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

September 3, 2010

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-10241

Subject: MHI's Responses to US-APWR DCD RAI No. 606-4827 REVISION 2

Reference: 1) "Request for Additional Information No. 606-4827 Revision 2, SRP Section: 17.04 - Reliability Assurance Program (RAP), Application Section: 17.4 Reliability Assurance Program," dated July 20, 2010.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Responses to Request for Additional Information No. 606-4827 Revision 2".

Enclosed are the responses to the RAIs contained within Reference 1.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of the submittals. His contact information is below.

Sincerely,

Y. Ogata

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

Enclosure:

1. Responses to Request for Additional Information No. 606-4827 Revision 2.

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

D081
NRO

Enclosure 1

UAP-HF-10241
Docket Number 52-021

Responses to Request for Additional Information No. 606-4827
Revision 2

September 2010

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/3/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: **NO. 606-4827 REVISION 2**

SRP SECTION: **17.04 – Reliability Assurance Program (RAP)**

APPLICATION SECTION: **17.4 Reliability Assurance Program**

DATE OF RAI ISSUE: **7/20/2010**

QUESTION NO. : 17.04-50

Section 17.4.4 ("Quality Controls") of the US-APWR DCD, Revision 2, describes the quality controls for D-RAP activities. Part e ("Corrective Action") of Section 17.4.4 states: "The CAP utilized to support the QAPD can be used to implement the corrective actions related to the RAP." The use of the word "can" in the above statement suggests that there may be a possible alternative method for implementing the corrective actions related to the RAP (e.g., if the CAP described under the QAPD is not utilized, then what method would be used to implement the corrective actions related to the RAP).

The staff requests that MHI clarify the above statement. For example, the following clarification would be acceptable: "The CAP utilized to support the QAPD is used to implement the corrective actions related to the RAP."

ANSWER:

MHI will clarify the statement as pointed out in the above question.

Impact on DCD

Section 17.4.4 ("Quality Controls") of the US-APWR DCD will be revised as follows:

> "The CAP utilized to support the QAPD is used to implement the corrective actions related to the RAP."

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/3/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: **NO. 606-4827 REVISION 2**

SRP SECTION: **17.04 – Reliability Assurance Program (RAP)**

APPLICATION SECTION: **17.4 Reliability Assurance Program**

DATE OF RAI ISSUE: **7/20/2010**

QUESTION NO. : 17-04-51

The non-safety-related systems, structures, and components in the scope of RAP (RAP SSCs) should be subjected to quality assurance (QA) controls in accordance with the provisions of Subsection V ("Nonsafety-Related SSC Quality Controls") in Section 17.5 of the Standard Review Plan (SRP) for all phases of the D-RAP. Therefore, during Phase 1 of the D-RAP for the design certification (DC), the non-safety-related RAP SSCs should be subjected to the appropriate QA controls described in Section 17.5 ("Quality Assurance Program Description") of the US-APWR DCD, Revision 2. During Phases II and III of the D-RAP for the combined license (COL) applicant and holder, the nonsafety-related RAP SSCs should be subjected to the appropriate QA controls described in the COL's QA program description (QAPD). However, it is not clear in Section 17.4 of the US-APWR DCD that the nonsafety-related RAP SSCs will be subjected to these QA controls. In addition, the boundaries (e.g., electrical and mechanical boundaries) of the RAP SSCs should be defined so that the RAP SSCs can be effectively communicated to the organizations that implement the D-RAP and to provide a common basis for understanding the RAP SSCs (e.g., it is important to know the boundaries of the RAP SSCs for which the QA controls are applicable).

The staff requests that MHI clarify in Section 17.4 of the US-APWR DCD that the nonsafety-related RAP SSCs would be subjected to the appropriate QA controls that are described in the QAPD of the DC and COL for all phases of the D-RAP. Also, MHI should define or identify in Section 17.4 the boundaries (e.g., electrical and mechanical boundaries) of the RAP SSC (it is acceptable to cite specific documents where the RAP SSC boundaries are defined).

ANSWER:

1) MHI will clarify in Section 17.4 of the US-APWR DCD that the nonsafety-related RAP SSCs would be subjected to the appropriate QA controls that are described in the QAPD of the DC and COL for all phases of the D-RAP.

2) For the RAP, the boundary of SSCs is applicable to components such as valve and pump, and that of system or structure such as containment vessel corresponds to itself. The boundary of components modeled in the PRA is summarized with its failure probability or rate in Tables 7.1-2 and 7.1-3 of US-APWR PRA technical report (MUAP-07030 rev.2, Proprietary), which is based on the failure database such as NUREG/CR-6928 (for mechanical) and IEEE std. 500 (for electrical). For example, motor-operated valve includes the valve, the valve operator, local circuit breaker, and local instrumentation and control circuitry, which is referred from Appendix 2.29 in NUREG/CR-6928. The description to identify the boundary will be added in the DCD.

Impact on DCD

1) The following statement will be added after 17.4.2 of the US-APWR DCD:

   The nonsafety-related RAP SSCs would be subjected to the appropriate QA controls that are described in the Section 17.5 of the US-APWR DCD for the phase I of the D-RAP, and in Section 17.5 of the site specific COL for the phase II and III of the D-RAP.

2) For the discussion about the boundary of the RAP SSCs, the description to identify the boundary will be added in the DCD as follows:

17.4.7.3 Phase I D-RAP Implementation and SSCs included

The implementation of the Phase I D-RAP is the responsibility of MHI as it applies to the reactor design process. The SSCs included in this phase are listed in Table 17.4-1. The boundary for the SSCs listed in the table can be identified as follows:

1. Boundary for the RAP SSCs is applicable to components and that for system or structure represents itself.

2. The boundary for the components modeled in the PRA is basically referred from US-APWR PRA technical report (Ref. 17.4-8), which is based on the general failure data.

17.4.10 References

17.4-7 Analysis of Core Damage Frequency: Internal Events Methodology, NUREG/CR-4550 Volume 1, Rev. 1, U.S. Nuclear Regulatory Commission, Washington, DC, January 1990.

17.4-8 US-APWR Probabilistic Risk Assessment, MUAP-07030-P Rev. 2 (Proprietary), Mitsubishi Heavy Industries, December 2009.

Impact on COLA

The COL applicant should provide the appropriate QA controls for the phase II and III of the D-RAP in the Section 17.5 of the COL.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/3/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: **NO. 606-4827 REVISION 2**

SRP SECTION: **17.04 – Reliability Assurance Program (RAP)**

APPLICATION SECTION: **17.4 Reliability Assurance Program**

DATE OF RAI ISSUE: **7/20/2010**

QUESTION NO. : 17.04-52

SECY-95-132, Item E, states that an application for advanced reactor design certification must describe the process to determine dominant failure modes that considers industry operating experience, analytical models, and applicable requirements. It is not clear in Part b ("Dominant Failure Mode Identification") in Section 17.4.7.1 ("SSCs Identification") of the US-APWR DCD, Revision 2, that industry operating experience was considered by the expert panel in the identification of the dominant failure modes.

The staff requests that MHI include in their process for determining dominant failure modes (which is described in Part b of Section 17.4.7.1 of the US-APWR DCD) the consideration or review of industry operating experience.

ANSWER:

MHI will include the consideration or review of industry operating experience through the expert panel in the process for determining dominant failure modes.

Impact on DCD

The following statement will be added to Part b of Section 17.4.7.1 of the US-APWR DCD:

> In the expert panel's discussion, review of dominant failure modes are also considered in order to reflect industry operating experience.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/3/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: **NO. 606-4827 REVISION 2**

SRP SECTION: **17.04 – Reliability Assurance Program (RAP)**

APPLICATION SECTION: **17.4 Reliability Assurance Program**

DATE OF RAI ISSUE: **7/20/2010**

QUESTION NO. : 17.04-53

Section 17.4.7.2 ("Expert Panel") of the US-APWR DCD, Revision 2, describes the qualification requirements for members of the reliability assurance program (RAP) expert panel. Section 17.4.7.2 states:

> "The level of education and experience of voting member of the RAP EP is defined in the Expert Panel Implementing Procedure for US-APWR Reliability Assurance Program as follows:
>
> - A person who has graduated science and technology university or who has identical educational background, and who has more than 10 years of experience in the specific area of Nuclear Power Plant, such as design, or has identical experience.
>
> or
>
> - A person who has graduated high school or who has identical educational background, and who has more than 15 years of experience in the specific area of Nuclear Power Plant, such as design, or has identical experience."

The qualification requirements described in the statement above is not clear. For example, "A person who has graduated science and technology university" does not necessarily imply a science or technical/engineering degree. "A person who has graduated high school" includes those who have "graduated science and technology university." It should be noted that MHI's response to RAI 17.04-14 (in the letter dated December 12, 2008) satisfactorily described the qualification requirements for members of the expert panel. However, this description was not used in Section 17.4.7.2 of the US-APWR DCD, Revision 2.

The staff requests that MHI more clearly describe in Section 17.4.7.2 of the US-APWR DCD the qualification requirements for members of the expert panel.

ANSWER:

MHI will describe in Section 17.4.7.2 of the US-APWR DCD the qualification requirements for members of the expert panel more clearly.

Impact on DCD

Section 17.4.7.2 of the US-APWR DCD will be revised as follows:

- For a person who has a science or technical/engineering degree, more than 10 years of experience in the specific area of Nuclear Power Plant, such as design, or identical experience, is required.

- For a person who does not have a science or technical/engineering degree, more than 15 years of experience in the specific area of Nuclear Power Plant, such as design, or identical experience, is required.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/3/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: **NO. 606-4827 REVISION 2**

SRP SECTION: **17.04 – Reliability Assurance Program (RAP)**

APPLICATION SECTION: **17.4 Reliability Assurance Program**

DATE OF RAI ISSUE: **7/20/2010**

QUESTION NO. : 17.04-54

Regulatory Guide 1.206, Section C.III.1, Subsection C.I.17.4.4 states that the COL applicant should provide in Chapter 17 of the final safety analysis report (FSAR), in accordance with the provisions in SRP Section 17.4, the quality controls (organization, design control, procedures and instructions, records, corrective action, and audit) for developing and implementing the D-RAP. Section 17.4.4 ("Quality Controls") of the USAPWR DCD, Revision 2, discusses the quality controls for developing and implementing the D-RAP that MHI imposed during the design certification phase. While the D-RAP quality controls that are applied by a COL applicant referencing the US-APWR DCD may be similar to that described in the Section 17.4.4 of the US-APWR DCD, the COL applicant should impose its own quality controls for developing and implementing DRAP.

The staff requests that MHI add a COL license information item to Section 17.4.9 of the US-APWR DCD for the COL applicant to describe the D-RAP quality controls (organization, design control, procedures and instructions, records, corrective action, and audit) that will be applied by the COL applicant during Phases II and III of the DRAP (e.g., the COL applicant should update Section 17.4.4 with their plant-specific design, programmatic, procedural, and organizational information).

ANSWER:

Since identical requirements for COL applicant are already described in the first paragraph of COL license information item (1), Section 17.4.9 of the US-APWR DCD, Rev. 2, MHI does not think to add a new COL license information item.

<u>Impact on DCD</u>

There is no impact on DCD from this RAI.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/3/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: **NO. 606-4827 REVISION 2**

SRP SECTION: **17.04 – Reliability Assurance Program (RAP)**

APPLICATION SECTION: **17.4 Reliability Assurance Program**

DATE OF RAI ISSUE: **7/20/2010**

QUESTION NO. : 17.04-55

COL License Information Item 17.4(2) in Section 17.4.9 ("Combined License Information") of the US-APWR DCD, Revision 2, states:

> "The COL Applicant shall be responsible for the development and implementation of the O-RAP, in which the RAP activities should be integrated into the existing operational program (i.e., Maintenance Rule, surveillance testing, in-service inspection, in-service testing, and QA).

The use of the text "i.e.," (which means "that is") in the above statement implies that the RAP activities should be integrated into maintenance rule, surveillance testing, in-service inspection, in-service testing, and QA. While, the RAP activities would likely be integrated into the above mentioned programs, the COL applicant may also identify other applicable programs (e.g., maintenance program). As such, the use of the text "i.e.," in the above quoted statement is not appropriate. However, replacing that text with "e.g.," (which means "for example") would be more appropriate.

The staff requests that MHI make this appropriate change in COL License Information Item 17.4(2) in Section 17.4.9 of the US-APWR DCD; otherwise provide a justification for not making this change.

ANSWER:

MHI will make the appropriate change in COL License Information Item 17.4(2) in Section 17.4.9 of the US-APWR DCD.

<u>Impact on DCD</u>

COL License Information Item 17.4(2) in Section 17.4.9 ("Combined License Information") of the US-APWR DCD will be revised as follows:

"The COL Applicant shall be responsible for the development and implementation of the O-RAP, in which the RAP activities should be integrated into the existing operational program e.g., Maintenance Rule, surveillance testing, in-service inspection, in-service testing, and QA).

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/3/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: **NO. 606-4827 REVISION 2**

SRP SECTION: **17.04 – Reliability Assurance Program (RAP)**

APPLICATION SECTION: **17.4 Reliability Assurance Program**

DATE OF RAI ISSUE: **7/20/2010**

QUESTION NO. : 17.04-56

The staff requests that MHI address the following comments on Table 17.4-1 ("Risk-Significant SSCs") of the US-APWR DCD, Revision 2:

a) In general, the SSCs within the scope of RAP in Table 17.4-1 are clearly identified using text descriptions and specific SSC identification numbers, when applicable. However, the acronym "TBD" (to be determined) is used throughout Table 17.4-1 and needs to be completed. Note, it is acceptable to clearly identify the risk-significant SSCs using text descriptions when specific SSC identification numbers are not available.

b) Item 1 on page 17.4-17 in Table 17.4-1 for the "Containment Isolation System" states:

"Instrument air system check valves
[IAS-MOV-002], [CAS-VLV-003]"

The Instrument Air system containment isolation valves include a motor-operated valve and a check valve. Therefore, there is an inconsistency between the above component text description and the component identification numbers.

c) Emergency Feedwater System (EFWS) motor-operated valves MOV-101A,B,C,D (see Figure 4.1-7 in the US-APWR Probabilistic Risk Assessment, PRA, MUAP-07030(R2)) are not considered risk-significant in Table 17.4-1 of the US-APWR DCD. Provide the basis for not including these valves in Table 17.4-1 of the USAPWR DCD. Please include in your discussion: the associated risk importance measures (e.g., RAWs and FVs) if available, the consideration of risk evaluations that cover the full spectrum of potential events and the range of plant operating modes considered in Chapter 19 of the US-APWR DCD, and the expert panel's deliberation for not including these valves in RAP.

d) The Emergency Feedwater Pump Actuation Cabinets are included in the Seismic Equipment List (see Table 24.4-1, page 24-66, in the US-APWR PRA, MUAP-07030(R2)). Provide the basis for not including these cabinets in Table 17.4-1 of the US-APWR DCD.

e) Fire Suppression System valve FSS-MOV-004, check valve FSS-VLV-006, and orifice FS02 (see Figure 4.1-13 in the US-APWR PRA, MUAP-07030(R2)) are not considered risk-significant in Table 17.4-1 of the US-APWR DCD. Provide the basis for not including these components in Table 17.4-1 of the US-APWR DCD. Please include in your discussion: the associated risk importance measures (e.g., RAWs and FVs) if available, the consideration of risk evaluations that cover the full spectrum of potential events and the range of plant operating modes considered in Chapter 19 of the US-APWR DCD, and the expert panel's deliberation for not including these components in RAP.

f) MHI stated in their response to RAI 17.04-15 (dated December 12, 2008) that the fire suppression pumps will be added to Table 17.4-1 considering the expert panel deliberations. Based on the US-APWR DCD, Revision 2, the fire suppression pumps were not added to Table 17.4-1. Provide the basis for not including these pumps in Table 17.4-1 of the US-APWR DCD. Please include in your discussion: the associated risk importance measures (e.g., RAWs and FVs) if available, the consideration of risk evaluations that cover the full spectrum of potential events and the range of plant operating modes considered in Chapter 19 of the US-APWR DCD, and the expert panel's deliberation for not including these pumps in RAP.

g) Item 14 on page 17.4-31 in Table 17.4-1 states:

"Minimum flow line manual valves
[SIS-MOV-024 A(B,C,D)]"

However, according to Figure 6.3-2 of the US-APWR DCD and Figure 4.1-2 of the US-APWR PRA, valves SIS-MOV-024A,B,C,D are motor-operated valves and not manual valves. Therefore, there is an inconsistency between the above component text description and the component identification numbers.

h) Item 5 on page 17.4-37 in Table 17.4-1 states that Main Steam Safety Valves MSS-VLV-509A-D and MSS-VLV-510A-D are risk-significant. However, Main Steam Safety Valves MSS-VLV-511A-D, 512A-D, 513A-D, 514A-D (see Figure 4.1-9 of the US-APWR PRA) are not considered risk-significant in Table 17.4-1. Provide the basis for not including these valves in Table 17.4-1 of the US-APWR DCD. Please include in your discussion: the associated risk importance measures (e.g., RAWs and FVs) if available, the consideration of risk evaluations that cover the full spectrum of potential events and the range of plant operating modes considered in Chapter 19 of the US-APWR DCD, and the expert panel's deliberation for not including these valves in RAP.

i) Item 13 on page 17.4-40 in Table 17.4-1 considers the piping for CS/RHR Train A as risk-significant. Provide the basis for not including in Table 17.4-1 of the USAPWR DCD the piping for CS/RHR Trains B, C, and D. Please include in your discussion: the associated risk importance measures (e.g., RAWs and FVs) if available, the consideration of risk evaluations that cover the full spectrum of potential events and the range of plant operating modes considered in Chapter 19 of the US-APWR DCD, and the expert panel's deliberation for not including this piping in RAP.

j) Chilled Water System (VWS) check valves VWS-VLV-005B,C (see Figure 4.1-19 of the US-APWR PRA) are not considered risk-significant in Table 17.4-1. However, common cause failure

of these check valves could fail VWS Trains B and C; and therefore, fail HVAC to the motor-driven EFWS pumps. Provide the basis for not including in Table 17.4-1 of the US-APWR DCD these check valves. Please include in your discussion: the associated risk importance measures (e.g., RAWs and FVs) if available, the consideration of risk evaluations that cover the full spectrum of potential events and the range of plant operating modes considered in Chapter 19 of the US-APWR DCD, and the expert panel's deliberation for not including these check valves in RAP.

k) During an ATWS (anticipated transient without scram) event, the operators initiate boric acid transfer to concentrate the boron in the reactor coolant. Provide the basis for not including in Table 17.4-1 of the US-APWR DCD the boric acid transfer SSCs. Please include in your discussion: the associated risk importance measures (e.g., RAWs and FVs) if available, the consideration of risk evaluations that cover the full spectrum of potential events and the range of plant operating modes considered in Chapter 19 of the US-APWR DCD, and the expert panel's deliberation for not including these SSCs in RAP.

