REQUEST FOR ADDITIONAL INFORMATION 279-1899 REVISION 1

3/13/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 06.02.04 - Containment Isolation System
Application Section: 6.2.4

QUESTIONS for Containment and Ventilation Branch 1 (AP1000/EPR Projects) (SPCV)

06.02.04-37

RAI 6.2.4-37:
Provide justification for Systems with single valve isolation- Hot Leg CS/RHR line.

The staff requested in RAI 6.2.4-1 that the applicant provide additional justification that the Hot Leg CS/RHR line meets the requirements of the ANSI N271-1976 “other defined basis” of GDC 55 by providing a discussion on why this configuration is more reliable, how a single active failure can be accommodated, and how leak testing the portion of the RHRS outside containment is performed.

For the hot leg CS/RHR Pump Suction Line valves (Figure 6.2.4-1 sheet 12) the applicant provided the following justification:

The lines from the RCS hot leg to the CS/RHR pump suctions each contain two remote manual (motor operated) valves, which are closed during normal plant power operation. The valves are interlocked such that they cannot be opened when the RCS pressure is greater than the design pressure of the RHR system. The valve which is located closer to the RCS inside the missile barrier is not considered a containment isolation valve. The second valve defines the limit of the reactor coolant pressure boundary. This valve also provides the containment isolation barrier inside containment and is considered to be sealed closed.

Since these lines connect to the Containment Spray recirculation loops which are filled with sump water and at least two of which is in operation post accident, there is no need for any containment isolation valves in these lines outside containment. If a leak occurs in the line upstream (toward the RCS) of the valve inside containment, the closed valve isolates the line. If a leak occurs in the recirculation system outside containment, the sump valve is closed to prevent loss of sump water and the closed valve in the RHR suction line prevents any containment atmosphere from entering the system- outside containment. If a leak should occur in the short length of pipe between the valve inside containment and the containment, any containment atmosphere will get only as far as the fluid-filled system. Since this system is filled with sump water and is most likely in operation, no gas could escape to the outside. The fluid in the RHR suction line would drop to approximately the level of fluid in the sump and any containment

atmosphere which did leak into the line would be contained in this length of closed piping.

Another closed valve in .the line would do nothing except somewhat decrease the length of pipe outside containment which could possibly be exposed to containment atmosphere following a leak. It is possible that a valve in this section of pipe would increase the probability of leakage of gas through the stem packing and could not be considered as tight as a clean length of pipe. No single failure of any active or passive component anywhere in the present system can cause any release of containment atmosphere to the outside. Any additional valves would complete normal residual heat removal operation and are unnecessary for containment isolation.

This arrangement is intended to provide guidance in satisfying Criterion 55 on the other defined basis in that system reliability is enhanced by a single valve and there is at least a single mechanical barrier after a single failure.

Inservice testing and inspection of these isolation valves and the associated piping system outside the containment is performed periodically under the inservice inspection requirements of ASME XI as described-in subsection 3.9.6 and section 6.6. During normal operation, the systems are water filled, and degradation of valves or piping is readily detected.

The staff has reviewed the response and has identified that the following needs to be addressed by the applicant:

Revise the DCD to add the provided justification for SI pump suction, RHR-CS/RHR pump suction, and CS-CS/RHR pump suction lines to the DCD. Justification information should be added as a note to the respective sheet in Figure 6.2.4-1 (i.e. see ANS 56.2 Appendix A)

06.02.04-38

RAI 6.2.4-38:

<u>Provide justification for Systems with single valve isolation-SI pump suction line; provide discussion on leak housing.</u>

The staff requested in RAI 6.2.4-2 that the applicant provide additional justification that the SI pump suction line meets the requirements of the ANSI N271-1976 “other defined basis” of GDC 55 by providing a discussion on why this configuration is more reliable, how a single active failure can be accommodated, and how leak testing the portion of the RHRS outside containment is performed.

