3.2, ESFAS Instrumentation (16.3.3.2-18)

Justify the STAGGERED TEST BASIS frequency of 92 days based on the expected reliability of the Protection and Safety Monitoring System in the US-APWR TS LCO 3.3.2, SR 3.3.2.2 on page B 3.3.2-52. NUREG-1431, Rev 3.1, establishes a 92-day STAGGERED TEST BASIS frequency based on a topical report, WCAP-15376, Rev 0, October 2000 (WOG STS Page B 3.3.2-49). MHI did not provide a comparable analysis.

ANSWER:

There is an error in this SR. SR 3.3.2.2 ACTUATION LOGIC TEST should be 24 months, which is the same as all other actuation logic tests (i.e. SR 3.3.1.5, SR 3.3.4.2, SR 3.3.5.4, SR 3.3.6.4), not 92 days. The justification is as follows:

With the exception of the "continuity check of output devices", the PSMS self-testing, which is conducted continuously, is equivalent to the conventional system's Actuation Logic Test, which is conducted on a 92 day STAGGERED TEST BASIS frequency. Both of these tests check for random hardware failures. The continuous self-testing in the PSMS assures random failures are immediately detected.

MHI estimates that the probability of the self-testing to detect Actuation Logic failures is 100% except the non digital side of the input and output modules as described in Reference 6 and 7. But, the conservative value, 90% probability of the self test capability, is used in the PSMS reliability analysis. And, the PSMS reliability analysis is based on that the rest 10% failure can only be found by the periodic ACTUATION LOGIC TEST and TADOT which is performed every 24 months period. So, the 90% portion of the Actuation Logic of the PSMS is continuously tested, and the test interval for the only 10% portion is increased from 92-days to 24 months.

For the ESFAS and SLS, the complete operability of all output devices, including the "continuity check of output devices", is included in the TADOT. The TADOT overlaps with continuous self-testing. The TADOT frequency ensures the continuity check of each output device is conducted every 24 months. This test frequency is justified by the MTBF reliability of the PSMS output device and the redundant train configuration of the PSMS.

The result of the PSMS reliability analysis, which is based on the above test descriptions and test intervals, is evaluated and confirmed in the US-APWR PRA Chapter 19.

But, the detail explanation and Fault Tree Analyses (FTA) of the PSMS to consider the test interval

for the non-digital side of the PSMS is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.2-52, SR 3.3.2.2, last paragraph:

> The complete continuity check from the input device to the output device is performed by the combination of the continuous CHANNEL CHECK, and the 24 month CHANNEL CALIBRATION for the non digital side of the input module, the continuous self-testing for the digital side, the 24 month COT, the 24 month ACTUATION LOGIC TEST and the 24 month ESFAS and SLS TADOT for the non-digital side of the output module. The Channel CALIBRATION, COT, ACTUATION LOGIC TEST and TADOT, which are manual tests, overlap with the CHANNEL CHECK and self-testing and confirm the functioning of the self-testing.
>
> The ACTUATION LOGIC TEST interval of 24 months with the self test capability is justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

Also, the detail explanation and FTA of the test function which are performed by the digital and non digital side of the PSMS to consider the 90% self test probability and 24 months test interval will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6A.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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QUESTION NO.: 16-192

LCO 3.3.3, Post Accident Monitoring (PAM) Instrumentation (16.3.3.3-01)

Justify not applying Condition F (together with its required action(s) and completion time) of LCO 3.3.3 in NUREG 1431, Rev 3.1, to the US-APWR. Condition F (together with its required action(s) and completion time) of LCO 3.3.3 in NUREG 1431, Rev 3.1 and not including it in the US-APWR TS LCO 3.3.3.

Table 3.3.3-1 in NUREG 1431, Rev 3.1, provides a list of key variables for post accident monitoring, along with the number of "Required Channels" (second column) and the "Condition Referenced from Required Action D.1" (third column). The entries for this third column for the variables "Reactor Vessel Water Level" and "Containment Area Radiation (High Range)" differ from the corresponding entries in the US-APWR. It is not clear why the entries for "Reactor Vessel Water Level" and "Containment Area Radiation (High Range)" should be "E" and not "F." Condition "F" of NUREG 1431, Rev 3.1, requires the unit to immediately "initiate action in accordance with Specification 5.6.5." This specification states the following:

> When a report is required by Condition B or F of LCO 3.3.3, "Post Accident Monitoring (PAM) Instrumentation," a report shall be submitted within the following 14 days. The report shall outline the preplanned alternate method of monitoring, the cause of the inoperability, and the plans and schedule for restoring the instrumentation channels of the Function to OPERABLE status.