ANSWER:

a) Table 17.4-1 in the DCD will be revised using not the acronym "TBD" but the brief description in order to identify risk-significant SSCs, which are shown in Attachment 1.

b) As NRC's staffs pointed out, there is an inconsistency between the text description and component identification number in Item 1 of "5. Containment isolation system". The text description will be revised as follows:

Instrument air system motor-operated and check valves
[IAS-MOV-002], [CASIAS-VLV-003]

c) The EFWS motor-operated valves (EFS-MOV-101A (B-D) are modeled in the level 1 and level 2 internal event, flood and fire PRA during power operation and the failure modes considered in the PRA are plug, spurious close and external leak. The maximum Fussell-Vesely (FV) importance is on the order of magnitude of 1.0E-10, and the maximum risk achievement worth (RAW) is approximately equal to 1.0, which is less than the values to identify risk-significant SSCs (i.e., either FV importance ≥ 5.0E-03 or RAW ≥ 2.0). However, if these valves are inoperable, turbine-driven EFW pumps are unavailable. The turbine-driven EFW pumps are effective in the events of station blackout (SBO) and total loss of CCW (LOCCW) where motor-driven EFW pumps cannot operate. Therefore, these valves are identified as risk-significant SSCs by engineer judge and will be added in Table 17.4-1.

d) This is the MHI's error. The EFW pump actuation cabinets are considered to be risk significant for seismic margin analysis. The dominant failure mode is functional failure by seismic hazard (FS). The cabinet and its dominant failure mode will be added to Table 17.4-1 shown in Attachment 1.

e) The valves (FSS-MOV-004 and FSS-VLV-006) and the orifice (FSO2) are modeled in the level 2 internal event, flood and fire PRA during power operation. The failure modes considered in the PRA are plug, fail to open and external leak for the valves and plug for the orifice. The maximum FV importance and RAW estimated by importance analysis are respectively 1.6E-06 and 1.0, which is

less than the criteria to identify risk-significant SSC. However, the fire water injection to the reactor cavity is one of the effective measures against the US-APWR severe accident. Therefore, these valves are identified as risk-significant SSCs by engineer judge and will be added in Table 17.4-1.

f) Both motor-driven and diesel turbine driven fire suppression pumps are identified as risk-significant SSCs by expert panel. The pumps will be added to Table 17.4-1 shown in Attachment 1.

g) This is the MHI's editorial error. The text description for Item 14 of "11. High head safety injection system" will be revised as follows:

   Minimum flow line manual motor-operated valves
   [SIS-MOV-024 A (B, C, D)]

h) Two main steam safety valves (MSSVs) [MSS-SRV-509A (B-D) and MSS-SRV-510A (B-D)] are modeled in the PRA and identified as risk-significant SSCs based on the results. On the other hand, other four MSSVs [MSS-SRV-511A (B-D), MSS-SRV-512A (B-D), MSS-SRV-513A (B-D) and MSS-SRV-514A (B-D)] are not modeled in the PRA. The reason that only two MSSVs are modeled in the PRA is as follows:

   Six MSSVs are categorized into three stages by its actuation pressure: the first is MSS-SRV-509A (B-D), the second is MSS-SRV-510A (B-D) and the final is MSS-SRV-511A (B-D) through MSS-SRV-514A (B-D). As described in Table 10.3.2-2 of the US-APWR DCD Chapter 10, the actuation pressure for the first and second MSSVs is designed to be lower than that of the final ones. If the main steam line pressure rises, the first and second MSSVs automatically opens prior to the final MSSVs. The PRA conservatively assumes that failure of either first or second MSSV results in loss of the MSSV function, and other four MSSVs are not expected as back up for the failure.

   MSSVs MSS-SRV-509A (B-D) and MSS-SRV-510A (B-D) has been identified as risk-significant SSCs, based on the PRA results. On the other hand, other four MSSVs play important role for the depressurization of main steam line under the condition where MSSVs are inoperable. Therefore, the four MSSVs not modeled in the PRA are identified to be risk significant by engineer judge and will be incorporated in Table 17.4-1.

i) This is the typographical error. Not only CS/RHR piping for Train A but also the piping for Trains B, C and D are similarly identified as risk significant SSCs. Table 17.4-1 will be revised shown in Attachment 1.

j) The failure modes of essential chilled water system depend on the PRA assumptions (e.g., initial condition) where essential service water system (ESWS) for Trains A and C is operating and the system for Trains B and D is in standby. During normal plant operation, the check valve in the standby train (VWS-VLV-005B) is closing. However, the valve in the operating train (VWS-VLV-005C) is opening, and nether single failure "Fail to open" nor its common cause failure is considered in the PRA. Risk importance measures of the failure mode cannot be assessed.

   As NRC's staffs mentioned in the question of this RAI, loss of HVAC caused by the CCF of two check valves will result in the failure of motor-driven EFW pumps to operate. If PRA assumes that the Trains B and C are in standby, the CCF of check valves to open must be modeled. The CCF that causes the loss of HVAC will have the equal risk measures of the pumps (RAW = 3.7). Considering the uncertainty of initial condition, the CCF is identified as risk significance. Therefore, the check valves and its dominant failure mode "OD" (fail to open) will be added to Table 17.4-1

shown in Attachment 1.

k) SSCs such as boric acid transfer pumps and boric acid transfer tank are modeled in the PRA as that for the boric acid transfer during ATWS. For the SSCs, boric injection line air-operated valves (CVS-AOV-220A and 220B) have the maximum risk importance measures, and the FV importance and RAW are 1.4E-04 and 1.1, respectively. The measures of other SSCs are less than the values. However, the boric acid transfer system is necessary to prevent core damage in the ATWS event and the system has no backup. The SSCs related to the boric acid transfer are considered to be risk significant and will be added in Table 17.4-1.

Impact on DCD

Regarding the expert panel, risk significant SSCs list (Table 17.4-1) will be revised as shown in Attachment 1.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

Table 17.4-1 Risk-significant SSCs (sheet 1 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
1	Accumulator injection system			
1	Discharge line secondary isolation check valves [SIS-VLV-102A (B, C, D)]	RAW(L1, L1-CC, L2-CC)	OD, EL, PR	The accumulator provides safety injection function for refill and re-flooding of the reactor vessel following a loss of coolant accident (LOCA). Also provides negative reactivity to shutdown the reactor. Single failure of any SSCs listed here has potential to cause failure of its dedicated train to inject coolant to RCS.
2	Boundary check valves (Discharge line) [SIS-VLV-103A (B, C, D)]	RAW(L1, L1-CC, L2-CC)	OD, EL, PR	
3	Discharge line isolation motor operated valves [SIS-MOV-101A (B, C, D)]	RAW(L1)	EL	
4	Discharge line orifices train A through D ~~[TBD]~~[SIS-SRO-006A (B, C, D)]	RAW(L1)	PR	
5	~~Piping of discharge lines train A through D [TBD (from accumulator tank to RCS cold leg piping)]~~Piping train A through D (Accumulator injection line)	RAW(L1) SM	EL, SS	
6	Accumulators [SIS-MTK-001A (B, C, D)]	EJ SM	SR, SS	

Table 17.4-1 Risk-significant SSCs (sheet 2 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
2	Chemical volume control system			
1	Charging line air operated valves [CVS-AOV-146] [CVS-FCV-048][CVS-AOV-159]	RAW(L1, L2, LP, FR1, FR2)	CM, EL, PR	The chemical volume control system (CVCS) maintains appropriate volume and quality of reactor coolant for the primary reactor coolant system, adjusts boron concentration for the chemical shim control, and supplies seal water to the reactor coolant pump seals, and disposes borated water discharged from the primary reactor coolant system. RCP seal water injection provided by the CVCS is an essential function to prevent RCP seal LOCA under loss of CCW conditions. When loss of CCW occurs, either the fire suppression system or the non-essential chilled water system is connected to the charging pump cooling line. Thus, the RCP seal water injection is maintained under loss of CCW conditions. Since CVCS is not completely separated in trains, large external leak from SSCs that result in loss of inventory is assumed to result in degradation or failure of the system. Accordingly, SSCs that has the potential of large leak are risk significant. SSCs that have potential to cause common cause failures among multiple trains are also important. Such common cause failure results in loss of redundant S SCs.
2	RCP seal cooling injection line air operated valves [CVS-FCV-050] [CVS-AOV-165]	RAW(L1, L2, LP, FR, FR2)	CM, EL, PR	
3	Auxiliary spray injection line air operated valve [CVS-AOV-155]	RAW(L1, L2, LP)	EL, IL	
4	Charging pumps [CVS-MPP-001A (B)]	FV(L1-CC, L2-SUM, LP, FL1, FL2) RAW(L1, L1-CC, L2, L2-CC, LP, FL1-CC, FR1-CC, FL2-CC, FR2-CC)	AD, BD, EL, YR	
5	Volume control tank discharge line check valve [CVS-VLV-125]	RAW(L1, L2, LP)	EL, PR	
6	Volume control tank discharge line motor operated valves [CVS-LCV-031B (C)]	RAW(L1, L2, LP, LP-CC)	CD, CM, EL, PR	
7	Refueling water storage auxiliary tank discharge line change valves [CVS-LCV-031D (E, F, G)]	RAW(L2, LP, LP-CC)	EL, OD	
8	Refueling water storage auxiliary tank discharge line check valve [CVS-VLV-595]	RAW(L1, L2, LP, FR1, FR2)	EL, OD, PR	
9	Refueling water storage auxiliary tank discharge line manual valve [CVS-VLV-591]	RAW(LP)	EL, PR	

Table 17.4-1 Risk-significant SSCs (sheet 3 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
10	Charging pump minimum flow line check valves ~~[CVC-VLV-129A (B)]~~ [CVS-VLV-129A (B)]	RAW(L1, L2, LP)	EL, OD, PR	During low power and shutdown operation, CVCS provides RCS make up function. On low VCT level, suction is switched from the VCT to the refueling water storage auxiliary tank, which is supplied by the refueling water storage pit. Low-pressure letdown line isolation valves are automatically closed and the CVCS is isolated from the RHRS with receiving the RCS loop low-level signal to prevent loss of RCS inventory at mid-loop operation. When these valves are not closed, loss of a RCS inventory is prevented by manually closing the air-operated valve at the downstream of these valves.
11	Charging pump discharge line check valves ~~[CVC-VLV-131A (B)]~~ [CVS-VLV-131A (B)]	RAW(L1, L2, LP)	EL, PR	
12	Charging line containment isolation check valve [CVS-VLV-153]	RAW(L1, L2, LP)	EL, PR	
13	Charging line isolation check valve [CVS-VLV-160]	RAW(L1, L2, LP)	EL, PR	
14	Charging line boundary isolation check valve [CVS-VLV-161]	RAW(L1, L2, LP)	EL, PR	
15	RCP seal water injection line boundary isolation check valves ~~[CVC-VLV-182A (B, C, D)]~~[CVS-VLV-182A (B, C, D)]	RAW(L1, L2, FR1, FR2)	EL, OD, PR	
16	RCP seal water injection line secondary isolation check valves ~~[CVC-VLV-181A (B, C, D)]~~[CVS-VLV-181A (B, C, D)]	RAW(L1, L2 ,FR1, FR2)	EL, OD, PR	
17	RCP seal water injection line third isolation check valves ~~[CVC-VLV-179A (B, C ,D)]~~[CVS-VLV-179A (B, C, D)]	RAW(L1, L2, FR1, FR2)	EL, OD, PR	
18	Charging line containment isolation motor operated valve [CVS-MOV-152]	RAW(L1, L2, LP)	CM, EL, PR	

Table 17.4-1 Risk-significant SSCs (sheet 4 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
19	Charging line containment isolation motor operated valve [CVS-MOV-151]	RAW(L1, L2, LP)	CM, EL, PR	The "Insights and Assumptions" for these SSCs are described on the previous page.
20	RCP seal water injection line containment isolation motor operated valves ~~[CVC-MOV-178A (B, C, D)]~~[CVS-MOV-178A (B, C, D)]	RAW(L1, L2)	CM, EL, PR	
21	Charging line orifice [CVS-FE-048]	RAW(LP, FR1, FR2)	PR	
22	Charging flow control orifice ~~[TBD]~~[CVS-SRO-003]	RAW(LP)	PR	
23	RCP seal water injection line orifices [CVS-FE-060 (070, 080, 090)]	RAW(L1, L2, LP, FR1, FR2)	PR	
24	Regenerative heat exchanger [CVS-MHX-001]	RAW(L1, L2, LP)	EL	
25	Charging pump minimum flow line manual valves ~~[CVC-VLV-130A (B)]~~[CVS-VLV-130A (B)]	RAW(L1, L2, LP)	EL, PR	
26	Charging pump discharge line manual valves [CVS-VLV-132A (B)]	RAW(L1, L2, LP)	EL, PR	
27	Charging pump discharge line cross tie-line manual valve [CVS-VLV-133]	RAW(L1, L2, LP)	EL, PR	
28	Charging pump suction line manual valves ~~[CVC-VLV-126A (B)]~~[CVS-VLV-126A (B)]	RAW(L1, L2, LP)	EL, PR	
29	Charging line manual valves [CVS-VLV-145] [CVS-VLV-147]	RAW(L1, L2, LP)	EL, PR	

Table 17.4-1 Risk-significant SSCs (sheet 5 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
30	Charging line by-pass line manual valve [CVS-VLV-144]	RAW(L1, L2, LP)	EL	The "Insights and Assumptions" for these SSCs are described on the previous page.
31	RCP seal water injection line manual valves [CVS-VLV-164] [CVS-VLV-166] [CVS-VLV-168] [CVS-VLV-170A(B)] [CVS-VLV-171A(B)] [CVS-VLV-173]	RAW(L1, L2, LP)	EL, PR	
32	RCP seal water injection line filters [CVS-MFT-003A (B)]	RAW(L1, L2) EJ*2	PR	
33	RCP seal water injection by-pass line manual valve [CVS-VLV-163]	RAW(L1, L2, LP)	EL	
34	RCP seal water injection line manual valves [~~CVC~~CVS-VLV-180A (B, C, D)]	RAW(L1, L2)	EL, PR	
35	RCP seal water injection line needle valves [~~CVC~~CVS-VLV-177A (B, C, D)]	RAW(L1, L2)	EL, PR	
36	Low-pressure letdown line air operated valve [CVS-HCV-012]	LP	EL, CD	
37	Charging pump minimum flow orifice [CVS-SRO-002A (B)]	RAW(LP)	PR	
38	Seal water line manual valve [CVS-VLV-167]	RAW(L1, L2, LP)	EL	
39	RWSAT outlet check valve [CVS-VLV-592]	RAW(LP)	EL, PR, OD	
40	SFP outlet check valve [CVS-VLV-594]	RAW(LP)	EL	

Table 17.4-1 Risk-significant SSCs (sheet 6 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
41	Volume control tank [CVS-MTK-001]	RAW(L1, L2)	EL	
42	Piping ~~[TBD~~(CVS charging injection line piping, between RWSAT and CVS-VLV-595)]	RAW(L1, L2, LP)	EL	

Table 17.4-1 Risk-significant SSCs (sheet 7 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
3	Component cooling water system (CCWS)			
1	CCW pump discharge line check valves [NCS-VLV-016A (B, C, D)]	RAW(L1, L1-CC, L2, L2-CC, LP, LP-CC, FL1-CC, FR1-CC, FR2)	EL, PR, OD	The component cooling water system (CCWS) transfer heat from plant safety-related components to the essential service water system (ESWS). This system supports various safety and non-safety mitigation systems. Accordingly, reliability of CCWS emergency feedwater system (EFWS) has significant impact on risk. CCWS has four trains, each having a component cooling water pump and a component cooling water heat exchanger. Two trains compose a subsystem, which shares a supply / return header and a surge tank. SSCs that have either of the following characteristics are risk significant. - SSCs that have potential to cause common cause failures among multiple trains. Common cause failure of such system will result in loss of multiple trains. - SSCs that have potential to cause large external leak are risk significant. Since the two trains that compose a subsystem are not physically isolated, large external leak from SSCs that result in loss of inventory is assumed to result in degradation or failure of two trains.
2	Component cooling water pumps [NCS-MPP-001A (B, C, D)]	FV(L1-CC, L2-CC, LP-CC, FL1, FL2) RAW(L1, L1-CC, L2, L2-CC, LP, LP-CC, FL1, FL1-CC, FL2-CC, FL2, FR-CC, FR2, FR2-CC,) SM	BD, YR, EL, SS, FS	
3	Component cooling water heat exchangers [NCS-MHX-001A (B, C, D)]	RAW(L1, L1-CC, L2, L2-CC, LP, LP-CC, FL1, FL1-CC, FL2, FL2-CC, FR1-CC, FR2, FR2-CC) SM	PR, EL, SS	
4	CCW pump discharge cross tie-line motor operated valves [NCS-MOV-020A (B, C, D)]	RAW(L1- CC, L2, L2-CC, LP, FL1, FL1-CC, FL2, FL2-CC, FR1-CC, FR2-CC)	CD, EL, OD	
5	CCW pump suction line cross tie-line motor operated valves [NCS-MOV-007A (B, C, D)]	RAW(L1-CC, L2, L2-CC, LP, FL1, FL1-CC, FL2, FL2-CC, FR1-CC, FR2-CC)	CD, EL, OD	
6	CCW surge tank outlet manual valves [NCS-VLV-005A (B, C, D)]	EJ RAW(L1,L2, LP, FL1,FL2, FR2)	PR, EL	
7	CCW pump inlet manual valves [NCS-VLV-008 A (B, C, D)]	RAW(L1, L2, LP, FL1, FL2, FR2)	PR, EL	
8	CCW heat exchanger outlet manual valves [NCS-VLV-018 A (B, C D)]	RAW(L1, L2, LP, FL1, FL2, FR2)	PR, EL	

Table 17.4-1 Risk-significant SSCs (sheet 8 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
9	CCW pump motor inlet manual valves [NCS-VLV-101 A (B, C, D)]	RAW(L1,L2,,LP FL1,FL2,FR2)	PR, EL	These valves are used (opened) to provide alternative CCW from the fire suppression system or the non-essential chilled water system to the charging pump cooling line under loss of CCW events. These are important SSCs at loss of CCW events to prevent RCP seal LOCA.
10	CCW pump motor outlet manual valves [NCS-VLV-104 A (B, C, D)]	RAW(L1, L2, LP FL1, FL2, FR2)	PR, EL	
11	A-A(B-B,C-C,D-D) supply header flow meter orifices [NCS-FE-034 (035, 037, 038)]	RAW(L1, L2, LP, FL1, FL2, FR2)	PR	
12	A-A(B-B,C-C,D-D) CCW pump cooling line flow meter orifice [NCS-FE-040 (041, 042, 043)]	RAW(L1, L2, LP, FL1, FL2, FR2)	PR	
13	Safety injection pump motor outlet manual valves [NCS-VLV-114A (B, C, D)]	RAW(L1, L2, LP, FL1)	EL	
14	Safety injection oil cooler outlet manual valves [NCS-VLV-115A (B, C, D)]	RAW(L1, L2, LP, FL1)	EL	
15	Safety injection pump outlet manual valves [NCS-VLV-116A (B, C, D)]	RAW(L1, L2, LP, FL1)	EL	
16	Safety injection pump outlet manual valves [NCS-VLV-119A (B, C, D)]	RAW(L1, L2, LP, FL1)	EL	
17	Safety injection pump outlet flow meter orifices [NCS-FE-080 (081, 082, 083)]	RAW(FL1)	PR	
18	Safety injection pump motor outlet flow meter orifices [NCS-FE-084 (085, 086, 087)]	RAW(FL1)	PR	
19	Safety injection pump inlet manual valves [NCS-VLV-111A (B, C, D)]	RAW(L1, L2, LP, FL1)	EL	

Table 17.4-1 Risk-significant SSCs (sheet 9 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
20	CS/RHR heat exchanger discharge line motor operated valves [NCS-MOV-145A (B, C, D)]	FV(L1-CC, L2-CC, FL1, FL2, FR2) RAW(L1-CC, L2, L2-CC, LP, FL1, FL1-CC, FR1-CC, FL2, FL2-CC, FR2, FR2-CC) LP / SM	EL, CD, CM, OD, OM, PR, FS	The "Insights and Assumptions" for these SSCs are described on the previous page.
21	CS/RHR pump outlet manual valves [NCS-VLV-131A (B, C, D)]	RAW(L2, LP, FL1, FL2, FR2)	EL, PR	
22	CS/RHR pump motor outlet manual valves [NCS-VLV-128A (B, C, D)]	RAW(L2, LP, FL1, FL2, FR2)	EL, PR	
23	CS/RHR pump outlet flow meter orifices [NCS-FE-056 (057, 058, 059)]	RAW(L2, LP , FL1, FL2, FR2)	PR	
24	CS/RHR pump motor outlet flow meter orifices [NCS-FE-060 (061, 062, 063)]	RAW(L2, LP , FL1, FL2, FR2)	PR	
25	CS/RHR pump inlet manual valves [NCS-VLV-125A (B, C, D)]	RAW(L2, LP, FL1, FL2, FR2)	EL, PR	
26	CS/RHR heat exchanger inlet manual valves [NCS-VLV-141A (B, C ,D)]	RAW(L2, LP , FL1, FL2, FR2)	EL, PR	
27	CS/RHR heat exchanger outlet flow meter orifices [NCS-FE-052 (053, 054, 055)]	RAW(L2, LP, FL1, FL2, FR2)	PR	
28	CS/RHR ~~CS/RHR~~ heat exchanger outlet manual valves [NCS-VLV-144A (B, C, D)]	RAW(L2, LP, FL1, FL2, FR2)	EL, PR	
29	Charging injection pump cooling line check valves [NCS-VLV-306A (B)]	RAW(L1, L1-CC, L2, L2-CC, LP, FR1-CC, FR2-CC)	CD, EL, IL, PR	
30	Charging injection pump cooling line motor operated valves [NCS-MOV-316A (B)]	FV(LP) RAW(L1, L1-CC, L2, L2-CC, LP)	CD, CM, EL, PR	