For the SI pump suction line valves (Figure 6.2.4-1 sheet 11) the applicant provided the following justification:

The lines from refueling water storage pit (RWSP) to the suctions of the safety injection (SI) pumps and containment spray /residual heat removal (CS/RHR) pumps are each provided with a single remote manual gate valve. The valve does not provide a barrier outside containment to prevent loss of sump water should a leak develop in a recirculation loop. (The valve .is to be closed remotely from the control room to accomplish this. Leak detection is provided for each line, so that the operator can determine which valve is to be closed.) These lines and valves are designed to preclude a breach of piping integrity. Therefore, guard pipe are not provided in these lines. (Reference: SRP 6.2.4 Rev.3 SRP Acceptance Criteria 5) This arrangement is intended to provide guidance in satisfying Criterion 56 on the other defined basis in that system reliability is enhanced by a single valve and a single barrier is still maintained after accommodating a single active failure. Inservice testing and inspection of these isolation valves and the associated piping system outside the containment is performed periodically under the inservice inspection requirements of ASME XI as described in subsection 3.9.6 and section 6.6. During normal operation, the systems are water filled, and degradation of valves or piping is readily detected

The staff has reviewed the response and has identified that the following needs to be addressed by the applicant:

1) Revise the DCD to add the provided justification for SI pump suction, RHR-CS/RHR pump suction, and CS-CS/RHR pump suction lines to the DCD. Justification information should be added as a note to the respective sheet in Figure 6.2.4-1 (i.e., see ANS 56.2 Appendix A)

2) The explanation is unclear, please clarify the sentence “The valve does not provide a barrier outside containment to prevent loss of sump water should a leak develop in a recirculation loop.”

06.02.04-39

RAI 6.2.4-39:

<u>Provide justification for systems with single valve isolation-CS/RHR pump suction line; provide discussion on leak housing.</u>

The staff requested in RAI 6.2.4-3 that the applicant provide additional justification that the CS/RHR pump suction line meets the requirements of the ANSI N271-1976 “other defined basis” of GDC 55 by providing a discussion on why this configuration is more reliable, how a single active failure can be accommodated, and how leak testing the portion of the RHRS outside containment is performed.

For the CS/RHR pump suction line valves (Figure 6.2.4-1 sheet 18) the applicant provided the following justification:

*The lines from refueling water storage pit (RWSP) to the suctions of the safety injection (SI) pumps and containment spray **/** residual heat removal (CSIRHR)*

pumps are each provided with a single remote manual gate valve. The valve does not provide a barrier outside containment to prevent loss of sump water should a leak develop in a recirculation loop. (The valve .is to be closed remotely from the control room to accomplish this. Leak detection is provided for each line, so that the operator can determine which valve is to be closed.) These lines and valves are designed to preclude a breach of piping integrity. Therefore, guard pipe are not provided in these lines. (Reference: SRP 6.2.4 Rev.3 SRP Acceptance Criteria 5) This arrangement is intended to provide guidance in satisfying Criterion 56 on the other defined basis in that system reliability is enhanced by a single valve and a single barrier is still maintained after accommodating a single active failure. Inservice testing and inspection of these isolation valves and the associated piping system outside the containment is performed periodically under the inservice inspection requirements of ASME XI as described in subsection 3.9.6 and section 6.6. During normal operation, the systems are water filled, and degradation of valves or piping is readily detected.

The staff has reviewed the response and has identified that the following needs to be addressed by the applicant:

1) Revise the DCD to add the provided justification for SI pump suction, RHR-CS/RHR pump suction, and CS-CS/RHR pump suction lines to the DCD. Justification information should be added as a note to the respective sheet in Figure 6.2.4-1 (i.e. see ANS 56.2 Appendix A)

2) The explanation is unclear, please clarify the sentence “The valve does not provide a barrier outside containment to prevent loss of sump water should a leak develop in a recirculation loop.”

06.02.04-40

RAI 6.2.4-40:

<u>Describe ITAAC for verification of containment isolation valve placement.</u>

The staff requested in RAI 6.2.6-6 that the applicant describe how completion of COL item 6.2(6), as written in the US-APWR DCD (rev 0), ensures that the supplied list as-built piping distances from the outer containment isolation valve to the containment will be such that the valves are located as close to containment as practical? The applicant was asked to describe any ITAAC for verification of containment isolation valve placement.

In a letter dated September 22, 2008, Mitsubishi provided the following response for RAI 6.2.4-6:

A list of as-built pipe run distances from the outer containment isolation valves to the containment penetrations will be prepared prior to initial fuel load to confirm that as-built pipe run- distance will not exceed those listed in table 6.2.4-3.

Subsequently in a letter dated November 7, 2008, Mitsubishi informed the staff that DCD COL item 6.2(6) will be deleted.

The staff has reviewed the response and has identified that the following needs to be addressed by the applicant:

Provide ITAAC that verifies, for each containment penetration, that the no-greater-than distances from containment to the outermost isolation valve listed in DCD Tier 2 Table 6.2.4-3 are not exceeded.