It is not clear why the above action should not be applicable to the US-APWR for "Reactor Vessel Water Level" and "Containment Area Radiation (High Range)."

ANSWER:

The Reactor Vessel Water Level has the alternate method of monitoring which is the Pressurizer Water Level, and the Containment Area Radiation (High Range) has the alternate method of monitoring which is the Containment Pressure.

So, the Condition F which is described in NUREG 1431, Rev 3.1 can be applied to the Reactor Vessel Water Level monitoring and the Containment Area Radiation (High Range) monitoring.

The description will be added in the DCD, LCO 3.3.3 and BASIS to incorporate the comment in QUESTION NO.16-192.

Impact on DCD

The Condition F will be added in the DCD chapter 16, LCO 3.3.3, Page 3.3.3-2, ACTIONS and BASES, Page B 3.3.3-10, ACTIONS.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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QUESTION NO.: 16-193

LCO 3.3.3, Post Accident Monitoring (PAM) Instrumentation (16.3.3.3-02)

In the US-APWR TS LCO 3.3.3, the Note associated with Required Action C.2, indicates that Required Action C.2 is "only required to be performed when the Emergency Feedwater Pit Level is inoperable." Clarify the term "required."

Required Action C.2 is the second option in an OR condition. Clarify whether the Note intends for Required Action C.2 to be an option only if the Emergency Feedwater Pit Level is inoperable and under no other situations where Condition C might apply or whether the intention of the Note is that option C.2 must be selected if the Emergency Feedwater Pit Level is inoperable. The concern is operator misinterpretation. The clarification should be addressed in the LCO statement and in the BASES.

ANSWER:

The Note will be clarified as stated below to incorporate the comment in QUESTION NO.16-193.

Impact on DCD

The LCO 3.3.3, Note associated with Required Action C.2 in C.2 will be changed as follows:

> This alternate action may be used only when the Emergency Feedwater Pit Level is inoperable.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 16-194

LCO 3.3.5, LOP Class 1E GTG Start Instrumentation (16.3.3.5-01)

Justify the frequency of 24 months based on the expected reliability of the Protection and Safety Monitoring System in the US-APWR TS LCO 3.3.5 BASES, SR 3.3.5.4 on page B 3.3.5-6.

The reliability of the Protection and Safety Monitoring System has yet to be established. Provide analysis documentation to substantiate a 24-month Surveillance frequency.

ANSWER:

The Frequency of every 24 months is justified because with the exception of the "continuity check of output devices", the PSMS self-testing, which is conducted continuously, is equivalent to the conventional system's ACTUATION LOGIC TEST, which is conducted on a 92 day STAGGERED TEST BASIS frequency. Both of these tests check for random hardware failures. The continuous self-testing in the PSMS assures random failures are immediately detected.

MHI estimates that the probability of the self-testing to detect Actuation Logic failures is 100% except the non digital side of the input and output modules as described in Reference 6 and 7. But, the conservative value, 90% probability of the self test capability, is used in the PSMS reliability analysis.

And, the PSMS reliability analysis is based on that the rest 10% failure can only be found by the periodic ACTUATION LOGIC TEST and TADOT which are performed every 24 months period. So, the 90% portion of the Actuation Logic of the PSMS is continuously tested, and the test interval for only the 10% portion is increased from 92-days to 24 months.

For the ESFAS and SLS which perform the GTG start logic, the complete operability of all output devices, including the "continuity check of output devices", is included in the TADOT. The TADOT overlaps with continuous self-testing. The TADOT frequency ensures the continuity check of each output device is conducted every 24 months. This test frequency is justified by the MTBF reliability of the PSMS output device and the redundant train configuration of the PSMS.

The result of the PSMS reliability analysis, which is based on the above test descriptions and test intervals, is evaluated and confirmed in the US-APWR PRA Chapter 19.