Table 17.4-1 Risk-significant SSCs (sheet 10 of 51)

#	Systems, Structures and Components (SSCs)	Rationale(1)	Failure Mode(2)	Insights and Assumptions
31	Charging injection seal water heat exchanger inlet manual valves [NCS-VLV-311A (B)]	RAW(LP)	EL, PR	The "Insights and Assumptions" for these SSCs are described on the previous page.
32	Charging injection oil cooler inlet manual valves [NCS-VLV-312A (B)]	RAW(LP)	EL, PR	
33	Charging injection pump motor inlet manual valves [NCS-VLV-301A (B)]	RAW(LP)	EL, PR	
34	Charging injection pump motor line manual valves [NCS-VLV-315A (B)]	RAW(LP)	EL, PR	
35	Charging injection pump motor line flow meter orifices [NCS-FE-076 (077)]	RAW(LP) EJ*2	PR	
36	Charging injection oil cooler line flow meter orifices [NCS-FE-070 (071)]	RAW(LP) EJ*2	PR	
37	CCWS - RWSP line boundary check valves [NCS-VLV-065A (B)]	RAW(L1, L2, LP, FL1)	EL	
38	CCWS - RWSP line boundary manual valves [NCS-VLV-066A (B)]	RAW/(L1, L2, LP, FL1)	EL	
39	AB(CD) Supply header flow meter orifices [NCS-FE-036 (039)]	RAW(LP)	PR	
40	A2(C2) Supply header line manual valves [NCS-VLV-033A (B)]	RAW(LP)	EL, PR	
41	A2(C2) Return header line manual valves [NCS-VLV-034A (B)]	RAW(LP)	EL, PR	
42	B-CCW Surge tank nitrogen supply line stop valve [NCS-PCV-022]	FV(L2) RAW/(L2)	CM, EL, OD, PR	

Table 17.4-1 Risk-significant SSCs (sheet 11 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
43	B-CCW Surge tank vent valves [NCS-RCV-056B]	RAW/(L2)	EL, IL, OM	The "Insights and Assumptions" for these SSCs are described on the previous page.
44	B-Component cooling water surge tank ~~[NCS-RTK-001B]~~[NCS-MTK-001B]	RAW/(L2) SM	EL, SS	
45	B-CCW Surge tank safety valve ~~[NCS-VLV-003B]~~ [NCS-SRV-003B]	RAW/(L2)	OM	
46	B-CCW Surge tank nitrogen supply stop bypass valve [NCS-VLV-045B]	RAW/(L2)	EL	
47	Charging pump alternate CCW supply line valves [NCS-MOV-322A (B)]	FV(LP) RAW/(L1, L1-CC, L2, L2-CC, LP)	EL, OD, CM, PR	
48	Charging pump alternate CCW return line valves [NCS-MOV-324A (B)]	FV(LP) RAW/(L1, L1-CC, L2, L2-CC, LP)	CM, EL, OD, PR	
49	Piping ~~[TBD~~ (Fire suppression water tank line piping, ~~ACW CHIP~~Alternate charging pump cooling suction line piping, Alternate charging pump cooling~~ACW CHIP~~ discharge line piping, CCW surge tank line piping, ~~CWS~~ CCWS train piping, ~~CWS~~ CCWS heater piping)]	RAW(L1, L2, LP) SM	EL~~, SF~~	
50	FSS - CCWS boundary motor operated valves [NCS-MOV-321A (B)] [NCS-MOV-325A (B)]	FV(LP) RAW(L1, L1-CC, L2, LP)	CM, EL, OD, PR	Large external leak from these valves result in loss of alternative component cooling water from both non-essential chilled water system and fire suppression system. On the other hand, external leak from other SSCs degrade the fire suppression system but the non-essential chilled water system is still available for alternative component cooling. Therefore these valves are risk-significant SSCs in preventing core damage.
51	CCWS – non-essential chilled water system boundary motor operated valves [NCS-MOV-323A (B)] [NCS-MOV-326A (B)]	RAW(L1, L2, LP)	EL, IL	

Table 17.4-1 Risk-significant SSCs (sheet 12 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
4	Containment system			
1	Containment vessel (PCCV) ~~[TBD]~~	EJ SM	SS	The containment vessel is designed to completely enclose the reactor and reactor coolant system and to ensure that essentially no leakage of radioactive materials to the environment would result even if a major failure of the reactor coolant system were to occur. Hydrogen ignition system are provided for protection against possible detonation following a core damage accident to meet the requirement of 10CFR50.34(f) and 10CFR50.44(c).
2	Hydrogen igniters ~~[TBD]~~	EJ	SR	
3	Interior containment structure ~~[TBD]~~	SM	SS	
4	Equipment hatches~~[TBD]~~	SM	SS	
5	Containment isolation system			
1	Instrument air system motor operated and check valves [IAS-MOV-002], [~~CAS~~IAS-VLV-003]	RAW(L2,FR2), SM	CD, IL, FS	In the case of core damage accident, the containment isolation valve is important to prevent radionuclide releases to the environment.
2	RCP seal water return line : C/V isolation valves [CVS-MOV-203~~(204)~~, [CVS-MOV-204]	RAW(L2-CC) SM	CD, FS	
3	RCP seal water return line C/V isolation system piping	SM	SS	
4	C/V sump pump outlet pipe line C/V isolation system piping	SM	SS	
5	Instrument air pipe C/V isolation system piping	SM	SS	
6	C/V clean up pipe line C/V isolation system piping	SM	SS	

Table 17.4-1 Risk-significant SSCs (sheet 13 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
6	Emergency feedwater system (EFWS)			
1	EFW pit discharge line check valves [EFS-VLV-008A (B)]	RAW(L1, L1-CC, L2, L2-CC, FL1, FL1-CC, FR1, FR1-CC, FL2, FL2-CC, FR2, FR2-CC) LP	EL, OD, PR	The emergency feedwater system (EFWS) supplies feedwater to the steam generators in order to remove reactor decay heat and RCS residual. This system is required after all initiating events exceeding large and medium LOCA. Accordingly, reliability of EFW system has significant impact on risk. Two trains share one emergency feedwater pit, which has 50% capacity to perform cold shutdown. Large leak from SSCs or failure that result in degradation of water supply from EFW pit will lead to lack of EFW. In this case manual action to supply feedwater from Secondary Demineralizer Water Tank is required. SSCs that have either of the following characteristics are risk significant. - SSCs that have potential to cause common cause failures among multiple trains. Common cause failure of such system will result in loss of multiple trains. - SSCs that have potential to cause large leak or failure that result in degradation of water supply from EFW pit will lead are risk important. If such failure occurs, manual action to supply feedwater from secondary demineralizer water tank will be required.
2	Turbine driven emergency feedwater pump actuation valves [EFS-MOV-103A (D)]	FV(FR2) RAW(L1, L1-CC, L2, L2-CC FL1, FL1-CC, FR1, FR1-CC, FL2, FL2-CC, FR2, FR2-CC LP	EL, OD, PR	
3	Motor driven emergency feedwater pumps [EFS-MPP-001B (C)]	RAW(L1-CC, L2-CC, FL1, FL1-CC, FR1, FR1-CC, FL2, FL2-CC, FR2, FR2-CC) LP SM	AD, LR, SR, FS	
4	Turbine driven emergency feedwater pumps [EFS-MPP-001A (D)]	FV(L1, L1-CC, L2, L2-CC, FL1, FR1, FL2 ,FR2) RAW(L1, L1-CC, L2, L2-CC, FL1, FR1, FL2, FR2) LP SM	AD, EL, LR, SR, FS	
5	Feedwater line check valves [EFS-VLV-018A (B, C, D)]	RAW((L1, L1-CC, L2, L2-CC, FL1, FL1-CC, FR1, FR1-CC, FL2, FL2-CC, FR2, FR2-CC) LP	EL, OD	

Table 17.4-1 Risk-significant SSCs (sheet 14 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
6	EFW pump discharge line check valves [EFS-VLV-012A (B, C, D)]	RAW((L1, L1-CC, L2, L2-CC, FL1, FL1-CC, FR1, FR1-CC, FL2, FL2-CC, FR2, FR2-CC) LP	EL, OD, PR	The "Insights and Assumptions" for these SSCs are described on the previous page.
7	Minimum/Full flow line check valves [EFS-VLV-020A (B, C D)] [EFS-VLV-022A (B, C, D)]	RAW(L1, L2, FL1) LP	EL	
8	Minimum/Full flow line manual valves [EFS-VLV-021A (B, C, D)] [EFS-VLV-023A (B, C, D)]	RAW(L1, L2 ,FL1) LP	EL	
9	Emergency feedwater control valves [EFS-MOV-017A (B, C, D))	RAW((L1, L1-CC, L2, L2-CC, FL1) LP	EL, FC	
10	Emergency feedwater isolation valves [EFS-MOV-019A (B, C, D)]	RAW(L1,L2, FL1,FR1,FL2,FR2)	EL	
11	Emergency feedwater line orifices [EFS-FE-016 (026, 036, 046)]	RAW (FL1, FR1, FL2, FR2)	PR	
12	Emergency feedwater line tie-line valves [EFS-MOV-014A (B, C, D)]	RAW(L1, L2-CC, FL1, FL2, FR2, FR2-CC)	EL	
13	EFW system piping ~~[TBD~~ (EFW pit discharge line piping, EFW pit discharge line tie-line piping, A-D-emergency feedwater line ~~A(B,C,D)~~ piping, Minimum/Full flow line piping)~~]~~	RAW(L1, L2, LP) SM	EL, SS	
14	T/D EFW pump steam supply line piping ~~[TBD]~~	RAW(L1, L2) LP / SM	EL, SS	

Table 17.4-1 Risk-significant SSCs (sheet 15 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
15	Emergency feedwater pits ~~[EFS-RPT-001A(B)]~~[EFS-MPT-001A (B)]	RAW(L1, L2, FL1, FR1, FR2) LP/SM	EL, SS	The "Insights and Assumptions" for these SSCs are described on the previous page.
16	Minimum/Full flow line manual valves [EFS-VLV-026A (B)]	RAW(L1, L2, FL1, FR1, FR2) LP	EL	
17	EFW pump suction line manual valves [EFS-VLV-009A (B, C, D)]	RAW(L1, L2, FL1, FR1, FR2) LP	EL, PR	
18	EFW pump discharge line manual valves [EFS-VLV-013A (B, C, D)]	RAW(L1, L2, FL1, FR1, FR2) LP	EL, PR	
19	EFW pit discharge line manual valves [EFS-VLV-007A (B)]	RAW(L1, L2, FL1, FL2, FR1, FR2)	CD, EL, PR	
20	Secondary demineralizer water tank discharge line manual valves [EFS-VLV-006A (B)]	RAW(L1, L2, FL1, FL2, FR1, FR2) LP	EL, OD,PR	
21	Secondary demineralizer water tank discharge line check valve [EFS-VLV-005]	RAW(L1, L2, FL1)	EL, OD,PR	
22	Secondary demineralizer water tank discharge line manual valve [EFS-VLV-004]	FV(FL1) RAW(FL1, FL2)	EL, OD,PR	
23	Turbine driven pump steam supply line check valves [EFS-VLV-102A (B, C, D)]	SM	FS	

Table 17.4-1 Risk-significant SSCs (sheet 16 of 51)

#	Systems, Structures and Components (SSCs)	Rationale(1)	Failure Mode(2)	Insights and Assumptions
24	Emergency feedwater pump actuation cabinets	SM	FS	The "Insights and Assumptions" for these SSCs are described on the previous page.
25	Turbine driven pump steam supply line motor-operated valves [EFS-MOV-101A (B, C, D)]	EJ	CM, EL, PR	

Table 17.4-1 Risk-significant SSCs (sheet 17 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
7	Emergency power source (EPS)			
1	Class 1E 480V motor control centers (MCC) [MCC-A (B, C, D)], [MCC-A1 (D1)]	RAW(L1, L2, LP, FL1, FR1, FL2, FR2) LP SM	FF,SS	The EPS consists of four separate trains. Each safety train consists of one 6.9kV AC medium voltage bus and 480V AC low voltage buses (Load Centers, Motor Control Centers). Each AC medium voltage bus connects to class 1E gas turbine generator. This system supports various safety mitigation systems and therefore, reliability of the EPS system has significant impact on risk. Since the EPS consists of four separate trains, single failure in trains not significantly impact risk. However, failure of multiple trains is have significant impact on risk. Accordingly, SSCs that have potential to cause common cause failures among multiple trains are risk significant
2	Class 1E 480V load centers [LC-A (B, C, D)], [LC-A1 (D1)]	RAW(L1, L2, LP, FL1, FR1, FL2, FR2) LP SM	FF,SS	
3	Class 1E 6.9kV switchgears [MC-A (B, C, D)]	RAW(L1, L2, LP, FL1, FR1, FL2, FR2)/EJ/LP SM	FF, SS	
4	Class 1E DC switchboards [DCC-A (B, C, D)], [DCC-A1 (D1)]	RAW (L1, L2, LP, FL1, FR1, FL2, FR2)	FF	
5	Class 1E AC120V panelboards [IBD-A (B, C, D)]	RAW(L2, FL1, FR1, FL2, FR2) SM	FF, FS	
6	Circuit breakers between Class 1E 480V load centers A, B (C, D) and A1(D1) [52/LLAA, LLBB, LLDA, LLBA] [52/LLBC, LLAD, LLBD, LLDD] ~~[52/LLAA (BB, CC, DD)]~~ ~~[52/LLDA (BA, BD, DD)]~~	RAW(L1-CCF, L2, L2-, /CC, /LP-CCF)	SO	
7	Class 1E Batteries [BAT-A (B, C, D)]	RAW(L1-CC, L2-CC, LP-CC ,FL1, FL1-CC, FR1, FR1-CC, FL2, FL2-CC, FR2, FR2-CC) LP	FF, SO	
8	Class 1E Battery chargers [BCP-A (B, C, D)]	RAW(FL1) SM	FF, WR, SS	

Table 17.4-1 Risk-significant SSCs (sheet 18 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
9	Class 1E 6.9kV bus incoming circuit breakers from reserve auxiliary transformer [52/RATA (B, C, D)]	FV(L1-CC, L2-CC, LP-SUM,) RAW(L1, L1-/CC, L2, L2-CC,/LP, LP-CC)	SC, FO	The "Insights and Assumptions" for these SSCs are described on the previous page.
10	Class 1E Gas turbine discharge circuit breakers [52/EPSA (B, C, D)]	FV(L1-SUM,FR) RAW(L1-CC, L2, L2-CC, LP, LP-CC)	FC, FO, SC, SO	
11	Circuit breakers between Class 1E 6.9kV ~~bus~~ switchgear and Class 1E station service transformers [52/STHA (B, C, D)]	RAW(L1, L1-CC, L2, L2-CC, LP, LP-CC)	SO	
12	Circuit breakers between Class 1E 480V load center and MCC [52/LCA (B, C, D)]	FV(L2-CC) RAW(L1, L1-CC,L2, L2-CC, LP, /LP-CC)	SO	
13	Circuit breakers between DC switchboard and MOV Inverter [72/DUA1 (DUB, DUC, DUD1)]	RAW(L2-CC) CC/ LP	SO	
14	Circuit breakers between Class 1E 480V MCC and battery chargers [52/DCA (B, C, D)]	RAW(FL1)	WR	
15	Class 1E gas turbine generators [A (B, C, D)-EGTG]	FV(L1,L1-CC, L2, L2-CC, LP, LP-CC, FL1,FR1, FR1-CC, FL2, FR2, FR2-CC,) RAW(L1-CC, L2-CC, LP-CC, FL1-CC, FR1-CC, FL2, FL2-CC, FR2-CC) LP	AD, LR, SR	
16	Class 1E gas turbines generator sequencers [EPBA (B, C, D)]	FV(L1-CC, L2-SUM, FR1) RAW(FL1-CC, FR1, FR1-CC, FL2, FL2-CC, FR2-CC) LP	FF	

Table 17.4-1 Risk-significant SSCs (sheet 19 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
17	~~Class 1E~~ MOV Inverters [MVIA1, MVIA2, MVIB, MVIC, MVID1, MVID2] ~~[MVIA1(A2)], [MVIB(C)], [MVID1(D2)]~~	RAW(L1-CC, L2-CCFL1, FL1-CC, FL2, FL2-CC, FR1-CC ,FR2-CC)/ ,LP / SM	FF	The "Insights and Assumptions" for these SSCs are described on the previous page.
18	Main transformers [MT]	RAW(L2, FL1, FL2)	FF	
19	Reserve auxiliary transformer 3 and 4 [RAT3(4)]	RAW(L2, FL1, FL2)	FF	
20	Class 1E station service transformers [STA (B, C, D)]	RAW(FL1, FR1, FL1, FL2), LP	FF	
21	Circuit breakers between AAC and ~~class~~ Class 1E 6.9kV ~~bus~~ switchgear [52/AACA (B, C, D)]	RAW(L1, L2, L2-CC, LP, LP-CC)	FC, SO	
22	Circuit breakers between ~~class~~ Class 1E 480V load center A1 (D1) and MCC A1 (D1) [52/LCA1 (D1)]	RAW(L1, L2, L2-CC,, LP-CC)	SO	
23	Circuit breakers between ~~class~~ Class 1E 480V load center and ~~class~~ Class 1E station service transformer [52/STLA (B, C, D)]	FV(L2-CCF) RAW()L1, L1-CC, L2, L2-CC,LP, LP-CC)	SO	
24	Circuit breakers between Class 1E UPS unit and ~~I&C~~Class 1E AC 120V panelboard [52/UAA (B, C,D)]	RAW()L1-CC, L2-CC, LP-CC)	SO	
25	Circuit breakers between unit auxiliary transformer and Class 1E 6.9kV ~~bus~~switchgear [52/UATA (B, C, D)]	FV(L1-CC, L2-CC, LP-SUM) RAW()L1, L1-CC, L2, L2-CC,LP, LP-CC)	FO,SC	

Table 17.4-1 Risk-significant SSCs (sheet 20 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
26	Circuit breakers between Class 1E DC switchboard and Class 1E UPS unit [72/AUA (B, C, D)]	RAW()L1-CC, L2-CC, LP-CC)	SO	The "Insights and Assumptions" for these SSCs are described on the previous page.
27	Circuit breakers between Class 1E battery and Class 1E DC switchboard [72/DBA (B, C, D)]	RAW()L1-CC, L2-CC, LP-CC)	SO	
28	Circuit breakers between Class 1E DC switchboards and DC Switchboard A1 (D1) [72/DDAA (DDBB, DDBC, DDAD)] [72/DDDA (DDBA, DDBD, DDDD)]	RAW()L1-CC, L2-CC, LP-CC)	SO	
29	Class 1E UPS Units [IBC-A (B, C, D)]	RAW(L1-CC, L2-CC, LP-CC) SM	FF	
30	Class 1E Gas turbine generators control centers ~~[EPCC-A (B, C, D)]~~	SM	FS, SS	
31	Class 1E I&C power transformers [IBB-A (B, C, D)]	SM	SS	
32	Cable trays (~~used for~~ safety related SSCs)	SM	FS	

Table 17.4-1 Risk-significant SSCs (sheet 21 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
8	Alternative AC power sources (Permanent bus)			
1	Non-Class 1E gas turbine generators (AAC) [ACC-A(B)]	FV(FR1, FR2, FL2) RAW(FR1-CC, FR2-CC) LP	AD, SR, LR	Two non-safety buses called "Permanent bus", which is connected to Alternative AC (AAC), which consists of non-class 1E gas turbine generators respectively. Each non-class 1E gas turbine generators is manually connected to two safety medium voltage buses via selector circuit under the occurrence of loss of safety AC power. The AAC is a countermeasure against station blackout events. SSCs that have potential to cause failures that degrade the availability to supply AAC power to safety medium voltage are risk significant. Systems for the mitigation of core damage accident are connected to permanent bus.
2	P1, P2 Non-Class 1E 480V load centers [LC-P1 (P2)]	RAW(L2)	FF	
3	P1, P2 Non-Class 1E 6.9kV switchgears [MC-P1 (P2)]	RAW(L2)	FF	
4	Circuit breakers between P1 (P2) Non-Class 1E 6.9kV ~~bus~~ switchgear and station service transformer [52/STHP1 (2)]	RAW(L2, L2-CC, FL1, FR1, FR2)	SO, WR	
5	N1, N2 Non-Class 1E batteries [BAT-N1(N2)]	RAW(FR1-CC) LP	FF,	
6	Circuit breakers between Non-class 1E gas turbine generator (AAC) and P1 (P2) Non-Class 1E 6.9kV ~~bus~~switchgear [52/AACP1 (2)]	RAW(FR1-CCF, FR2-CC) LP	TD	
7	Circuit breakers between Non-Class 1E gas turbine generator (AAC) and selector switch [52/AACAP (52/AACBP)]	RAW(L1-CC, L2-CC,LP-CC, FR1-CC,FR2-CC) LP	FC, SO	
8	Non-Class 1E gas turbine generators (AAC) sequencers [AAS-A (B)]	FV(L2, LP) RAW(L1-CC, L2, L2-CC, LP, LP-CC)	FF	
9	P1, P2 Non-Class 1E station service transformers [STP1 (2)]	RAW(L2) LP	FF	