06.02.04-41

RAI 6.2.4-41:

<u>Justify Failed-Open position of penetration #283 valves upon loss of power.</u>

The staff requested in RAI 6.2.6-10 that, pursuant to the requirement of GDC 55 as it relates to the criteria that, upon the loss of actuating power, the automatic isolation valves should take the position of greatest safety, the applicant should explain how a failed- open position of the two MOVs in series, as shown in Figure 6.2.4-1 sheet 8, is the position of greatest safety upon loss of power.

The applicant provided the following justification:

The two motor operated valves in series are designed that inside and outside valves are powered from different Class-IE power source trains. This means that both valve actuating powers are not lost simultaneously under a single failure condition. Therefore, if one motor operated valve cannot be closed due to loss of actuating power, the other motor operated valve can be closed.

The staff has reviewed the response and has identified that the following needs to be addressed by the applicant:

Notwithstanding your explanation that the valve configuration meets single failure criteria, the valve design (MOV) does not conform to the GDC 55 requirement for automatic isolation valves to take the position of greatest safety upon loss of power for this application, since you have designated that the valves' safety position is the closed position. These valves can be classified as automatic isolation valves since they are to automatically close upon receipt of a containment isolation signal, therefore the GDC requirement that they close automatically upon loss of power applies. Your explanation needs to address why the failed open position is the position of greatest safety for these valves, or it needs to provide additional information that clarifies how these valves will close upon loss of power to the valve actuator.

06.02.04-42

RAI 6.2.4-42:

Justify the failed open position of penetration #267L valves upon loss of power.

The staff requested in RAI 6.2.6-11 that pursuant to the requirement of GDC 55 as it relates to the criteria that, upon the loss of actuating power, the position of automatic isolation valves should take the position of greatest safety, the applicant should explain how a failed- open position of the two MOVs in series, as shown in Figure 6.2.4-1 sheet 27, is the position of greatest safety upon loss of power.

The applicant provided the following justification:

The two motor operated valves in series are designed that inside and outside valves are powered from different Class-IE power source trains. This means that both valve actuating powers are not lost simultaneously under a single failure condition. Therefore, if one motor operated valve cannot be closed due to loss of actuating power, the other motor operated valve can be closed.

The staff has reviewed the response and has identified that the following needs to be addressed by the applicant:

Notwithstanding your explanation that the valve configuration meets single failure criteria, the valve design (MOV) does not conform to the GDC 55 requirement for automatic isolation valves to take the position of greatest safety upon loss of power for this application, since you have designated that the valves' safety position is the closed position. These valves can be classified as automatic isolation valves since they are to automatically close upon receipt of a containment isolation signal, therefore the GDC requirement that they close automatically upon loss of power applies. Your explanation needs to address why the failed open position is the position of greatest safety for these valves, or needs to provide additional information that clarifies how these valves will close upon loss of power to the valve actuator.

06.02.04-43

RAI 6.2.4-43:

Justify the failed open position of penetration #269R valves upon loss of power.

The staff requested in RAI 6.2.6-12 that pursuant to the requirement of GDC 55 as it relates to the criteria that, upon the loss of actuating power, the position of automatic isolation valves should take the position of greatest safety, the applicant should explain how a failed- open position of the two MOVs in series, as shown in Figure 6.2.4-1 sheet 28, is the position of greatest safety upon loss of power.

The applicant provided the following justification:
The two motor operated valves in series are designed that inside and outside valves are powered from different Class-lE power source trains. This means that both valve actuating powers are not lost simultaneously under a single failure condition. Therefore, if one motor operated valve cannot be closed due to loss of actuating power, the other motor operated valve can be closed.

The staff has reviewed the response and has identified that the following needs to be addressed by the applicant:

Notwithstanding your explanation that the valve configuration meets single failure criteria, the valve design (MOV) does not conform to the GDC 55 requirement for automatic isolation valves to take the position of greatest safety upon loss of power for this application, since you have designated that the valves' safety position is the closed position. These valves can be classified as automatic isolation valves since they are to automatically close upon receipt of a containment isolation signal, therefore the GDC requirement that they close automatically upon loss of power applies. Your explanation needs to address why the failed open position is the position of greatest safety for these valves, or needs to provide additional information that clarifies how these valves will close upon loss of power to the valve actuator.

06.02.04-44

RAI 6.2.4-44:

<u>Justify failed open position of penetration #161 valves upon loss of power.</u>

The staff requested in RAI 6.2.6-13 that pursuant to the requirement of GDC 55 as it relates to the criteria that, upon the loss of actuating power, the position of automatic isolation valves should take the position of greatest safety, the applicant should explain how a failed- open position of the two MOVs in series, as shown in Figure 6.2.4-1 sheet 32, is the position of greatest safety upon loss of power.