But, the detail explanation and Fault Tree Analyses (FTA) of the PSMS to consider the test interval for the non-digital side of the PSMS is not described in the current US-APWR Technical Report MUAP-07030(R1) PRA.

Impact on DCD

The following description will be added in the DCD chapter 16, Page B 3.3.5-6, SR 3.3.5.4, last paragraph:

> The complete continuity check from the input device to the output device is performed by the combination of the continuous CHANNEL CHECK, the 24 month CHANNEL CALIBRATION for the non digital sided of the input module, the continuous self-testing for the digital side, the 24 month ACTUATION LOGIC TEST, and the 24 month ESFAS and SLS TADOT for the non-digital side of the output module. The Channel CALIBRATION, ACTUATION LOGIC TEST and TADOT, which are manual tests, overlap with the CHANNEL CHECK and self-testing and confirm the functioning of the self-testing.
>
> The ACTUATION LOGIC TEST interval of 24 months with the self test capability is justified in the PSMS reliability analysis. The result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19.

Also, the detail explanation and FTA of the test function which are performed by the digital and non digital side of the PSMS to consider the 90% self test probability and 24 months test interval will be added in the next revised version of the US-APWR Technical Report MUAP-07030 PRA, Attachment 6A.12.

Impact on COLA

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

Impact on PRA

There is no impact on the PRA result.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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QUESTION NO.: 16-195

3.3 Instrumentation, General Comments (16.3.3-01)

The following apparent typographical or editorial errors were noted in US-APWR TS LCO 3.3 and associated BASES:

1. Page 3.3.1-14, Table 3.3.1-1, "Reactor Trip System Instrumentation," Item 1: The word "initiation" should be capitalized.

2. Page 3.3.1-18, Table 3.3.1-1, "Reactor Trip System Instrumentation," Item 14: The word "actuation" should be capitalized.

3. Page 3.3.2-18, Table 3.3.2-1, "Engineered Safety Feature Actuation System Instrumentation," Item 7c: The words "coincident" and "no" should be capitalized.

4. Page 3.3.6-4, Table 3.3.6-1, "Diverse Actuation System Instrumentation," Item 1f: The word "set" should be capitalized.

5. Page B 3.3.1-34, ACTIONS F.1 and F.2, top of page: Insert hard return (space) between 1st and 2nd paragraphs. The 2nd paragraph starts with "If the inoperable ..."

6. Page B 3.3.1-34, ACTIONS F.1 and F.2, Last Paragraph: The last sentence is missing an object.

7. Page B 3.3.2-7, APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY, Last Bullet: The word Pump is missing a P.

8. Page 3.3.2-13, Table 3.3.2-1, "Engineered Safety Feature Actuation System Instrumentation," Item 2.c: The Trip Setpoint value is missing an end bracket.

9. Page B 3.3.2-19, APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY, Last Paragraph: The last sentence reference to "1.e.1" should be "1.e".

10. Page B 3.3.2-22, APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY, First Paragraph: It appears that the word "Low" in the first sentence should immediately precede "Tavg" in the same sentence.

11. Page B 3.3.2-31, APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY, Second Paragraph: The acronym reference for Reactor Coolant Pumps should be RCPs instead of PCPs.

12. Page B 3.3.3-1, BACKGROUND, Fourth Paragraph: The word "base" in the second line should be "based".

13. Page B 3.3.3-2, LCO, Third Paragraph from the Bottom: The word "for" is missing from the first sentence between the words "requirements" and "Type".

14. Page B 3.3.4-2, APPLICABILITY, Fourth Paragraph: The letter "t" is missing from the word "the" which precedes the acronym MCR in the fourth line.

15. Page B 3.3.4-4, SURVEILLANCE REQUIREMENTS, SR 3.3.4.3, Fourth Paragraph: The word "capability" should be replaced by the word "capable" in the context of the statement.

16. Page 3.3.6-4, Table 3.3.6-1, "Diverse Actuation System Instrumentation," Function 2.c: The word "requirement" should be plural.

ANSWER:

The all typographical or editorial errors in US-APWR TS LCO 3.3 and associated BASES will be revised to incorporate the comment in QUESTION NO.16-185.

Impact on DCD

The DCD chapter 16, LCO 3.3 and associated BASES will be revised to incorporate the comment in QUESTION NO.16-185.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.