Table 17.4-1 Risk-significant SSCs (sheet 22 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
10	P11, P12, P21, P22 Non-Class 1E 480V MCC [MCC-P11 (P12, P21, P22)]	RAW(L2)	FF	The "Insights and Assumptions" for these SSCs are described on the previous page.
11	Circuit breakers between P1(P2) ~~non~~Non-Class 1E 480V load center and MCC [52/LCP11 (LCP12, LCP21, LCP22)]	RAW(L2, L2-CC)	SO	
12	Circuit breakers between P1(P2) ~~non~~Non-Class 1E 480V load center and ~~non~~Non-Class 1E station service transformer [52/STLP1 (LP2)]	RAW(L2, L2-CC)	SO	
13	AAC selector switches [89/AACA (B, C, D)]	RAW(L1, L2, L2-CC, LP, LP-CC)	FC, SO	

Table 17.4-1 Risk-significant SSCs (sheet 23 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
9	Non-essential chilled water system			
1	Non-essential chilled water system - CCWS boundary motor operated valves [VWS-MOV-424] [VWS-MOV-425]	FV(L2) RAW(L2)/LP	CM, EL, OD, PR	In the case of loss of component cooling water events, non-essential chilled water system or fire suppression system provides alternative component cooling water to charging pumps in order maintain RCP seal water injection. These SSCs are risk significant because large external leak from these valves result in loss of alternative component cooling water from both non-essential chilled water system and fire suppression system. On the other hand, failure of other SSCs of this system affects only the non-essential chilled water system itself.
2	Containment fan cooler unit supply line changeover valve [VWS-MOV-401] [VWS-MOV-409]	RAW(L2)	EL	
3	Containment fan cooler unit containment isolation valves [VWS-MOV-403] [VWS-MOV-407] [VWS-MOV-422]	FV(L2) RAW(L2)	CM,EL,OD,PR	
5	Containment fan cooler unit cooling coil inlet valve [VWS-MOV-411A (B,C,D)]	FV(L2) RAW(L2)	CM, EL, OD, PR	
6	CRDM cooling unit cooling coil inlet valve [VWS-MOV-414]	FV(L2) RAW(L2)	CD, EL, IL, OM	
7	Containment fan cooler unit line piping	RAW(L2)	EL	
8	Containment fan cooler unit outlet air operated valves [VWS-TCV-041A (B), 042A (B)]	RAW(L2)	CM, EL, PR	
9	Containment fan cooler unit outlet manual valves [VWS-VLV-412A (B,C,D)]	RAW(L2)	EL, PR	

Table 17.4-1 Risk-significant SSCs (sheet 24 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
10	Containment fan cooler unit bypass line valves [VWS-VLV-413A (B,C,D)]	RAW(L2)	EL	The "Insights and Assumptions" for these SSCs are described on the previous page.
11	CRDM cooling unit outlet valve [VWS-VLV-415]	RAW(L2)	EL	
12	Containment fan cooler unit supply line check valve [VWS-VLV-421]	RAW(L2)	EL, OD, PR	
13	Containment fan cooler unit return line check valve [VWS-VLV-423]	RAW(L2)	EL	

Table 17.4-1 Risk-significant SSCs (sheet 25 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
10	Fire suppression systems (FSS)			
1	FSS pump discharge motor operated valve~~[TBD]~~	FV(L2) RAW(L2)	EL, OD, PR	In the case of core damage accident, Fire Suppression Systems (FSS) injects water from Raw Water Tank into the reactor cavity via the direct injection line by the fire water pumps. The containment spray system and/or safety injection system perform the reactor cavity flooding through the drain line at loop compartment to prevent core-concrete interaction when the reactor vessel is failed. The Fire suppression system performs as alternative function for the reactor cavity flooding. In the case of loss of component cooling water events, fire suppression system or non-essential chilled water system provides alternative component cooling water to charging pumps in order maintain RCP seal water injection.
2	FSS pump discharge flow meter ~~[TBD]~~	RAW(L2)	FF, PR	
3	Reactor cavity injection line orifice ~~[TBD]~~	RAW(L2)	PR	
4	FSS piping ~~[TBD~~ (from tank to tie line piping, from tie line to CSS-VLV-012 piping, from FWT to tie line)~~]~~	RAW(L2)	EL	
5	~~Raw~~ Fire suppression water tank ~~[TBD]~~	RAW(L2)	EL	
6	FSS pump discharge manual valve ~~[TBD]~~	RAW(L2)	EL,PR	
7	Motor driven fire suppression pump	EP	BD, YR, EL	
8	Diesel driven fire suppression pump	EP	BD, YR, EL	
9	Reactor cavity injection line motor-operated valve [FSS-MOV-004]	EJ	EL, OD, PR	
10	Reactor cavity injection line check valve [FSS-VLV-006]	EJ	EL, OD, PR	
11	Reactor cavity injection line orifice	EJ	PR	

Table 17.4-1 Risk-significant SSCs (sheet 26 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
11	High head safety injection system			
1	Safety injection pump discharge check valves [SIS-VLV-004A (B, C, D)]	RAW(L1, L1-CC, L2, L2-CC, LP, LP-CC, FL1, FL1-CC, FR1, FR1-CC, FL2-CC, FR2, FR2-CC) SM	EL, OD, PR, FS	In the case of LOCA, high head safety injection system injects coolant from refueling water storage pit (RWSP) into the reactor vessel via the Direct Vessel Injection (DVI) line by the safety injection pumps. This system is also essential for bleed and feed operation. Since this system consists of four independent trains, failure of one train does not have significant impact on risk. However, failures of SSCs that impact multiple trains are risk significant. SSCs that have either of the following characteristics are risk significant. - SSCs that have potential to cause common cause failures among multiple trains. Common cause failure of such system will result in loss of multiple trains. - SSCs that have potential to cause loss of RWSP inventory out side the containment due to large external leaks. Loss of RWSP inventory impacts not only all four trains of high head safety injection system but also other systems that use RWSP as water source.
2	Safety injection pump outlet orifices [SIS-FE-062 (063, 064, 065)]	RAW(FL1)	PR	
3	Minimum flow line orifices [SIS-FE-072 (073, 074, 075)]	RAW(FL1)	PR	
4	Containment isolation check valves [SIS-VLV-010A (B, C, D)]	RAW(L1-CC, L2-CC, LP-CC, FL1, FL1-CC, FR1-CC, FL2-CC, FR2-CC) SM	OD, EL, PR, FS	
5	Containment isolation motor operated valves [SIS-MOV-011 A(B, C, D)]	RAW(FL1) FV(FL1)	FF, CM, EL, PR	
6	RV injection line orifices ~~(between SIS-VLV-012 A(B,C,D) and SIS-MOV-011 A(B,C,D))~~[SIS-SRO-001A (B, C, D)]	RAW(FL1)	PR	
7	Injection line secondary isolation check valves [SIS-VLV-012A (B,C,D)]	RAW(L1-CC, L2-CC, LP-CC, FL1, FL1-CC, FR1-CC, FL2-CC, FR2-CC)	OD,EL,PR	
8	Injection line boundary check valves [SIS-VLV-013A (B,C,D)]	RAW(L1-CC, L2-CC, LP-CC, FL1, FL1-CC, FR1-CC, FL2-CC, FR2-CC)	OD, EL, PR	
9	Safety injection pumps [SIS-MPP-001A (B,C,D)]	FV(L1-CC, FL1) RAW(L1, L1-CC, L2, L2-CC, LP, LP-CC, FL1, FL1-CC, FR1, FR1-CC, FL2, FL2-CC, FR2, FR2-CC) SM	AD, EL, LR, SR, FS, SS	

Table 17.4-1 Risk-significant SSCs (sheet 27 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
10	Containment isolation motor operated valves [SIS-MOV-009A (B,C,D)]	FV(FL1) RAW (L1, L2, LP, FL1, FR1, FR2)	CM, EL, FF, PR	The "Insights and Assumptions" for these SSCs are described on the previous page.
11	Safety injection pump suction Isolation valves [SIS-MOV-001A (B,C,D)]	FV(FL1) RAW(L1, L2, FL1, FR1, FR2, LP)	CM, EL, FF, PR	
12	Piping train A through D ~~[TBD (~~[Between ~~SIP~~ safety injection pump and SIS-MOV-001A (B, C, D), ~~SIP~~ Safety injection pump discharge Line out of CV, between RWSP and SIS-MOV-001A (B, C, D)]~~)]~~	RAW(L1, L2 ,LP) SM	EL, SS	
13	Minimum flow line orifices~~[TBD (next to SIS-VLV-023 A(B,C,D))]~~ [SIS-SRO-003A (B, C, D)]	RAW(FL1)	PR	
14	Minimum flow line ~~manual~~ motor operated valves [SIS-MOV-024A (B,C,D)]	RAW(FL1)	EL, IL	
15	Minimum flow line manual valves [SIS-VLV-023A (B,C,D)]	RAW(FL1)	EL, PR	
16	Hot leg recirculation line isolation valves [SIS-MOV-014A (B,C,D)]	RAW(FL1)	EL, IL, OM	

Table 17.4-1 Risk-significant SSCs (sheet 28 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
12	Heating, ventilation, and air conditioning (HVAC) system			
1	B,C-Emergency feedwater pump room fans ~~[VRS-RFN-401B,C]~~[VRS-MFN-401B, C]	FV(FL1, FR2) RAW(FL1, FL1-CC, FR1, FR1-CC, FR2, FR2-CC), LP	AD, LR, SR	EFW M/D pump room fans maintain room temperature when pumps are running. EFW M/D pumps are assumed to be unavailable within the mission time without room cooling due to high room temperature. HVAC systems of other rooms are considered not to be risk significant for the following reasons. - HVAC of emergency gas turbine room Gas turbine units itself has function to intake outer air to remove heat out to atmosphere. Accordingly, HVAC is considered not essential to maintain gas turbine function. - HVAC of ESF room (RHR/CSS pump, SI pump) According to room temperature analysis, room temperature will not exceeds limit of the system during the mission time regardless of availability of HVAC. - HVAC of class1E electric power room (Class 1E I&C, switch gear, battery, battery charger) This system is running during normal operation and continues to run after initiating events. Reliability of normally operating HVAC systems are considered to be high and failure of this system is unlikely to occur during the mission time. - HVAC of EFW T/D pump room Since T/D driven EFW pump room can operate under high room temperature conditions, they are assumed to be available regardless of room cooling during the mission time.
2	B,C-Emergency feedwater pump air handling units ~~[VRS-RAH-401B,C]~~[VRS-MAH-401B, C]	RAW(L1-CC, L2-CC)	AD, LR, SR	

Table 17.4-1 Risk-significant SSCs (sheet 29 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
13	Containment fan cooler system			
1	Containment fan cooler units ~~[VCS-CAH-001A (B,C,D)]~~[VCS-MAH-001A (B, C, D)]	EP RAW(L2)	EL, PR	Temperature control of Containment Vessel atmosphere is judged important by experts from a point of view of keeping function of safety components in Containment Vessel.
14	Main control room HVAC system			
1	Main control room air handling units ~~[VRS-RAH-101A (B,C,D)]~~[VRS-MAH-101A (B, C, D)]	EP	FC	Temperature control of main control room atmosphere is judged important by experts from the viewpoint of operator habitability during an accident.
2	Air conditioner ducts ~~[TBD]~~	SM	SS	

Table 17.4-1 Risk-significant SSCs (sheet 30 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
15	Instrumentation and control (I&C) system			
1	Permanent bus low voltage signal software	RAW/CC	FF	This software provides start signal to non-class 1E gas turbine generator. Under SBO, This software must operate in order to backup of the safety bus by AAC power source. SSCs that have potential to cause common cause failure of signals are risk significant since such failure may result in loss of total system function. EFW T/D pump start signals are risk significant since such failure results in loss of one of two available EFW pumps under, SBO and loss of EFW room cooling conditions. Reliability of signals other than "S signal" is assumed to have same reliability with "P signal".
2	Black out signal software	RAW(FR1-CC, FR2-CC)	FF	
3	Containment pressure sensors (Safety related) ~~[TBD]~~ [CSS-PT-010 (011, 012, 013)]	RAW(L2)/CC(L2) RAW(L1-CC, L2-CC)	FF	
4	Steam generator water level sensors (Narrow range) ~~[TBD]~~ [FWS-LT-510 (511, 512, 513, 520, 521, 522, 523, 530, 531, 532, 533, 540, 541, 542, 543)]	EJ*3 FV(L2) RAW(L1, L1-CC, L2, L2-CC)	FF	
5	CCW pump breaker position sensing device	EJ*3	FF	
6	Reactor protection system	EJ*3 FV(FL1-CC, FL2-CC, LP, LP-CC) RAW(FL1-CC, FL2-CC, LP-CC) SM	FF, SF, HF, FS	
7	Engineered Safety Features Actuation System	EJ*3 FV(FL1-CC, FL2-CC, LP, LP-CC) RAW(FL1-CC, FL2-CC, LP-CC) SM	FF, SF, HF, FS	
8	Safety Logic System	EJ*3 FV(FL1-CC, FL2-CC, LP, LP-CC) RAW(FL1-CC, FL2-CC, LP-CC) SM	FF, SF, HF, FS	

Table 17.4-1 Risk-significant SSCs (sheet 31 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
9	CCW supply header pressure sensor [NCS-PT-030 (031, 032, 033)]	RAW(LP-CC)	FF	The "Insights and Assumptions" for these SSCs are described on the previous page.
10	Pressurizer pressure sensor [RCS-PT-061 (062, 063, 064)]	RAW(L1-CC, L2-CC)	FF	
11	CS/RHR header pressure sensor [RHS-PT-011 (021, 031, 041)]	RAW(LP-CC)	FF	
12	Volume control tank water level sensor [CVS-LT-030 (031)]	RAW(LP-CC)	FF	
13	RWSP water level sensor [RWS-LT-010 (011, 012, 013)]	RAW(LP-CC)	FF	
14	RWSAT water level sensor [RWS-LT-020]	RAW(LP-CC)	FF	
15	RCS mid-loop water level sensor (Narrow range) [RCS-LT-014 (015)]	RAW(LP-CC)	FF	
16	RCS mid-loop water level sensor (Middle range) [RCS-LT-012]	RAW(LP-CC)	FF	
17	Containment pressure sensor (non-safety related) [CSS-PT-014]	RAW(L1,L2)	FF	
18	B-CCW surge tank water pressure transmitter ~~[NCS-PCA-022]~~[NCS-PT-022 (023)]	RAW(L2)	FF	
19	EFW pit water level transmitters [EFS-LT-060 (061, 070, 071)]	EJ*2	FF	

Table 17.4-1 Risk-significant SSCs (sheet 32 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
20	Ventilation chiller control cabinets	SM	FS	
21	Diverse actuation system	EJ FV(L1, L2) RAW(L1, L2)	FF	The unreliability of this system is assumed to be 0.01.
22	Reactor coolant Hot leg temperature sensor (Wide range) [RCS-TE-020 (030, 040, 050)]	EJ	FF	These sensors are necessary to perform operator action.
23	Reactor coolant cold leg temperature sensor (Wide range) [RCS-TE-025 (035, 045, 055)]	EJ	FF	
24	Reactor coolant pressure sensor [RCS-PT-020 (030, 040, 050)]	EJ	FF	
25	Pressurizer water level sensor [RCS-LT-061 (062, 063, 064, 065)]	EJ	FF	
26	RCS mid-loop water level sensor (~~Narrow~~ Wide range) [RCS-LT-011]]	EJ	FF	
27	Boric acid transfer tank water level transmitter [CVS-LT-116, 118]	EJ	FF	

Table 17.4-1 Risk-significant SSCs (sheet 33 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
16	Waste management system (WMS)			
1	Refueling water storage (RWS) system – WMS line boundary check valve [LMS-VLV-037]	RAW(L1, L2, FL1)	EL	Large External leak of the boundary check valve results in loss of inventory from the RWS system. Systems that relies on the RWS as water source is affected by this failure mode.
17	Main feedwater system (MFWS)			
1	Main feedwater system ~~[TBD]~~	FV(L1)	SR	The Main feedwater system is credited as a function to secondary side cooling during general transients, which does not involve loss of main feedwater.
2	Main feedwater isolation check valves [FWS-VLV-511A (B, C, D)]	SM	FS	
3	Main feedwater isolation valves [FWS-SMV-512A (B, C, D)]	SM	FS	

Table 17.4-1 Risk-significant SSCs (sheet 34 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
18	Main steam supply system (MSS)			
1	Main steam isolation valves [MSS-SMV-515A (B,C,D)]	FV(L1-SUM ,FR1-CC, FR2-CC) RAW(L1-CC, L2, L2-CC, FL1, FL1-CC, FR1, FR1-CC, FR2, FR2-CC)	CD, IL, OM	Main steam isolation valve isolates the ruptured Steam Generator (SG) at the Steam Generator Tube Rupture (SGTR). In case of secondary line break, main steam isolation is required to prevent unlimited steam release. Main steam line piping is required to be intact to isolate the ruptured SG at SGTR events. Main steam safety valves are designed to have different actuation pressure and relieving capacity.
2	Main steam bypass isolation valves [MSS-HCV-565 (575, 585,595)]	FV(FR2) RAW(L2, FR1, FR2)	IL, OM	
3	Main steam line piping	RAW(L1, L2) SM	EL, SS	
4	Main steam line isolation check valves [MSS-VLV-516A(B, C, D)]	RAW(FL1)	CD, IL	
5	-Main steam safety valves ~~[MSS -VLV-509A (B,C,D)]~~ ~~[MSS -VLV-510A (B,C,D)]~~[MSS-SRV-509A (B, C, D)] [MSS-SRV-510A (B, C, D)] [MSS-SRV-511A (B, C, D)] [MSS-SRV-512A (B, C, D)] [MSS-SRV-513A (B, C, D)] [MSS-SRV-514A (B, C, D)]	RAW(L1, L2)	CD, OM	
6	A,B,C,D,E,F,G,H,J,K,L,M,N,P,Q-Turbine bypass valves [MSS-TCV-550A (B,C,D,E,F,G,H,J,K, L,M,N, P,Q)]	FV(L2-SUM) RAW(L2)	CD	

Table 17.4-1 Risk-significant SSCs (sheet 35 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
7	Main steam relief valve isolation valves [MSS -MOV-507A (B,C,D)]	RAW(L2)	~~CF~~CD	
8	Main steam depressurization valves [MSS -MOV-508A (B,C,D)]	RAW(L2-CC) LP	OD	
9	Main steam relief valves [MSS-PCV-~~465~~ 515 (~~475~~525,~~485~~535,~~495~~545)]	RAW(L2-CC)	OD	

Table 17.4-1 Risk-significant SSCs (sheet 36 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
19	Pressurizer pressure control system part of emergency core cooling system (ECCS)			
1	Safety depressurization valves [RCS-MOV-117A (B)]	FV(FL1, FR1-CC, FR2, FR2-CC) RAW(L1-CC, L2-CC, FL1, FL1-CC, FR1, FR1-CC, FL2, FL2-CC, FR2, FR2-CC,)	OD	Safety Depressurization Valves (SDVs) are required to open during bleed and feed operation. Pressurizer safety valves releases RCS pressure in case of high RCS pressure. Failure of safety valves to re-close results in loss of primary coolant.
2	Safety depressurization valves [RCS-MOV-116A (B)]	RAW(FL1, FL2, FR1, FR2)	CM, PR	
3	Pressurizer safety valves ~~[RCS-VLV-120]~~[RCS-SRV-120] ~~[RCS-VLV-121]~~[RCS-SRV-121] ~~[RCS-VLV-122]~~[RCS-SRV-122] ~~[RCS-VLV-123]~~[RCS-SRV-123]	RAW(L1, L2, FL1, FL2, FR1, FR2) SM	CD, FS	
4	Pressurizer [RCS-MTK-002]	SM	SS	
5	Pressurizer piping ~~[TBD~~ (Pressurizer safety valve piping, Pressurizer safety depressurization valve piping, Pressurizer spray piping)~~]~~	SM	SS	
6	Pressurizer spray line vent valve [RCS-VLV-153]	EJ	FC, IL, EL	
20	Depressurization system for severe accident			
1	Depressurization valves [RCS-MOV-118] [RCS-MOV-119]	FV(L2)	FC	In the case of core damage accident, depressurization of the reactor coolant system is required to prevent high pressure melt ejection and direct containment heating.