The applicant provided the following justification:

The two motor operated valves in series are designed that inside and outside valves are powered from different Class-lE power source trains. This means that both valve actuating powers are not lost simultaneously under a single failure condition. Therefore, if one motor operated valve cannot be closed due to loss of actuating power, the other motor operated valve can be closed.

The staff has reviewed the response and has identified that the following needs to be addressed by the applicant:

Notwithstanding your explanation that the valve configuration meets single failure criteria, the valve design (MOV) does not conform to the GDC 55 requirement for automatic isolation valves to take the position of greatest safety upon loss of

power for this application, since you have designated that the valves' safety position is the closed position. These valves can be classified as automatic isolation valves since they are to automatically close upon receipt of a containment isolation signal, therefore the GDC requirement that they close automatically upon loss of power applies. Your explanation needs to address why the failed open position is the position of greatest safety for these valves, or needs to provide additional information that clarifies how these valves will close upon loss of power to the valve actuator.

06.02.04-45

RAI 6.2.4-45:

Justify failed open position of penetration #266 valves upon loss of power.

The staff requested in RAI 6.2.6-14 that pursuant to the requirement of GDC 55 as it relates to the criteria that, upon the loss of actuating power, the position of automatic isolation valves should take the position of greatest safety, the applicant should explain how a failed- open position of the two MOVs in series, as shown in Figure 6.2.4-1 sheet 44, is the position of greatest safety upon loss of power.

The applicant provided the following justification:

The two motor operated valves in series are designed that inside and outside valves are powered from different Class-IE power source trains. This means that both valve actuating powers are not lost simultaneously under a single failure condition. Therefore, if one motor operated valve cannot be closed due to loss of actuating power, the other motor operated valve can be closed.

The staff has reviewed the response and has identified that the following needs to be addressed by the applicant:

Notwithstanding your explanation that the valve configuration meets single failure criteria, the valve design (MOV) does not conform to the GDC 55 requirement for automatic isolation valves to take the position of greatest safety upon loss of power for this application, since you have designated that the valves' safety position is the closed position. These valves can be classified as automatic isolation valves since they are to automatically close upon receipt of a containment isolation signal, therefore the GDC requirement that they close automatically upon loss of power applies. Your explanation needs to address why the failed open position is the position of greatest safety for these valves, or needs to provide additional information that clarifies how these valves will close upon loss of power to the valve actuator.

06.02.04-46

RAI 6.2.4-46:

Provide justification of containment setpoint pressure for phase A containment isolation.

The staff requested in RAI 6.2.6-15 that MHI provide justification of containment setpoint pressure for phase A containment isolation.

The applicant provided the following justification:

Automatic containment isolation phase-A is activated by the signal generation of ECCS activation, which includes containment. High-1 at 6.8 psig of the containment pressure. This setpoint is, selected as 10% of the containment design pressure (68 psig). On the other hand the maximum expected pressure inside containment during normal operation is 2.0 psig, and accuracy of the pressure instrument channel is 2.5 psi, which was estimated by combining instrumentation factors that affect the accuracy of each component in the channel (DCD 7.2.2.7.1). In order to prevent an inadvertent actuation of containment isolation, a certain margin was considered. This margin for the setpoint is 2.3 psi, which is adequate and small enough. Therefore this pressure setpoint for containment isolation is consistent with the requirement of 10 CFR 50.34(f)(2)(xiv). Dose evaluation was performed with this setpoint including a margin. This assumption generates the conservative results by estimating longer duration of containment purge flow than actual. It was confirmed that this conservative results satisfied the criterion for dose evaluation (DCD 15.6.5.5).

The staff has reviewed the response and has identified that the following needs to be addressed by the applicant:

Include the above discussion in DCD Section 6.2.4.

06.02.04-47

RAI 6.2.4-47:

Provide information on leak detection capability in remote manual systems.

The staff requested in RAI 6.2.4-29 that pursuant demonstrating that the US-APWR design meets the requirements of GDC 54 as it relates to the ability to detect leakage from, lines where remote manual valves are acceptable and employed, the applicant should provide details of leakage detection capability for each system needed for safe shutdown of the plant listed in table 6.2.4-3.

The applicant provided the following information:

Systems that are including remote manual valve for containment isolation are followings:

- Safety injection system.
- Containment spray system
- Residual heat removal system
- Emergency feedwater system
- Main steam system
- Seal water injection
- Post-accident sampling return line
- Fire protection water supply system

The condition in which containment isolation is needed in safety injection system, containment spray system and residual heat removal system is when leak occurs in these systems. These systems are located in safeguard component area. Leak detection system is installed in each system. Level instruments are installed in each pump compartment sump. In addition, if leak is occurred, operators can notice by pump suction/discharge pressure and pump flow rate. As for main steam system, NMS-MOV-507A, B, C, D, NMS-MOV-701A, B, C, D and EFS-MOV-101A, B, C, D are remote manual isolation valves. The condition in which containment isolation is needed is to prevent fission product from releasing such as in SGTR. In each main steam line, radiation monitors is installed. So operators can notice that these valves should be closed. As for seal water injection line, CVS-MOV-178 A, B, C, D are remote manual isolation valves. The condition in which containment isolation is needed is the case that seal injection flow. is lost. In each injection line, flow rate instrument is installed. So operators can notice that these valves should be closed. As for post-accident sampling return line and fire protection water supply system, PSS-MOV-071 and FSS-MOV-004 are remote manual isolation valves. The reason why these valves does not receive containment isolation signal is that these are closed under administrative control, such as locked closed. Therefore, these valves are not needed to be closed if leak occur.

The staff has reviewed the response and has identified that the following needs to be addressed by the applicant:

The above information is part of the design basis of the plant and needs to be included in DCD Section 6.2.4-2

06.02.04-48

RAI 6.2.4-48:

<u>Provide information on provisions to alert the operator to isolate RM systems.</u>

The staff requested in RAI 6.2.4-30 that pursuant demonstrating that the US-APWR design meets the requirements of GDC 54 as it relates to provisions to alert the operator of the need to isolate fluid systems where remote manual isolation valves are acceptable and employed, the applicant should provide details as to what provisions are provided to alert the operator of the need to isolate fluid systems equipped with remote manual isolation valves.

The applicant provided the following information:

Systems that are including remote manual valve for containment isolation are followings:

- *Safety injection system.*
- *Containment spray system*
- *Residual heat removal system*
- *Emergency feedwater system*
- *Main steam system*
- *Seal water injection*
- *Post-accident sampling return line*
- *Fire protection water supply system*

The condition in which containment isolation is needed in safety injection system, containment spray system and residual heat removal system is when leak occurs in these systems. These systems are located in safeguard component area. Leak detection system is installed in each system. Level instruments are installed in each pump compartment sump. In addition, if leak is occurred, operators can notice by pump suction/discharge pressure and pump flow rate. As for main steam system, NMS-MOV-507A, B, C, D, NMS-MOV-701A, B, C, D and EFS-MOV-101A, B, C, D are remote manual isolation valves. The condition in which containment isolation is needed is to prevent fission product from releasing such as in SGTR. In each main steam line, radiation monitors is installed. So operators can notice that these valves should be closed. As for seal water injection line, CVS-MOV-178A, B, C, D are remote manual isolation valves. The condition in which containment isolation is needed is the case that seal injection flow is lost. In each injection line, flow rate instrument is installed. So operators can notice that these valves should be closed. As for post-accident sampling return line and fire protection water supply system, PSS-MOV-071 and FSS-MOV-004 are remote manual isolation valves. The reason why these valves does not receive containment isolation signal is that these are closed under administrative control, such as locked closed. Therefore, these valves are not needed to be closed if leak occur.

The staff has reviewed the response and has identified that the following needs to be addressed by the applicant:

The above information is part of the design basis of the plant and needs to be included in DCD Section 6.2.4-2

06.02.04-49

RAI 6.2.4-49:

<u>Clarify use of resilient seals on containment vent and purge valves and accommodations for seal replacement if supplied.</u>

The staff requested in RAI 6.2.6-32 that the applicant specify if the containment purge and vent valves will be supplied with resilient seals. If supplied, the applicant should specify what accommodations are provided for resilient seal

replacement when required by leakage rate testing or manufacturer recommendation.

The applicant provided the following information:

Containment purge and vent valves (Containment Purge System) may be supplied with resilient seals and the subject containment penetrations and containment isolation valves will receive preoperational and periodic Type C leak rate testing in accordance with 10 CFR 50, Appendix J. The soft seated containment isolation butterfly valves in the containment purge system which may require resilient seal replacement following the leakage rate testing will be subject to seals replacement based on a valve manufacturer recommendation.

The staff has reviewed the response and has identified that the following needs to be addressed by the applicant:

The above information is part of the design basis of the plant and needs to be included in DCD Section 6.2.4-2, along with a description of the accommodations to facilitate replacement of the seals.