Table 17.4-1 Risk-significant SSCs (sheet 37 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
21	Containment spray / residual heat removal (CS/RHR) system			
1	Heat exchanger bypass valves [RHS-FCV-021] [RHS-FCV-031]	RAW(L1, L2, LP, FL1)	EL	The Containment Spray / Residual Heat Removal (CS/RHR) System consists of four independent trains. The CS/RHR System has the following three functions. a. Containment Spray b. Alternative Core Cooling c. RHR Operation during operating modes 4 , 5 and 6.. Since CS/RHR system consists of four independent trains, failure of one train does not have significant impact on risk. However, failures of SSCs that impact multiple trains are risk significant. SSCs that have either of the following characteristics are risk significant. - SSCs that have potential to cause common cause failures among multiple trains. Common cause failure of such system will result in loss of multiple trains. - SSCs that have potential to cause loss of RWSP inventory out side the containment due to large external leaks. Loss of RWSP inventory impacts not only all four trains of CS/RHR system but also other systems that use RWSP as water source.
2	RHR line heat exchanger discharge air operated valves [RHS-HCV-023] [RHS-HCV-033]	RAW(L1, L2, LP, FL1)	EL	
3	Pump suction line check valves [RHS-VLV-004A (B, C, D)]	RAW(L1, L1-CC, L2, L2-CC/, LP, LP-CC, FL1, FL1-CC, FR1, FR1-CC, FL2, FL2-CC, FR2,FR2-CC)	EL,OD,PR	
4	RHR line containment isolation check valves [RHS-VLV-022A (B, C, D)]	RAW(LP, LP-CC)	OD,PR	
5	RHR line containment isolation motor operated valves [RHS-MOV-021A (B, C, D)]	RAW(L1, L2, LP, FL1, FR1)	EL, OD, CM	
6	Containment spray/residual heat removal pumps [RHS-MPP-001A (B,C,D)]	FV(L2-CC, FL1, FL2, FR2) RAW(L1, L1-CC, L2, L2-CC, LP, LP-CC, FL1, FL1-CC, FR1, FR1-CC, FL2, FL2-CC, FR2, FR2-CC) SM	AD, LR, SR, EL, SS, FS	
7	CS/RHR pump outlet orifices [RHS-FE-011 (021, 031, 041)]	RAW(L2)	PR	
8	Containment spray/residual heat removal heat exchangers [RHS-MHX-001A (B, C, D)]	FV(L2-CC, FLOOD) RAW(L1, L1-CC, L2, L2-CC, LP, LP-CC, FL1,FL1-CC,FR1,FR1-CC,FL2,FL2-CC,FR2,FR2-CC) SM	PR, EL, SS	
9	RHR line boundary check valves [RHS-VLV-028A (B, C, D)]	RAW(L1, LP,LP-CC)	OD, PR	
10	RWSP discharge line isolation valves [CSS-MOV-001A (B, C, D)]	RAW(L1,L2,LP,FL1,FR1 ,FL2,FR2)	EL, CM, PR	

Table 17.4-1 Risk-significant SSCs (sheet 38 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
11	CS line containment isolation motor operated valves [CSS-MOV-004A (B, C, D)]	FV(L2-SUM, FL1, FL2, FL2-CC, FR2, FR2-CC,) RAW(L1,L1-CF,L2,L2-CC,LP)	OD, CM, EL, FC, PR	The "Insights and Assumptions" for these SSCs are described on the previous page.
12	CS line check valves [CSS-VLV-005A (B, C, D)]	RAW(L1, L2, L2-CC, FL1, FL1-CC, FR1-CC, FL2, FL2-CC, FR2, FR2-CC)	OD, PR	
13	Piping ~~[TBD~~ (between RWST and CSS-MOV-001A (B, C, D), between RHS-MOV-034A (D) and CS/RHR Pump, between RHS-VLV-031A (D) and alternate core cooling, ~~RHS-FCV-611~~RHS-FCV-021 (031) line, between CSS-MOV-001A (B, C, D) and A (B, C, D)-CS/RHR pump, A (B, C, D)-CS/RHR pump line, A (B, C, D)-CS/RHR pump line, alternate core cooling line A (B, C, D) (outside C/V) piping, Containment spray nozzles)~~]~~	RAW(L1,LP) SM	EL, SS	
14	CS line heat exchanger discharge manual valves [CSS-VLV-002A (B, C, D)]	RAW(L1, L2, LP, FL1, FR1, FL2, FR2)	EL, PR	
15	Minimum flow line manual valves [RHS-VLV-013A (B, C, D)]	RAW(L1, L2, LP, FL1, FR1, FL2, FR2)	EL, PR	
16	Minimum flow line orifices ~~(next to RHS-VLV-013A (B, C, D))~~[RHS-SRO-001A (B, C, D)]	RAW(FL1, FL2, FR2)	PR	
17	Minimum flow line orifices [RHS-FE-014 (024, 034, 044)]	RAW(FL1, FL2)	PR	
18	CS/RHR - spent fuel pit boundary manual valves (discharge line) [RHS-VLV-031A (D)]	RAW(L1, L2, LP)	EL	

Table 17.4-1 Risk-significant SSCs (sheet 39 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
19	From FSS to CSS tie line check valve [CSS-VLV-012]	RAW(L1,L2,LP)	EL,O D, PR	These valves are required to open to perform firewater injection from FSS to the spray header.
20	From FSS to CSS tie line motor operated valve [CSS-MOV-011]	RAW(L2)	EL, OD, PR	
21	CS/RHR - spent fuel pit boundary manual valves (suction line) [RHS-VLV-034A (D)]	RAW(L1, L2, LP, FL1, FR1, FR2)	EL, OD	These valves are required to open to perform gravitational injection from the spent fuel pit to the RCS when RCS is atmospheric pressure at LPSD operation.
22	CS/RHR - spent fuel pit boundary manual valves (suction line) [RHS-VLV-033A (D)]	RAW(LP, FL1, FR1, FR2)	EL, OD	
23	CS/RHR pump hot leg suction isolation valves [RHS-MOV-001A (B, C, D)] [RHS-MOV-002A (B, C, D)]	RAW(LP)	CM, OD, PR	
24	RCS cold leg injection line motor operated valves [RHS-MOV-026A (B, C, D)]	RAW(LP)	CM, OD	
25	RCS cold leg injection line check valves [RHS-VLV-027A (B, C, D)]	RAW(LP,LP-CC)	OD, PR	
26	Low-pressure letdown line isolation valves [RHS-AOV-024B (C)]	FV(LP) RAW(LP)	CD, OM	
27	CS/RHR pump full-flow test line stop valves [RHS-MOV-025A (B, C, D)]	RAW(LP)	OM	
28	RHR line safety valves [RHS-SRV-003A (B, C, D)]	RAW(LP)	OM	

Table 17.4-1 Risk-significant SSCs (sheet 40 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
22	Refueling water storage system (RWS)			
1	Refueling water storage pit (RWSP) sump strainers ~~[SIS-CSR-001A (B, C,D)]~~[SIS-SST-001A (B, C, D)]	FV(L1-CC, L2-CC, LP-CC, FL2-CC, FL2) RAW (L1, L1-CC, L2, L2-CC, LP-CC, FL1, FL1-CC, FR1-CC, FL2, FL2-CC, FR2, FR2-CC) SM	PR, SS	The RWSP is the source of borated water for containment spray and safety injection. During LPSD operation, RWSS has the following functions. a. Refill refueling water strage auxiliary tank (RWAT) for RCS injection via charging pumps. b. Refill SFP for gravitational injection to RCS. SSCs that have either of the following characteristics are risk significant. - SSCs that have potential to cause common cause failures among multiple trains. Sump strainers have potential of sump screen, which may occur in multiple trains. - SSCs that have potential to cause resulting loss of RWSP inventory out side the containment due to large external leaks are risk significant, since such failure impacts all systems that use RWSP as water source. SSCs that have potential to cause failure to supply RWSP water to RWAT or SFP during LPSD operation are also considered risk significant.
2	Refueling water storage pit ~~[RWS-CPT-001]~~[RWS-MCP-001]	RAW(I1, L2, LP, FL1, FR1, FL2, FR2)	EL	
3	Refueling water recirculation pump suction line manual valves [RWS-VLV-006A (B)]	RAW(I1, L2, LP, FL1)	EL	
4	Refueling water recirculation pump discharge line check valves [RWS-VLV-012A (B)]	RAW(L1, L2, LP, FL1)	EL	
5	Refueling water recirculation pump discharge line manual valves [RWS-VLV-013A (B)]	RAW(L1, L2, LP, FL1)	EL	
6	RWSP discharge line containment isolation motor operated valves [RWS-MOV-002] [RWS-MOV-004]	RAW(I1, L2, LP)	EL, CM, PR	
7	Refueling water recirculation pumps [RWS-MPP-001A (B)]	RAW(I1, L2 ,LP, LP-CC, FL1, FL2, FR1)	EL, AD, LR, SR	
8	RWSP discharge line manual valve [RWS-VLV-001]	RAW(I1, L2, LP)	EL, PR	
9	Refueling water recirculation pump suction cross tie line manual valve [RWS-VLV-005]	RAW(I1, L2, LP, FL1)	EL	

Table 17.4-1 Risk-significant SSCs (sheet 41 of 51)

#	Systems, Structures and Components (SSCs)	Rationale(1)	Failure Mode(2)	Insights and Assumptions
10	Refueling water recirculation pump discharge cross tie line manual valve [RWS-VLV-014]	RAW(I1, L2, LP, FL1)	EL	The "Insights and Assumptions" for these SSCs are described on the previous page.
11	Refueling water storage auxiliary tank [RWS-MTK-002]	RAW(L1, L2, LP)	EL	
12	Refueling water storage auxiliary tank inlet line manual valve [RWS-VLV-052]	RAW(LP)	EL, OD, PR	
13	Refueling water storage auxiliary tank discharge line manual valve [RWS-VLV-101]	RAW(I1, L2, LP, FL1)	EL	
14	Refueling water storage auxiliary tank suction line manual valves [RWS-VLV-021], [RWS-VLV-051]	RAW(I1, L2, LP, FL1)	EL,OD,PR	
15	Refueling water storage auxiliary tank line orifice ~~[TBD : downstream side of VLV-021]~~	RAW(LP)	EL	
16	RWSP suction line containment isolation air operated valve [RWS-AOV-022]	LP	EL, CD, OM	
17	RWSP return line check valve [RWS-VLV-023]	RAW(I1, L2, LP)	EL	
18	RWSP Return Line Manual Valve [RWS-VLV-024]	RAW(I1, L2, LP)	EL	
19	Piping ~~[TBD~~ (between RWSP and RWS-VLV-023 ,between RWSP and RWS-MOV -002, between RWS-MOV-002 and RWS-MOV -004 ,between RWS-MOV -004 and RWSAT ,between RWS-VLV-021 and RWSAT)~~]~~	RAW(I1, L2, LP)	EL	

Table 17.4-1 Risk-significant SSCs (sheet 42 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
23	Reactor trip system (RTS)			
1	Reactor trip breakers ~~[TBD]~~	RAW(L1-CC, L2-CC)	FF	These systems are necessary to provide negative reactivity for plan t trip.
2	Control rods ~~[TBD]~~	FV(L1) RAW(L1,L2)	~~CF,~~ FS, FR	
3	Control rod drive mechanism	RAW(L1, L2) SM	~~CF,~~ FS	
4	Fuel assembly (Reactor internals and core assembly)	SM	FS	
24	Chilled water system (VWS)			
1	Essential chiller units ~~[VWS-PEQ-001B(C)]~~[VWS-MEQ-001B (C)]	FV(L1) RAW(L1-CC, L2-CC) LP SM	YR, BD, SS, FS	The safety related water system supplies chilled water to safety related HVAC systems. SSCs that have potential to cause common cause failures among trains B and C are risk significant since such failures results in loss room cooling in M/D EWF pump area. SSCs that compose train A and D are not risk significant because the PRA assumes only the M/D EFW pumps to be dependent on room cooling during the mission time.
2	Essential chilled water pumps ~~[VWS-PPP-001B(C)]~~[VWS-MPP-001B (C)]	RAW(L1-CC) LP	YR	
3	Essential chilled water compression tanks ~~[VWS-PTK-001B(C)]~~ [VWS-MTK-001B (C)]	SM	FS	
4	HVAC chiller system piping	SM	FS	
5	Essential chilled water pump discharge line check valves [VWS-VLV-005B (C)]	EJ	OD	

Table 17.4-1 Risk-significant SSCs (sheet 43 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
25	Essential service water system (ESWS)			
1	EWS pump discharge line check valves [EWS-VLV-502A (B,C,D)]	RAW(L1, L1-CC, L2,L2-CC, LP ,LP-CC, FL1, FL1-CC, FR1, FR1-CC, FL2, FR2, FR2-CC,)	EL,PR,OD	The essential service water system (ESWS) transfers heat from the CCW system as Ultimate Heat Sink (UHS). This system supports the CCW system, which supports various safety and non-safety mitigation systems. Accordingly, reliability of CCWS EFW system has significant impact on risk. Since ESWS consists of four independent trains, failure of one train does not have significant impact on risk. However, failures of SSCs that impact multiple trains have risk-significant impact on risk. Accordingly, SSCs that have potential to cause common cause failures among multiple trains are risk significant.
2	Essential service water pump motor cooling line check valves [EWS-VLV-602A (B,C,D)]	RAW(L1, L1-CC, L2,L2-CC, LP , LP-CC, FL1, FL1-CC, FR1, FR1-CC, FL2, FR2, FR2-CC)	EL, PR, OD	
3	Essential service water pumps [EWS-MPP-001A (B,C,D)]	FV(L1-CC, L2-CC, LP-CC, FL1, FR1,-CC, FL2, FR2, FR2-CC) RAW(L1, L1-CC, L2, L2-CC, LP, LP-CC, FL1, FL1-CC, FR1, FR1-CC, FL2, FL2-CC,FR2, FR2-CC) SM	BD, YR, EL, SS, FS	
4	CCW heat exchanger inlet strainers ~~[TBD :between VLV-511A (B,C,D) and -514A (B,C,D)]~~[EWS-SST-003A (B, C, D)]	RAW(L1, L2, LP, FL1, FR1, FL2) LP	PR	
5	Essential service water pump outlet strainers ~~[TBD:~~ [EWS-SST-001A (B,C,D)]~~:between EWS-VLV-506A(B,C,D) and -508A(B,C,D)]~~ ~~[TBD:~~ [EWS-SST-002A(B,C,D)]~~:between EWS-VLV-507A(B,C,D) and -509A(B,C,D)]~~	RAW(L1, L2, LP, L1, R2, L2)	PR	
6	Valves located in essential service water pump motor cooling line [EWS-VLV-601A (B,C,D)]	RAW(L1, 2, P, L1, R1, L2, R2)	EL, PR	

Table 17.4-1 Risk-significant SSCs (sheet 44 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
7	ESW pump motor cooling line transmitters [EWS-FT-070 (071,072,073)]	RAW(L1, L2, LP, FL1, FR1, FL2, FR2)	PR	The "Insights and Assumptions" for these SSCs are described on the previous page.
8	ESW pump motor cooling line orifices ~~[TDB : (between EWS-VLV-602A (B,C,D) and EWS-FT-070 (071, 072, 073)]~~[EWS-SRO-002A (B, C, D)]	RAW(FL/FR) LP	PR	
9	Main piping orifices [EWS-FE-034 (035, 036, 037)]	RAW(L1, L2, LP, FL1, FR1, FL2, FR2)/ SM	PR, SS	
10	ESW pump discharge line motor operated valves [EWS-MOV-503A (B,C,D)]	RAW(L1, L2, LP, FL1, FR1, FL2)	CM, EL, OD, PR,	
11	Manual valves in main piping [EWS-VLV-506A (B,C,D)] [EWS-VLV-507A (B,C,D)] [EWS-VLV-508A (B,C,D)] [EWS-VLV-509A (B,C,D)] [EWS-VLV-511A (B,C,D)] [EWS-VLV-514A (B,C,D)] [EWS-VLV-517A (B,C,D)] [EWS-VLV-520A (B,C,D)]	RAW(L1, L2, LP, FL1, FR1, FL2)	EL, PR	
12	Piping ~~[TDB ({~~[ESW pump discharge line, ESW pump cooling line, CCW Hx cooling line A (B,C,D)~~)})~~]	RAW(L1, L2, LP) SM	EL, SS	
13	Orifices ~~[TDB (between EWS-FE-034 (035, 036, 037) and EWS-VLV-520A (B,~~	RAW(L1, L2, LP, FL1, FR1, FL2, FR2)	PR	

Table 17.4-1 Risk-significant SSCs (sheet 45 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
	C, D)]			
14	Essential chiller unit cooling line manual valves [EWS-VLV-701A (B-D)] [EWS-VLV-704A (B-D)]	RAW(L1, L2) EJ*1	EL	
15	Essential service water intake structure	SM	FS	
16	Essential service water pipe tunnel	SM	FS	

Table 17.4-1 Risk-significant SSCs (sheet 46 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
26	Spent fuel pit cooling and purification system (SFPCS)			
1	RWS – SFP inlet line boundary check valves [SFS-VLV-027]	RAW(L1, L2, LP, FL1)	EL	Large external leak of valves that form boundary between RWS result in loss of inventory of the RWS system. Accordingly, systems that relies on the RWS as water source is affected by failure of these valves. During RCS is atmospheric pressure at LPSD operation, the spent fuel pit is used as water source of gravitational injection in case loss of decay heat removal function occurs. SSCs associated with gravitational injection line are considered to be risk significant.
2	RWS – SFP inlet line manual valve [SFS-VLV-028]	RAW(L1, L2, LP, FL1)	EL	
3	RWS – SFP demineralizer line boundary manual valves [SFS-VLV-103A (B)]	RAW(L1, L2, LP, FL1)	EL	
4	RWS – SFP inlet line manual valves [SFS-VLV-029] [SFS-VLV-015] [SFS-VLV-017]	LP	EL	
5	Spent fuel pit [SFS-MPT-001]	LP / SM	EL, SS	
6	Spent fuel pit strainers ~~[SFS-SST-001A (B,C,D)]~~	LP	EL	
7	Spent fuel pit discharge line manual valves [SFS-VLV-021A(D)]	LP	EL	
8	Spent fuel pit discharge cross tie-line manual valve [SFS-VLV-022]	LP	EL	
9	Spent fuel pit heat exchangers [SFS-MHX-001A(B)]	SM	FS	
10	Spent fuel pit pumps [SFS-MPP-001A(B)]	SM	SS, FS	
11	Spent fuel pit water cooling system piping	SM	SS	
27	Remote Shutdown Panel (RSP)			
1	Remote shutdown panel	EJ	FF	In case of Fire event at power some operations are required to be carried out in remote shutdown panel therefore remote shut down panel are considered risk significant.

Table 17.4-1 Risk-significant SSCs (sheet 47 of 51)

#	Systems, Structures and Components (SSCs)	Rationale(1)	Failure Mode(2)	Insights and Assumptions
28	Buildings			
1	Reactor building	SM	FS	Considering the secondary effect to Reactor building and Safety power source buildings, Turbine building, Auxiliary building, Access building are risk significant.
2	Safety power source	SM	FS	
3	Turbine building	SM	FS	
4	Auxiliary building	SM	FS	
5	Access building	SM	FS	
29	Reactor Coolant System			
1	Steam generators (including Steam generator tubes) [RCS-MHX-001A (B,C,D)]	SM	FS	SSCs that compose boundary with primary system are risk significant.
2	RCS piping	SM	FS	
3	DVI piping	SM	FS	
4	Reactor coolant pumps [RCS-MPP-001A (B,C,D)]	SM	FS	
5	Reactor vessel [RCS-MTK-001]	SM	FS	
6	RCS instrumentation piping	SM	FS	
7	In-core instrumentation tube	SM	FS	
8	Emergency letdown piping	SM	SS	
30	Other Equipments			
1	Flood barriers	SM	FS	The flood barriers that separate the reactor building between east side and west side and between restricted area and non-restricted area are important to safety for the operation of the facility.

Table 17.4-1 Risk-significant SSCs (sheet 48 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
31	Boric Acid Transfer			
1	Boric injection line air-operated valves [CVS-FCV-130A (B)]	EJ	CM, EL, OD, PR	Boric acid transfer is effective to prevent core damage in the ATWS event. Operators start boric acid transfer pumps and open injection line air-operated valves to inject boric water into the RCS.
2	Boric acid tank return line air-operated valves [CVS-AOV-549A (B)]	EJ	EL, IL, OM	
3	Boric acid transfer pumps [CVS-MPP-002A (B)]	EJ	BD, SR, YR, EL	
4	Boric acid transfer pump discharge check valves [CVS-VLV-532A (B)]	EJ	EL, OD, PR	
5	Boric acid transfer line check valve [CVS-VLV-556]	EJ	EL, OD, PR	
6	Boric acid tank outlet manual valves [CVS-VLV-515A (B)]	EJ	EL, PR	
7	Boric injection line isolation manual valves [CVS-VLV-527A (B)]	EJ	EL	
8	Boric acid transfer pump suction manual valves [CVS-VLV-528A (B)]	EJ	EL, PR	

Table 17.4-1 Risk-significant SSCs (sheet 49 of 51)

#	Systems, Structures and Components (SSCs)	Rationale[1]	Failure Mode[2]	Insights and Assumptions
9	Boric acid transfer pump discharge manual valves [CVS-VLV-533A (B)]	EJ	EL, PR	
10	Boric acid filter inlet manual valve 1 [CVS-VLV-535]	EJ	EL	
11	Boric acid filter inlet manual valve 2 [CVS-VLV-536]	EJ	EL, PR	
12	Boric acid filter outlet manual valve [CVS-VLV-539]	EJ	EL, PR	
13	Boric injection line manual valve [CVS-VLV-555]	EJ	EL, PR	
14	Boric acid filter [CVS-MFT-004]	EJ	PR	
15	Boric acid tank [CVS-MTK-002A (B)]	EJ	EL	
16	Piping [Boric acid transfer pump discharge line, A (B) boric acid transfer pump suction line]	EJ	EL	

Table 17.4-1 Risk-significant SSCs (sheet 50 of 51)

Notes:

1. Definition of Rationale Terms:

FV = Fussell-Vesely
RAW = Risk Achievement Worth

EJ = Engineering Judge
EP = Expert Panel

L1/2 = Level1/2 Internal Event
LP = Low Power and Shut Down Operation

FL1/2 = Level1/2 Flood Event
FR1/2 = Leve1/2 Fire Event
SM = SEISMIC Event

CC = Common Cause Failure
SUM = Sum of specific SSCs' FV

*1 = Based on the equality and similarity in function and failure behavior to other SSCs, which are risk significant

*2 = Based on the risk-significant human error concerning the SSCs

*3 = Based on the risk-significant signal error concerning the SSCs

2. Definition of Failure Mode Terms:

AD = Fail to start [Pump, Chiller, GTG]
BD = Fail to start [Pump, Chiller, Fan]
CD = Fail to Close [Valve]
CM = Spurious Operation (Mis-Close) [Valve]
EL = External Leak [Valve, Pipe, Tube, Pump, Tank, Heat Exchanger(Shell/Tube)]
FC = Fail to Control [M/V, Optical Switch]
FS = Functional Failure by Seismic Hazard
FF = Fail to Operate [Indicator, Buttery Charger, Bus, Sequencer, Transformer, Switch, Breaker, Ignitor]
FO = Fail to Open [Circuit Breaker]
HF = Hardware Failure
LR = Fail to Run [Pump, Gas Turbine Generator, Fan]
IL = Internal Leak [Valve]
OD = Fail to Open [Valve]
OM = Spurious Operation (Mis-open) [Valve]
PR = Plug [Valve, Orifice, Strainer, Heat Exchanger, Nozzle, Sump]
SC = Spurious Close [Circuit Breaker]
SF = Software Failure
SO = Spurious Open [Circuit Breaker]
SR = Fail to Run [Pump, Gas Turbine Generator, Fan]
SS = Structural Failure by Seismic Hazard
TD = Fail to Close [Breaker]
WR = Fail to Operate [Breaker]
YR = Fail to Run [Pump, Chiller, Compressor]
FR = Functional Failure of Control Rod

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/3/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: **NO. 606-4827 REVISION 2**

SRP SECTION: **17.04 – Reliability Assurance Program (RAP)**

APPLICATION SECTION: **17.4 Reliability Assurance Program**

DATE OF RAI ISSUE: **7/20/2010**

QUESTION NO. : 17.04-57

Some component identification numbers (IDs) provided in Table 17.4-1 ("Risk Significant SSCs") of the US-APWR DCD, Revision 2, are not consistent with the component IDs used in the US-APWR Probabilistic Risk Assessment (PRA) (MUAP-07030(R2)). For the following listed components, the staff requests that MHI make the component IDs used in the US-APWR PRA consistent with that used in the US-APWR DCD (e.g., the component IDs in Table 17.4-1 and Chapter 19).

Component ID in Table 17.4-1 of DCD	Associated Component ID in MUAP-07030(R2)
CVS-FCV-048 (Page 17.4-8)	FCV-138 (Figure 4.1-5)
CVS-FCV-050 (Page 17.4-8)	FCV-140 (Figure 4.1-5)
CVS-LCV-031B,C (Page 17.4-8)	LCV-121B,C (Figure 4.1-5)
CVS-LCV-031D,E,F,G (Page 17.4-8)	LCV-121D,E,F,G (Figure 4.1-5)
CVS-FE-048 (Page 17.4-10)	FE-138 (Figure 4.1-5)
CVS-FE-060,070,080,090 (Page 17.4-10)	FE-150,160,170,180 (Figure 4.1-5)
NCS-FE-034, 035, 037, 038 (Page 17.4-13)	FE-1224, 1225, 1227, 1228 (Figure 4.1-14)
NCS-FE-040, 041, 042, 043 (Page 17.4-13)	FE-1230, 1231, 1232, 1233 (Figure 4.1-14)
NCS-FE-080, 081, 082, 083 (Page 17.4-13)	FE-1270, 1271, 1272, 1273 (Figure 4.1-14)
NCS-FE-084, 085, 086, 087 (Page 17.4-13)	FE-1274, 1275, 1276, 1277 (Figure 4.1-14)
NCS-FE-056, 057, 058, 059 (Page 17.4-14)	FE-1246, 1247, 1248, 1249 (Figure 4.1-14)
NCS-FE-060, 061, 062, 063 (Page 17.4-14)	FE-1250, 1251, 1252, 1253 (Figure 4.1-14)
NCS-FE-052, 053, 054, 055 (Page 17.4-14)	FE-1242, 1243, 1244, 1245 (Figure 4.1-14)
NCS-FE-076, 077 (Page 17.4-15)	FE-1266, 1267 (Figure 4.1-14)
NCS-FE-070, 071 (Page 17.4-15)	FE-1260, 1261 (Figure 4.1-14)
NCS-FE-036, 039 (Page 17.4-15)	FE-1226, 1229 (Figure 4.1-14)
VWS-TCV-041A,041B,042A,042B (Page 17.4-27)	TCV-2420A,B, 2423C,D (Figure 4.1-10)

MSS-HCV-565, 575, 585, 595 (Page 17.4-37)	HCV-3615, 3625, 3635, 3645 (Figure 4.1-9)
MSS-TCV-550A through Q (Page 17.4-37)	TCV-500A through Q (Figure 4.1-9)
RHS-FCV-021, 031 (Page 17.4-39)	Associated ID's in the PRA seem to be different
RHS-HCV-023, 033 (Page 17.4-39)	Associated ID's in the PRA seem to be different
RHS-FE-011, 021, 031, 041 (Page 17.4-39)	Associated ID's in the PRA seem to be different
EWS-FT-070, 071, 072, 073 (Page 17.4-46)	FT-2060, 2061, 2062, 2063 (Figure 4.1-15)
EWS-FE-034, 035, 036, 037 (Page 17.4-46)	FE-2024, 2025, 2026, 2027 (Figure 4.1-15)
Associated ID in DCD seem to be different	RHS-FCV-611 (Item 13 on Page 17.4-40)

ANSWER:

The component IDs in Table 17.4-1 are consistent with those in P&IDs of the DCD Chapters 6, 9 and 10. All component IDs listed in the question of this RAI are correct. Not clarified IDs in the question are as follows:

Component ID in Table 17.4-1 of DCD	**Associated Component ID in MUAP-07030(R2)**
RHS-FCV-021, 031 (Page 17.4-39)	~~Associated ID's in the PRA seem to be different~~ RHS-FCV-611, 621
RHS-HCV-023, 033 (Page 17.4-39)	~~Associated ID's in the PRA seem to be different~~ RHS-HCV-613, 623
RHS-FE-011, 021, 031, 041 (Page 17.4-39)	~~Associated ID's in the PRA seem to be different~~ RHS-FE-601, 611, 621, 631
~~Associated ID in DCD seem to be different~~ RHS-FCV-021	RHS-FCV-611 (Item 13 on Page 17.4-40)

Attachment 1 shows the consistency table for the component IDs between Table 17.4-1 (RAP) and MUAP-07030 Rev.2 (PRA) and summarizes only components that are inconsistent between RAP and PRA. The component IDs in Table 17.4-1 will be revised to reflect the response of the RAI as shown in Attachment 1 of #17.04-56.

Impact on DCD

Table 17.4-1 will be revised to be consistent with the component IDs between RAP and PRA as shown in Attachment 1 of RAI #17.04-56.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.

Table 1 Component ID List in PRA and RAP (sheet 1 of 8)

	System	Equipment Name	Component ID in PRA (Chapter 19)	Component ID in RAP (Chapter 17)
1-4	Accumulator Injection System	A-Discharge Line Orifice	SIS-ACC02A	SIS-SRO-006A
1-4	Accumulator Injection System	B-Discharge Line Orifice	SIS-ACC02B	SIS-SRO-006B
1-4	Accumulator Injection System	C-Discharge Line Orifice	SIS-ACC02C	SIS-SRO-006C
1-4	Accumulator Injection System	D-Discharge Line Orifice	SIS-ACC02D	SIS-SRO-006D
1-5	Accumulator Injection System	A-Accumulator	SIS-CTK-001A	SIS-MTK-001A
1-5	Accumulator Injection System	B-Accumulator	SIS-CTK-001B	SIS-MTK-001B
1-5	Accumulator Injection System	C-Accumulator	SIS-CTK-001C	SIS-MTK-001C
1-5	Accumulator Injection System	D-Accumulator	SIS-CTK-001D	SIS-MTK-001D
2-1	Chemical and Volume Control System	Charging line air operated valve	CVS-FCV-138	CVS-FCV-048
2-2	Chemical and Volume Control System	RCP seal cooling injection line air operated valves	CVS-FCV-140	CVS-FCV-050
2-4	Chemical and Volume Control System	A-Charging pump	CVS-RPP-001A	CVS-MPP-001A
2-4	Chemical and Volume Control System	B-Charging pump	CVS-RPP-001B	CVS-MPP-001B
2-6	Chemical and Volume Control System	Volume control tank line Motor operated Valve 1	CVS-LCV-121B	CVS-LCV-031B
2-6	Chemical and Volume Control System	Volume control tank line Motor operated Valve 2	CVS-LCV-121C	CVS-LCV-031C
2-7	Chemical and Volume Control System	Refueling water storage auxiliary tank discharge line change valve 1	CVS-LCV-121D	CVS-LCV-031D
2-7	Chemical and Volume Control System	Refueling water storage auxiliary tank discharge line change valve 2	CVS-LCV-121E	CVS-LCV-031E
2-7	Chemical and Volume Control System	Refueling water storage auxiliary tank discharge line change valve 3	CVS-LCV-121F	CVS-LCV-031F
2-7	Chemical and Volume Control System	Refueling water storage auxiliary tank discharge line change valve 4	CVS-LCV-121G	CVS-LCV-031G
2-21	Chemical and Volume Control System	Charging line orifice	CVS-FE-138	CVS-FE-048
2-22	Chemical and Volume Control System	Charging flow control orifice	CVS-OR02	CVS-SRO-003
2-23	Chemical and Volume Control System	A-RCP seal water injection line orifice	CVS-FE-150	CVS-FE-060
2-23	Chemical and Volume Control System	B-RCP seal water injection line orifice	CVS-FE-160	CVS-FE-070
2-23	Chemical and Volume Control System	C-RCP seal water injection line orifice	CVS-FE-170	CVS-FE-080
2-23	Chemical and Volume Control System	D-RCP seal water injection line orifice	CVS-FE-180	CVS-FE-090
2-24	Chemical and Volume Control System	Regenerative heat exchanger	CVS-CHX-001	CVS-MHX-001
2-32	Chemical and Volume Control System	A-RCP seal water injection line filter	CVS-MFT-003B	CVS-MFT-003A
2-32	Chemical and Volume Control System	B-RCP seal water injection line filter	CVS-KFT-003B	CVS-MFT-003B
2-36	Chemical and Volume Control System	Low-pressure letdown line air operated valve	CVS-HCV-102	CVS-HCV-012
2-37	Chemical and Volume Control System	A-Charging pump minimum flow orifice	CVS-OR1A	CVS-SRO-002A
2-37	Chemical and Volume Control System	B-Charging pump minimum flow orifice	CVS-OR1B	CVS-SRO-002B
2-41	Chemical and Volume Control System	Volume control tank	CVS-RTK-001	CVS-MTK-001
3-2	Component Cooling Water System	A-Component cooling water pump	NCS-RPP-001A	NCS-MPP-001A
3-2	Component Cooling Water System	B-Component cooling water pump	NCS-RPP-001B	NCS-MPP-001B
3-2	Component Cooling Water System	C-Component cooling water pump	NCS-RPP-001C	NCS-MPP-001C
3-2	Component Cooling Water System	D-Component cooling water pump	NCS-RPP-001D	NCS-MPP-001D
3-3	Component Cooling Water System	A-Component cooling water heat exchanger	NCS-RHX-001A	NCS-MHX-001A
3-3	Component Cooling Water System	B-Component cooling water heat exchanger	NCS-RHX-001B	NCS-MHX-001B
3-3	Component Cooling Water System	C-Component cooling water heat exchanger	NCS-RHX-001C	NCS-MHX-001C
3-3	Component Cooling Water System	D-Component cooling water heat exchanger	NCS-RHX-001D	NCS-MHX-001D
3-11	Component Cooling Water System	A-A Supply header flow meter orifice	NCS-FE-1224	NCS-FE-034

Table 1 Component ID List in PRA and RAP (sheet 2 of 8)

	System	Equipment Name	Component ID in PRA (Chapter 19)	Component ID in RAP (Chapter 17)
3-11	Component Cooling Water System	B-B Supply header flow meter orifice	NCS-FE-1225	NCS-FE-035
3-11	Component Cooling Water System	C-C Supply header flow meter orifice	NCS-FE-1227	NCS-FE-037
3-11	Component Cooling Water System	D-D Supply header flow meter orifice	NCS-FE-1228	NCS-FE-038
3-12	Component Cooling Water System	A-A CCW pump cooling line flow meter orifice	NCS-FE-1230	NCS-FE-040
3-12	Component Cooling Water System	B-B CCW pump cooling line flow meter orifice	NCS-FE-1231	NCS-FE-041
3-12	Component Cooling Water System	C-C CCW pump cooling line flow meter orifice	NCS-FE-1232	NCS-FE-042
3-12	Component Cooling Water System	D-D CCW pump cooling line flow meter orifice	NCS-FE-1233	NCS-FE-043
3-17	Component Cooling Water System	A-Safety injection pump outlet flow meter orifice	NCS-FE-1270	NCS-FE-080
3-17	Component Cooling Water System	B-Safety injection pump outlet flow meter orifice	NCS-FE-1271	NCS-FE-081
3-17	Component Cooling Water System	C-Safety injection pump outlet flow meter orifice	NCS-FE-1272	NCS-FE-082
3-17	Component Cooling Water System	D-Safety injection pump outlet flow meter orifice	NCS-FE-1273	NCS-FE-083
3-18	Component Cooling Water System	A-Safety injection pump motor outlet flow meter orifice	NCS-FE-1274	NCS-FE-084
3-18	Component Cooling Water System	B-Safety injection pump motor outlet flow meter orifice	NCS-FE-1275	NCS-FE-085
3-18	Component Cooling Water System	C-Safety injection pump motor outlet flow meter orifice	NCS-FE-1276	NCS-FE-086
3-18	Component Cooling Water System	D-Safety injection pump motor outlet flow meter orifice	NCS-FE-1277	NCS-FE-087
3-23	Component Cooling Water System	A-CS/RHR pump outlet flow meter orifice	NCS-FE-1246	NCS-FE-056
3-23	Component Cooling Water System	B-CS/RHR pump outlet flow meter orifice	NCS-FE-1247	NCS-FE-057
3-23	Component Cooling Water System	C-CS/RHR pump outlet flow meter orifice	NCS-FE-1248	NCS-FE-058
3-23	Component Cooling Water System	D-CS/RHR pump outlet flow meter orifice	NCS-FE-1249	NCS-FE-059
3-24	Component Cooling Water System	A-CS/RHR pump motor outlet flow meter orifice	NCS-FE-1250	NCS-FE-060
3-24	Component Cooling Water System	B-CS/RHR pump motor outlet flow meter orifice	NCS-FE-1251	NCS-FE-061
3-24	Component Cooling Water System	C-CS/RHR pump motor outlet flow meter orifice	NCS-FE-1252	NCS-FE-062
3-24	Component Cooling Water System	D-CS/RHR pump motor outlet flow meter orifice	NCS-FE-1253	NCS-FE-063
3-27	Component Cooling Water System	A-CS/RHR heat exchanger outlet flow meter orifice	NCS-FE-1242	NCS-FE-052
3-27	Component Cooling Water System	B-CS/RHR heat exchanger outlet flow meter orifice	NCS-FE-1243	NCS-FE-053
3-27	Component Cooling Water System	C-CS/RHR heat exchanger outlet flow meter orifice	NCS-FE-1244	NCS-FE-054
3-27	Component Cooling Water System	D-CS/RHR heat exchanger outlet flow meter orifice	NCS-FE-1245	NCS-FE-055
3-35	Component Cooling Water System	A-Charging injection pump motor line flow meter orifice	NCS-FE-1266	NCS-FE-076
3-35	Component Cooling Water System	B-Charging injection pump motor line flow meter orifice	NCS-FE-1267	NCS-FE-077
3-36	Component Cooling Water System	A-Charging injection oil cooler line flow meter orifice	NCS-FE-1260	NCS-FE-070
3-36	Component Cooling Water System	B-Charging injection oil cooler line flow meter orifice	NCS-FE-1261	NCS-FE-071
3-39	Component Cooling Water System	AB Supply header flow meter orifice	NCS-FE-1226	NCS-FE-036
3-39	Component Cooling Water System	CD Supply header flow meter orifice	NCS-FE-1229	NCS-FE-039
3-42	Component Cooling Water System	B-CCW Surge tank nitrogen supply line stop valve	NCS-PCV-1212	NCS-PCV-022
3-44	Component Cooling Water System	B-Component cooling water surge tank	NCS-RTK-001B	NCS-MTK-001B
3-45	Component Cooling Water System	B-CCW Surge tank safety valve	NCS-VLV-003B	NCS-SRV-003B
5-1	Containment Isolation System	Instrument air system motor operated valve	CAS-MOV-002	IAS-MOV-002
5-1	Containment Isolation System	Instrument air system check valve	CAS-VLV-003	IAS-VLV-003
6-3	Emergency Feedwater System	A-Motor driven emergency feedwater pump	EFS-RPP-001B	EFS-MPP-001B
6-3	Emergency Feedwater System	B-Motor driven emergency feedwater pump	EFS-RPP-001C	EFS-MPP-001C

Table 1 Component ID List in PRA and RAP (sheet 3 of 8)

	System	Equipment Name	Component ID in PRA (Chapter 19)	Component ID in RAP (Chapter 17)
6-4	Emergency Feedwater System	A-Turbine driven emergency feedwater pump	EFS-RPP-001A	EFS-MPP-001A
6-4	Emergency Feedwater System	B-Turbine driven emergency feedwater pump	EFS-RPP-001D	EFS-MPP-001D
6-11	Emergency Feedwater System	A-Emergency feedwater line orifice	EFS-FE-3716	EFS-FE-016
6-11	Emergency Feedwater System	B-Emergency feedwater line orifice	EFS-FE-3726	EFS-FE-026
6-11	Emergency Feedwater System	C-Emergency feedwater line orifice	EFS-FE-3736	EFS-FE-036
6-11	Emergency Feedwater System	D-Emergency feedwater line orifice	EFS-FE-3746	EFS-FE-046
6-15	Emergency Feedwater System	A-Emergency feedwater pit	EFS-RPT-001A	EFS-MPT-001A
6-15	Emergency Feedwater System	B-Emergency feedwater pit	EFS-RPT-001B	EFS-MPT-001B
9-8	Non-Essential Chilled Water System	A-Containment fan cooler unit outlet air operated valve	VWS-TCV-2420A	VWS-TCV-041A
9-8	Non-Essential Chilled Water System	B-Containment fan cooler unit outlet air operated valve	VWS-TCV-2420B	VWS-TCV-041B
9-8	Non-Essential Chilled Water System	C-Containment fan cooler unit outlet air operated valve	VWS-TCV-2423C	VWS-TCV-042A
9-8	Non-Essential Chilled Water System	D-Containment fan cooler unit outlet air operated valve	VWS-TCV-2423D	VWS-TCV-042B
11-2	High Head Safety Injection System	A-Safety injection pump outlet orifice	SIS-FE-962	SIS-FE-062
11-2	High Head Safety Injection System	B-Safety injection pump outlet orifice	SIS-FE-963	SIS-FE-063
11-2	High Head Safety Injection System	C-Safety injection pump outlet orifice	SIS-FE-964	SIS-FE-064
11-2	High Head Safety Injection System	D-Safety injection pump outlet orifice	SIS-FE-965	SIS-FE-065
11-3	High Head Safety Injection System	A-Minimum flow line orifice	SIS-FE-972	SIS-FE-072
11-3	High Head Safety Injection System	B-Minimum flow line orifice	SIS-FE-973	SIS-FE-073
11-3	High Head Safety Injection System	C-Minimum flow line orifice	SIS-FE-974	SIS-FE-074
11-3	High Head Safety Injection System	D-Minimum flow line orifice	SIS-FE-975	SIS-FE-075
11-6	High Head Safety Injection System	A-RV injection line orifice	SIS-OR003A	SIS-SRO-001A
11-6	High Head Safety Injection System	B-RV injection line orifice	SIS-OR003B	SIS-SRO-001B
11-6	High Head Safety Injection System	C-RV injection line orifice	SIS-OR003C	SIS-SRO-001C
11-6	High Head Safety Injection System	D-RV injection line orifice	SIS-OR003D	SIS-SRO-001D
11-9	High Head Safety Injection System	A-Safety injection pump	SIS-RPP-001A	SIS-MPP-001A
11-9	High Head Safety Injection System	B-Safety injection pump	SIS-RPP-001B	SIS-MPP-001B
11-9	High Head Safety Injection System	C-Safety injection pump	SIS-RPP-001C	SIS-MPP-001C
11-9	High Head Safety Injection System	D-Safety injection pump	SIS-RPP-001D	SIS-MPP-001D
11-13	High Head Safety Injection System	A-Minimum flow line orifice	SIS-OR002A	SIS-SRO-003A
11-13	High Head Safety Injection System	B-Minimum flow line orifice	SIS-OR002B	SIS-SRO-003B
11-13	High Head Safety Injection System	C-Minimum flow line orifice	SIS-OR002C	SIS-SRO-003C
11-13	High Head Safety Injection System	D-Minimum flow line orifice	SIS-OR002D	SIS-SRO-003D
12-1	Heating, Ventilation, and Air Conditioning (HVAC) System	B-Emergency feedwater pump room fan	VRS-RFN-401B	VRS-MFN-401B
12-1	Heating, Ventilation, and Air Conditioning (HVAC) System	C-Emergency feedwater pump room fan	VRS-RFN-401C	VRS-MFN-401C
12-2	Heating, Ventilation, and Air Conditioning (HVAC) System	B-Emergency feedwater pump air handling unit	VRS-RAH-401B	VRS-MAH-401B
12-2	Heating, Ventilation, and Air Conditioning (HVAC) System	C-Emergency feedwater pump air handling unit	VRS-RAH-401C	VRS-MAH-401C
13-1	Containment Fan Cooler System	A-Containment fan cooler unit	VCS-CAH-001A	VCS-MAH-001A
13-1	Containment Fan Cooler System	B-Containment fan cooler unit	VCS-CAH-001B	VCS-MAH-001B
13-1	Containment Fan Cooler System	C-Containment fan cooler unit	VCS-CAH-001C	VCS-MAH-001C
13-1	Containment Fan Cooler System	D-Containment fan cooler unit	VCS-CAH-001D	VCS-MAH-001D

Table 1 Component ID List in PRA and RAP (sheet 4 of 8)

	System	Equipment Name	Component ID in PRA (Chapter 19)	Component ID in RAP (Chapter 17)
15-18	Instrumentation and Control (I&C) System	B-B-CCW surge tank water pressure transmitter	NCS-PICA-1212	NCS-PCA-022
15-19	Instrumentation and Control (I&C) System	A-EFW pit water level transmitter 1	EFS-LT-3760	EFS-LT-060
15-19	Instrumentation and Control (I&C) System	A-EFW pit water level transmitter 2	EFS-LT-3761	EFS-LT-061
15-19	Instrumentation and Control (I&C) System	B-EFW pit water level transmitter 1	EFS-LT-3770	EFS-LT-070
15-19	Instrumentation and Control (I&C) System	B-EFW pit water level transmitter 2	EFS-LT-3771	EFS-LT-071
18-1	Main Steam Supply System	A-Main steam isolation valve	NMS-SMV-515A	MSS-SMV-515A
18-1	Main Steam Supply System	B-Main steam isolation valve	NMS-SMV-515B	MSS-SMV-515B
18-1	Main Steam Supply System	C-Main steam isolation valve	NMS-SMV-515C	MSS-SMV-515C
18-1	Main Steam Supply System	D-Main steam isolation valve	NMS-SMV-515D	MSS-SMV-515D
18-2	Main Steam Supply System	A-Main steam bypass isolation valve	NMS-HCV-3615	MSS-HCV-565
18-2	Main Steam Supply System	B-Main steam bypass isolation valve	NMS-HCV-3625	MSS-HCV-575
18-2	Main Steam Supply System	C-Main steam bypass isolation valve	NMS-HCV-3635	MSS-HCV-585
18-2	Main Steam Supply System	D-Main steam bypass isolation valve	NMS-HCV-3645	MSS-HCV-595
18-3	Main Steam Supply System	A-Main steam line isolation check valve	NMS-VLV-516A	MSS-VLV-516A
18-3	Main Steam Supply System	B-Main steam line isolation check valve	NMS-VLV-516B	MSS-VLV-516B
18-3	Main Steam Supply System	C-Main steam line isolation check valve	NMS-VLV-516C	MSS-VLV-516C
18-3	Main Steam Supply System	D-Main steam line isolation check valve	NMS-VLV-516D	MSS-VLV-516D
18-4	Main Steam Supply System	A-Main steam safety valve 1	NMS-VLV-509A	MSS-SRV-509A
18-4	Main Steam Supply System	B-Main steam safety valve 1	NMS-VLV-509B	MSS-SRV-509B
18-4	Main Steam Supply System	C-Main steam safety valve 1	NMS-VLV-509C	MSS-SRV-509C
18-4	Main Steam Supply System	D-Main steam safety valve 1	NMS-VLV-509D	MSS-SRV-509D
18-4	Main Steam Supply System	A-Main steam safety valve 2	NMS-VLV-510A	MSS-SRV-510A
18-4	Main Steam Supply System	B-Main steam safety valve 2	NMS-VLV-510B	MSS-SRV-510B
18-4	Main Steam Supply System	C-Main steam safety valve 2	NMS-VLV-510C	MSS-SRV-510C
18-4	Main Steam Supply System	D-Main steam safety valve 2	NMS-VLV-510D	MSS-SRV-510D
18-5	Main Steam Supply System	Turbine bypass valve 550A	NMS-TCV-500A	MSS-TCV-550A
18-5	Main Steam Supply System	Turbine bypass valve 550B	NMS-TCV-500B	MSS-TCV-550B
18-5	Main Steam Supply System	Turbine bypass valve 550C	NMS-TCV-500C	MSS-TCV-550C
18-5	Main Steam Supply System	Turbine bypass valve 550D	NMS-TCV-500D	MSS-TCV-550D
18-5	Main Steam Supply System	Turbine bypass valve 550E	NMS-TCV-500E	MSS-TCV-550E
18-5	Main Steam Supply System	Turbine bypass valve 550F	NMS-TCV-500F	MSS-TCV-550F
18-5	Main Steam Supply System	Turbine bypass valve 550G	NMS-TCV-500G	MSS-TCV-550G
18-5	Main Steam Supply System	Turbine bypass valve 550H	NMS-TCV-500H	MSS-TCV-550H
18-5	Main Steam Supply System	Turbine bypass valve 550J	NMS-TCV-500J	MSS-TCV-550J
18-5	Main Steam Supply System	Turbine bypass valve 550K	NMS-TCV-500K	MSS-TCV-550K
18-5	Main Steam Supply System	Turbine bypass valve 550L	NMS-TCV-500L	MSS-TCV-550L
18-5	Main Steam Supply System	Turbine bypass valve 550M	NMS-TCV-500M	MSS-TCV-550M
18-5	Main Steam Supply System	Turbine bypass valve 550N	NMS-TCV-500N	MSS-TCV-550N
18-5	Main Steam Supply System	Turbine bypass valve 550P	NMS-TCV-500P	MSS-TCV-550P
18-5	Main Steam Supply System	Turbine bypass valve 550Q	NMS-TCV-500Q	MSS-TCV-550Q

Table 1 Component ID List in PRA and RAP (sheet 5 of 8)

	System	Equipment Name	Component ID in PRA (Chapter 19)	Component ID in RAP (Chapter 17)
18-6	Main Steam Supply System	A-Main Steam relief valve isolation valve	NMS-MOV-507A	MSS-MOV-507A
18-6	Main Steam Supply System	B-Main Steam relief valve isolation valve	NMS-MOV-507B	MSS-MOV-507B
18-6	Main Steam Supply System	C-Main Steam relief valve isolation valve	NMS-MOV-507C	MSS-MOV-507C
18-6	Main Steam Supply System	D-Main Steam relief valve isolation valve	NMS-MOV-507D	MSS-MOV-507D
18-7	Main Steam Supply System	A-Main Steam depressurization valve isolation	NMS-MOV-508A	MSS-MOV-508A
18-7	Main Steam Supply System	B-Main Steam depressurization valve isolatio	NMS-MOV-508B	MSS-MOV-508B
18-7	Main Steam Supply System	C-Main Steam depressurization valve isolatio	NMS-MOV-508C	MSS-MOV-508C
18-7	Main Steam Supply System	D-Main Steam depressurization valve isolatio	NMS-MOV-508D	MSS-MOV-508D
18-8	Main Steam Supply System	A-Main Steam relief valve	NMS-PCV-465	MSS-PCV-515
18-8	Main Steam Supply System	B-Main Steam relief valve	NMS-PCV-475	MSS-PCV-525
18-8	Main Steam Supply System	C-Main Steam relief valve	NMS-PCV-485	MSS-PCV-535
18-8	Main Steam Supply System	D-Main Steam relief valve	NMS-PCV-495	MSS-PCV-545
19-3	Pressurizer Control System Part of Emergency Core Cooling System	Pressurizer safety valve 120	RCS-VLV-120	RCS-SRV-120
19-3	Pressurizer Control System Part of Emergency Core Cooling System	Pressurizer safety valve 121	RCS-VLV-121	RCS-SRV-121
19-3	Pressurizer Control System Part of Emergency Core Cooling System	Pressurizer safety valve 122	RCS-VLV-122	RCS-SRV-122
19-3	Pressurizer Control System Part of Emergency Core Cooling System	Pressurizer safety valve 123	RCS-VLV-123	RCS-SRV-123
21-1	Containment Spray / Residual Heat Removal (CS/RHR) System	B-Heat exchanger bypass valve	RHS-FCV-611	RHS-FCV-021
21-1	Containment Spray / Residual Heat Removal (CS/RHR) System	C-Heat exchanger bypass valve	RHS-FCV-621	RHS-FCV-031
21-2	Containment Spray / Residual Heat Removal (CS/RHR) System	B-RHR line heat exchanger discharge air operated valve	RHS-HCV-613	RHS-HCV-023
21-2	Containment Spray / Residual Heat Removal (CS/RHR) System	C-RHR line heat exchanger discharge air operated valve	RHS-HCV-623	RHS-HCV-033
21-6	Containment Spray / Residual Heat Removal (CS/RHR) System	A-CS/RHR pump	RHS-RPP-001A	RHS-MPP-001A
21-6	Containment Spray / Residual Heat Removal (CS/RHR) System	B-CS/RHR pump	RHS-RPP-001B	RHS-MPP-001B
21-6	Containment Spray / Residual Heat Removal (CS/RHR) System	C-CS/RHR pump	RHS-RPP-001C	RHS-MPP-001C
21-6	Containment Spray / Residual Heat Removal (CS/RHR) System	D-CS/RHR pump	RHS-RPP-001D	RHS-MPP-001D
21-7	Containment Spray / Residual Heat Removal (CS/RHR) System	A-CS/RHR pump outlet orifice	RHS-FE-601	RHS-FE-011
21-7	Containment Spray / Residual Heat Removal (CS/RHR) System	B-CS/RHR pump outlet orifice	RHS-FE-611	RHS-FE-021
21-7	Containment Spray / Residual Heat Removal (CS/RHR) System	C-CS/RHR pump outlet orifice	RHS-FE-621	RHS-FE-031
21-7	Containment Spray / Residual Heat Removal (CS/RHR) System	D-CS/RHR pump outlet orifice	RHS-FE-631	RHS-FE-041
21-8	Containment Spray / Residual Heat Removal (CS/RHR) System	A-Containment spray/residual heat removal heat exchanger	RHS-RHX-001A	RHS-MHX-001A
21-8	Containment Spray / Residual Heat Removal (CS/RHR) System	B-Containment spray/residual heat removal heat exchanger	RHS-RHX-001B	RHS-MHX-001B
21-8	Containment Spray / Residual Heat Removal (CS/RHR) System	C-Containment spray/residual heat removal heat exchanger	RHS-RHX-001C	RHS-MHX-001C
21-8	Containment Spray / Residual Heat Removal (CS/RHR) System	D-Containment spray/residual heat removal heat exchanger	RHS-RHX-001D	RHS-MHX-001D
21-16	Containment Spray / Residual Heat Removal (CS/RHR) System	A-Minimum flow line orifice 1	RHS-OR007A	RHS-SRO-001A
21-16	Containment Spray / Residual Heat Removal (CS/RHR) System	B-Minimum flow line orifice 1	RHS-OR007B	RHS-SRO-001B
21-16	Containment Spray / Residual Heat Removal (CS/RHR) System	C-Minimum flow line orifice 1	RHS-OR007C	RHS-SRO-001C
21-16	Containment Spray / Residual Heat Removal (CS/RHR) System	D-Minimum flow line orifice 1	RHS-OR007D	RHS-SRO-001D
21-17	Containment Spray / Residual Heat Removal (CS/RHR) System	A-Minimum flow line orifice 2	RHS-FE-604	RHS-FE-014
21-17	Containment Spray / Residual Heat Removal (CS/RHR) System	B-Minimum flow line orifice 2	RHS-FE-614	RHS-FE-024
21-17	Containment Spray / Residual Heat Removal (CS/RHR) System	C-Minimum flow line orifice 2	RHS-FE-624	RHS-FE-034
21-17	Containment Spray / Residual Heat Removal (CS/RHR) System	D-Minimum flow line orifice 2	RHS-FE-634	RHS-FE-044

Table 1 Component ID List in PRA and RAP (sheet 6 of 8)

	System	Equipment Name	Component ID in PRA (Chapter 19)	Component ID in RAP (Chapter 17)
21-28	Containment Spray / Residual Heat Removal (CS/RHR) System	A-RHR line safety valve	RHS-VLV-003A	RHS-SRV-003A
21-28	Containment Spray / Residual Heat Removal (CS/RHR) System	B-RHR line safety valve	RHS-VLV-003B	RHS-SRV-003B
21-28	Containment Spray / Residual Heat Removal (CS/RHR) System	C-RHR line safety valve	RHS-VLV-003C	RHS-SRV-003C
21-28	Containment Spray / Residual Heat Removal (CS/RHR) System	D-RHR line safety valve	RHS-VLV-003D	RHS-SRV-003D
22-1	Refueling Water Storage System	A-Refueling water storage pit (RWSP) sump strainer	SIS-CSR-001A	SIS-SST-001A
22-1	Refueling Water Storage System	B-Refueling water storage pit (RWSP) sump strainer	SIS-CSR-001B	SIS-SST-001B
22-1	Refueling Water Storage System	C-Refueling water storage pit (RWSP) sump strainer	SIS-CSR-001C	SIS-SST-001C
22-1	Refueling Water Storage System	D-Refueling water storage pit (RWSP) sump strainer	SIS-CSR-001D	SIS-SST-001D
22-2	Refueling Water Storage System	Refueling water storage pit	RWS-CPT-001	RWS-MCP-001
22-7	Refueling Water Storage System	A-Refueling water recirculation pump	RWS-RPP-001A	RWS-MPP-001A
22-7	Refueling Water Storage System	B-Refueling water recirculation pump	RWS-RPP-001B	RWS-MPP-001B
22-11	Refueling Water Storage System	Refueling water storage auxiliary tank	RWS-OTK-002	RWS-MTK-002
24-1	Heating, Ventilation, and Air Conditioning System	B-Essential chiller unit	VWS-PEQ-001B	VWS-MEQ-001B
24-1	Heating, Ventilation, and Air Conditioning System	C-Essential chiller unit	VWS-PEQ-001C	VWS-MEQ-001C
24-2	Heating, Ventilation, and Air Conditioning System	B-Essential chilled water pump	VWS-PPP-001B	VWS-MPP-001B
24-2	Heating, Ventilation, and Air Conditioning System	C-Essential chilled water pump	VWS-PPP-001C	VWS-MPP-001C
24-3	Heating, Ventilation, and Air Conditioning System	B-Essential chilled water compression tank	VWS-PTK-001B	VWS-MTK-001B
24-3	Heating, Ventilation, and Air Conditioning System	C-Essential chilled water compression tank	VWS-PTK-001C	VWS-MTK-001C
25-3	Essential Service Water System	A-Essential service water pump	EWS-OPP-001A	EWS-MPP-001A
25-3	Essential Service Water System	B-Essential service water pump	EWS-OPP-001B	EWS-MPP-001B
25-3	Essential Service Water System	C-Essential service water pump	EWS-OPP-001C	EWS-MPP-001C
25-3	Essential Service Water System	D-Essential service water pump	EWS-OPP-001D	EWS-MPP-001D
25-4	Essential Service Water System	A-CCW heat exchanger inlet strainer	EWS-ST02A	EWS-SST-003A
25-4	Essential Service Water System	B-CCW heat exchanger inlet strainer	EWS-ST02B	EWS-SST-003B
25-4	Essential Service Water System	C-CCW heat exchanger inlet strainer	EWS-ST02C	EWS-SST-003C
25-4	Essential Service Water System	D-CCW heat exchanger inlet strainer	EWS-ST02D	EWS-SST-003D
25-5	Essential Service Water System	A-Essential service water pump outlet strainer	EWS-ST01	EWS-SST-001A
25-5	Essential Service Water System	B-Essential service water pump outlet strainer	EWS-ST03	EWS-SST-001B
25-5	Essential Service Water System	C-Essential service water pump outlet strainer	EWS-ST05	EWS-SST-001C
25-5	Essential Service Water System	D-Essential service water pump outlet strainer	EWS-ST07	EWS-SST-001D
25-7	Essential Service Water System	A-ESW pump motor cooling line transmitter	EWS-FT-2060	EWS-FT-070
25-7	Essential Service Water System	B-ESW pump motor cooling line transmitter	EWS-FT-2061	EWS-FT-071
25-7	Essential Service Water System	C-ESW pump motor cooling line transmitter	EWS-FT-2062	EWS-FT-072
25-7	Essential Service Water System	D-ESW pump motor cooling line transmitter	EWS-FT-2063	EWS-FT-073
25-8	Essential Service Water System	A-ESW pump motor cooling line orifice	EWS-ESS0003A	EWS-SRO-002A
25-8	Essential Service Water System	B-ESW pump motor cooling line orifice	EWS-ESS0003B	EWS-SRO-002B
25-8	Essential Service Water System	C-ESW pump motor cooling line orifice	EWS-ESS0003C	EWS-SRO-002C
25-8	Essential Service Water System	D-ESW pump motor cooling line orifice	EWS-ESS0003D	EWS-SRO-002D
25-9	Essential Service Water System	A-Main piping orifice	EWS-FE-2024	EWS-FE-034
25-9	Essential Service Water System	B-Main piping orifice	EWS-FE-2025	EWS-FE-035

Table 1 Component ID List in PRA and RAP (sheet 7 of 8)

	System	Equipment Name	Component ID in PRA (Chapter 19)	Component ID in RAP (Chapter 17)
25-9	Essential Service Water System	C-Main piping orifice	EWS-FE-2026	EWS-FE-036
25-9	Essential Service Water System	D-Main piping orifice	EWS-FE-2027	EWS-FE-037
	Safety Injection System (ACC)	A-Accumulator Safety Valve	SIS-VLV-126A	SIS-SRV-126A
	Safety Injection System (ACC)	B-Accumulator Safety Valve	SIS-VLV-126B	SIS-SRV-126B
	Safety Injection System (ACC)	C-Accumulator Safety Valve	SIS-VLV-126C	SIS-SRV-126C
	Safety Injection System (ACC)	D-Accumulator Safety Valve	SIS-VLV-126D	SIS-SRV-126D
	Safety Injection System (ACC)	A-Accumulator Water Level Transmitter 1	SIS-LT-910	SIS-LT-010
	Safety Injection System (ACC)	A-Accumulator Water Level Transmitter 2	SIS-LT-911	SIS-LT-011
	Safety Injection System (ACC)	B-Accumulator Water Level Transmitter 1	SIS-LT-920	SIS-LT-020
	Safety Injection System (ACC)	B-Accumulator Water Level Transmitter 2	SIS-LT-921	SIS-LT-021
	Safety Injection System (ACC)	C-Accumulator Water Level Transmitter 1	SIS-LT-930	SIS-LT-030
	Safety Injection System (ACC)	C-Accumulator Water Level Transmitter 2	SIS-LT-931	SIS-LT-031
	Safety Injection System (ACC)	D-Accumulator Water Level Transmitter 1	SIS-LT-940	SIS-LT-040
	Safety Injection System (ACC)	D-Accumulator Water Level Transmitter 2	SIS-LT-941	SIS-LT-041
	Safety Injection System (ACC)	A-Accumulator Pressure Transmitter 1	SIS-PT-910	SIS-PT-010
	Safety Injection System (ACC)	A-Accumulator Pressure Transmitter 2	SIS-PT-911	SIS-PT-011
	Safety Injection System (ACC)	B-Accumulator Pressure Transmitter 1	SIS-PT-920	SIS-PT-020
	Safety Injection System (ACC)	B-Accumulator Pressure Transmitter 2	SIS-PT-921	SIS-PT-021
	Safety Injection System (ACC)	C-Accumulator Pressure Transmitter 1	SIS-PT-930	SIS-PT-030
	Safety Injection System (ACC)	C-Accumulator Pressure Transmitter 2	SIS-PT-931	SIS-PT-031
	Safety Injection System (ACC)	D-Accumulator Pressure Transmitter 1	SIS-PT-940	SIS-PT-040
	Safety Injection System (ACC)	D-Accumulator Pressure Transmitter 2	SIS-PT-941	SIS-PT-041
	Containment Spray / Residual Heat Removal System	A-Containment Spray Nozzle Orifice A	CSS-06AA	CSS-SRO-001A
	Containment Spray / Residual Heat Removal System	A-Containment Spray Nozzle Orifice B	CSS-06AB	CSS-SRO-002A
	Containment Spray / Residual Heat Removal System	A-Containment Spray Nozzle Orifice C	CSS-06AC	CSS-SRO-003A
	Containment Spray / Residual Heat Removal System	A-Containment Spray Nozzle Orifice D	CSS-06AD	CSS-SRO-004A
	Containment Spray / Residual Heat Removal System	B-Containment Spray Nozzle Orifice A	CSS-06BA	CSS-SRO-001B
	Containment Spray / Residual Heat Removal System	B-Containment Spray Nozzle Orifice B	CSS-06BB	CSS-SRO-002B
	Containment Spray / Residual Heat Removal System	B-Containment Spray Nozzle Orifice C	CSS-06BC	CSS-SRO-003B
	Containment Spray / Residual Heat Removal System	B-Containment Spray Nozzle Orifice D	CSS-06BD	CSS-SRO-004B
	Containment Spray / Residual Heat Removal System	C-Containment Spray Nozzle Orifice A	CSS-06CA	CSS-SRO-001C
	Containment Spray / Residual Heat Removal System	C-Containment Spray Nozzle Orifice B	CSS-06CB	CSS-SRO-002C
	Containment Spray / Residual Heat Removal System	C-Containment Spray Nozzle Orifice C	CSS-06CC	CSS-SRO-003C
	Containment Spray / Residual Heat Removal System	C-Containment Spray Nozzle Orifice D	CSS-06CD	CSS-SRO-004C
	Containment Spray / Residual Heat Removal System	D-Containment Spray Nozzle Orifice A	CSS-06DA	CSS-SRO-001D
	Containment Spray / Residual Heat Removal System	D-Containment Spray Nozzle Orifice B	CSS-06DB	CSS-SRO-002D
	Containment Spray / Residual Heat Removal System	D-Containment Spray Nozzle Orifice C	CSS-06DC	CSS-SRO-003D
	Containment Spray / Residual Heat Removal System	D-Containment Spray Nozzle Orifice D	CSS-06DD	CSS-SRO-004D
	Charging Injection System	A-Reactor Coolant Pump	Not modeled in PRA	RCS-MPP-001A
	Charging Injection System	B-Reactor Coolant Pump	Not modeled in PRA	RCS-MPP-001B

Table 1 Component ID List in PRA and RAP (sheet 8 of 8)

	System	Equipment Name	Component ID in PRA (Chapter 19)	Component ID in RAP (Chapter 17)
	Charging Injection System	C-Reactor Coolant Pump	Not modeled in PRA	RCS-MPP-001C
	Charging Injection System	D-Reactor Coolant Pump	Not modeled in PRA	RCS-MPP-001D
	Boric Acid Transfer	A-Boric Acid Transfer Pump	CVS-APP-002A	CVS-MPP-002A
	Boric Acid Transfer	B-Boric Acid Transfer Pump	CVS-APP-002B	CVS-MPP-002B
	Boric Acid Transfer	Boric Injection Line Air-Operated Valve 1	CVS-FCV-220A	CVS-FCV-130A
	Boric Acid Transfer	Boric Injection Line Air-Operated Valve 2	CVS-FCV-220B	CVS-FCV-130B
	Boric Acid Transfer	Boric Acid Blender	CVS-REQ-001	CVS-SBL-001
	Boric Acid Transfer	Boric Acid Filter	CVS-AFT-004	CVS-MFT-004
	Boric Acid Transfer	A-Boric Acid Tank Water Level Transmitter	CVS-LT-206	CVS-LT-116
	Boric Acid Transfer	B-Boric Acid Tank Water Level Transmitter	CVS-LT-208	CVS-LT-118
	Boric Acid Transfer	A-Boric Acid Tank	CVS-ATK-002A	CVS-MTK-002A
	Boric Acid Transfer	B-Boric Acid Tank	CVS-ATK-002B	CVS-MTK-002B
	Pressurizer Control System	Pressurizer Relief Tank	RCS-CTK-003	RCS-MTK-003
	Reactor Protection System	A-Steam Generators	Not modeled in PRA	RCS-MPP-001A
	Reactor Protection System	B-Steam Generators	Not modeled in PRA	RCS-MPP-001B
	Reactor Protection System	C-Steam Generators	Not modeled in PRA	RCS-MPP-001C
	Reactor Protection System	D-Steam Generators	Not modeled in PRA	RCS-MPP-001D
	Reactor Protection System	Reactor Vessel	Not modeled in PRA	RCS-MTK-001
	Main Steam Supply System	Main Steam Safety Valve 511A	NMS-VLV-511A	MSS-SRV-511A
	Main Steam Supply System	Main Steam Safety Valve 511B	NMS-VLV-511B	MSS-SRV-511B
	Main Steam Supply System	Main Steam Safety Valve 511C	NMS-VLV-511C	MSS-SRV-511C
	Main Steam Supply System	Main Steam Safety Valve 511D	NMS-VLV-511D	MSS-SRV-511D

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/3/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: **NO. 606-4827 REVISION 2**

SRP SECTION: **17.04 – Reliability Assurance Program (RAP)**

APPLICATION SECTION: **17.4 Reliability Assurance Program**

DATE OF RAI ISSUE: **7/20/2010**

QUESTION NO. : 17.04-58

Table 17.4-1 ("Risk-Significant SSCs") of the US-APWR DCD, Revision 2, provides the dominant failure modes for each risk-significant SSC. For the following listed SSCs, the staff requests that MHI provide the basis for not considering the associated failure modes as dominant failure modes in Table 17.4-1. [Note, some of the failure modes listed below are exhibited during implementation of risk-significant operator actions. For example, during the risk-significant operator action to operate alternate containment cooling, the operator closes isolation valves VWS-MOV-401, 409. Therefore, failure modes OM (spurious opening) and CD (fail to close) could be dominant failure modes for these valves.]

Component ID in Table 17.4-1 of DCD	Potentially Dominant Failure Modes
NCS-MOV-020C,D (Page 17.4-12)	OD (fail to open), CM (spurious closure)
[Note, operator action for alternate containment cooling by containment fan cooler unit requires opening these valves.]	
NCS-MOV-007C,D (Page 17.4-12)	OD (fail to open), CM (spurious closure)
[Note, operator action for alternate containment cooling by containment fan cooler unit requires opening these valves.]	
Piping (Item 49 on Page 17.4-16)	Failure mode "SF" (software failure) in Table 17.4-1 does not appear to be correct.
EFS-VLV-020A, B, C, D (Page 17.4-19)	OD (fail to open)
EFS-VLV-022A, B, C, D (Page 17.4-19	OD (fail to open)
EFS-MOV-014A, B, C, D (Page 17.4-19)	OD (fail to open), CD (fail to close), CM (spurious closure), OM (spurious opening)
EFS-MOV-019A, B, C, D (Page 17.4-19)	OD (fail to open), CD (fail to close), CM (spurious closure), OM (spurious opening)

EFS-VLV-102A, B, C, D (Page 17.4-20)	OD (fail to open), PR (plug)
VWS-MOV-401, 409 (Page 17.4-27)	CD (fail to close), OM (spurious opening)
SIS-VLV-010A, B, C, D (Page 17.4-30)	FS (functional failure by seismic hazard)
MSS-MOV-507A, B, C, D (Page 17.4-37)	Is failure mode "CF" correct in Table 17.4-1? This failure mode is not defined in Table 17.4-1.
RHS-MOV-021A, B, C, D (Page 17.4-39)	OD (fail to open), CD (fail to close), CM (spurious closure), OM (spurious opening)
RWS-VLV-012A,B (Page 17.4-42)	OD (fail to open)
RWS-VLV-006A,B (Page 17.4-42)	PR (plug)
RWS-VLV-013A,B (Page 17.4-42)	PR (plug)
RWS-VLV-005 (Page 17.4-42)	PR (plug)
RWS-VLV-014 (Page 17.4-43)	PR (plug)
RWS-VLV-101 (Page 17.4-43)	OD (fail to open), PR (plug)
RWS-AOV-022 (Page 17.4-43)	OD (fail to open), CD (fail to close), CM (spurious closure), OM (spurious opening)
RWS-VLV-023 (Page 17.4-43)	OD (fail to open)
Control Rods (Page 17.4-44)	Is failure mode "CF" correct in Table 17.4-1? in Table 17.4-1.
Control Rod Drive Mechanism (Page 17.4-44)	Is failure mode "CF" correct in Table 17.4-1? This failure mode is not defined in Table 17.4-1.

ANSWER:

US-APWR PRA models that either operator error or component failure will result in the mitigation system failure. For example, when water in the EFW pit cannot be supplied to an intact SG by EFW pump, operator attempts to open EFW tie-line valves [EFS-MOV-014A (B-D)]. Then, the failure factor is mainly categorized into human error, valve failure (fail to open, plug and spurious close) and their support system failure such as electric power supply. The importance analysis can estimate the risk importance measures for the component failure related to risk-significant operator actions.

The followings are the discussion to identify dominant failure mode, based on the design characteristics or identification criteria (FV importance ≥ 5.0E-03 or RAW ≥ 2.0). Table 17.4-1 will be revised to reflect the following discussion.

<u>NCS-MOV-020C and 020D and NCS-MOV-007C and 007D</u>

The following failure modes are related to risk-significant operator action for alternate containment cooling system.

- OD (fail to open)

  The failure mode with RAW higher than 2.0 is dominant and will be added to Table 17.4-1.

- CM (spurious close)

  FV importance and RAW are less than 1.0E-07 and 1.1, respectively. The mode is not considered to be risk-significant.

Piping (CCW system)

"SF" is the editorial error, and this failure mode will be deleted in Table 17.4-1.

EFS-VLV-020A (B-D) and FS-VLV-022A (B-D)

These valves are normally close and also remaining closed during an accident. For test and maintenance of EFW pumps, these valves are opened.

- OD (fail to open)

  Even if the valves fail to open, water in EFW pit can be supplied to SG. The failure mode has no impact on the availability of EFWS and not be added in Table 17.4-1.

EFS-MOV-014A (B-D)

These valves are normally closed. When water in EFW pit cannot be supplied to an intact SG by EFW pump in the same train, operator attempts to open the valves.

- OD (fail to open)

  FV importance and RAW are less than 1.0E-04 and 1.7, respectively. The mode is not considered to be risk-significant.
- CD (fail to close)

  The valves are not required to close during an accident. The failure mode has no impact on the availability of mitigation system and is not considered to be risk-significant.
- CM (spurious close)

  FV importance and RAW are less than 1.0E-06 and 1.5, respectively. The mode is not considered to be risk-significant.
- OD (spurious open)

  If the valves spuriously are opened during an accident, water in EFW pit can be supplied to an intact SG. The failure mode has no impact on the availability of EFWS. The mode is not considered to be risk-significant.

EFS-MOV-019A (B-D)

These valves are normally opened. The valve is automatically closed by detection of EFW isolation signal to isolate a ruptured SG.

- OD (fail to open)

  The valves are not required to open. The failure mode is not related to the availability of the mitigation system and is not considered to be risk-significant.
- CD (fail to close)

  FV importance and RAW are less than 1.0E-04 and 1.1, respectively. The mode is not considered to be risk-significant.
- CM (spurious close)

  FV importance and RAW are less than 1.0E-06 and 1.6, respectively. The mode is not considered to be risk-significant.
- OD (spurious open)

  FV importance and RAW are less than 1.0E-07 and 1.1, respectively. The mode is not considered to be risk-significant.

EFS-VLV-102A (B-D)

- OD (fail to open)

  FV importance and RAW are less than 1.0E-09 and 1.1, respectively. The mode is not considered to be risk-significant.
- PR (Plug)

  FV importance and RAW are less than 1.0E-09 and 1.1, respectively. The mode is not considered to be risk-significant.

VWS-MOV-401 and 409

The following failure modes are related to risk-significant operator action for alternate containment cooling system.

- CD (fail to close)
  FV importance and RAW are less than 1.0E-05 and 1.1, respectively. The mode is not considered to be risk-significant.
- OM (Spurious open)
  FV importance and RAW are less than 1.0E-10 and 1.1, respectively. The mode is not considered to be risk-significant.

SIS-VLV-010A (B-D)

As the NRC's staffs mentioned, the failure mode "FS" (functional failure by seismic hazard) are considered to be dominant and will be added in Table 17.4-1.

MSS-MOV-507A (B-D)

"CF" is the MHI's editorial error. The failure mode "CD" (Fail to close) is correct and will be added to Table 17.4-1.

RHS-MOV-021A (B-D)

These valves are normally locked close. Operator attempts to open the valves to inject water into the cold leg (Alternate core cooling).

- OD (fail to open)
  The failure mode with RAW exceeding 2.0 is dominant and will be added to Table 17.4-1.
- CD (fail to close)
  The valves are not required to close during accident. The failure mode has no impact on the availability of the mitigation system and is not considered to be risk-significant.
- CM (spurious close)
  The failure mode with RAW exceeding 2.0 is dominant and will be added to Table 17.4-1.
- OM (spurious open)
  The valves are normally locked close during plant operation and are not spuriously opened. The failure mode is not considered to be risk-significant.

RWS-VLV-012A and 012B

The valves are required to open for supplying water in RWSP to refueling water storage auxiliary tank (RWSAT) by refueling water recirculation pump during low-power and shutdown operation.

- OD (fail to open)
  FV importance and RAW are less than 1.0E-10 and 2.0, respectively. The mode is not considered to be risk-significant.

RWS-VLV-006A and 006B

These valves are normally opened.

- PR (plug)
  FV importance and RAW are less than 1.0E-06 and 1.1, respectively. The mode is not considered to be risk-significant.

RWS-VLV-013A and 013B

These valves are normally opened.

- PR (plug)
  FV importance and RAW are less than 1.0E-06 and 1.1, respectively. The mode is not considered to be risk-significant.

RWS-VLV-005

These valves are normally opened.

- PR (plug)
  FV importance and RAW are less than 1.0E-06 and 1.1, respectively. The mode is not considered to be risk-significant.

RWS-VLV-014

This valve is normally opened.

- PR (plug)
  FV importance and RAW are less than 1.0E-06 and 1.1, respectively. The mode is not considered to be risk-significant.

RWS-VLV-101

This valve is normally closed and remaining closed during an accident.

- OD (fail to open)
  The failure mode has no impact on the availability of mitigation system and is not considered to be risk-significant.
- PR (plug)
  If there is plugging in the valve, the failure mode has no impact on the availability of the mitigation system because of normally closing. The mode is not considered to be dominant.

RWS-AOV-022

This valve is normally opened and automatically closed upon detection of containment isolation signal.

- OD (fail to open)
  The valve is not required to open during an accident. The failure mode has no impact on the availability of mitigation system and is not considered to be risk-significant.
- CD (fail to close)
  The failure mode is not modeled in the PRA, However, the function may have impact on containment isolation. The failure mode is conservatively considered to be risk-significant and will be added to Table 17.4-1.
- CM (spurious close)
  If the valve spuriously closes, water in the RWSP can be supplied to safety injection pumps or CS/RHR pumps and the failure mode has no impact on the availability of mitigation system. The failure mode is considered to not be risk-signifcant.
- OM (spurious open)
  The failure mode is not modeled in the PRA, However, the function may have impact on containment isolation. The failure mode is conservatively considered to be risk-significant and will be added to Table 17.4-1

RWS-VLV-023

This valve is normally closed.

- OD (fail to open)
  The failure mode is not modeled in the PRA. If the valve fails to open, water in the RWSP can be supplied to safety injection pumps or CS/RHR pumps and the failure mode has no impact on the availability of mitigation system. Therefore, the failure mode is considered to not be risk-significant.

Control Rods

"CF" is incorrect. Failure modes modeled in the PRA are "failure of rod injection" and "fail to insert into the core". There are no failure mode terms in accordance with the modes in the PRA. New failure mode "FR" (Functional failure of Control rod) will be added to Table 17.4-1.

Control Rod Drive Mechanism

."CF" is incorrect and will be deleted in Table 17.4-1.

Impact on DCD

Regarding the expert panel, Table 17.4-1 will be revised as shown in Attachment 1 of the response in #17.04-56 of RAI #606-4827.

Impact on COLA

There is no impact on COLA from this RAI.

Impact on PRA

There is no impact on PRA from this RAI.