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November 12, 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-10311

Subject: **MHI's Responses to US-APWR DCD RAI No.649-5123 Revision 2 (SRP 19.0)**

References: 1) "Request for Additional Information No. 649-5123 Revision 2, SRP Section: 19 – Probabilistic Risk Assessment and Severe Accident Evaluation," dated October 13, 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. 649-5123 Revision 2".

Enclosed are the responses to all of the RAIs that are 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. 649-5123 Revision 2

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

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NRO

Enclosure 1

UAP-HF-10311
Docket Number 52-021

Responses to Request for Additional Information No.649-5123
Revision 2

November, 2010

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

11/12/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.:	**NO. 649-5123 REVISION 2**
SRP SECTION:	**19 – Probabilistic Risk Assessment and Severe Accident Evaluation**
APPLICATION SECTION:	**19.1.5.3**
DATE OF RAI ISSUE:	**10/13/2010**

QUESTION NO. : 19-484

The assumptions in Section 22.2.2 of the US-APWR PRA state that "Flood propagation from the flood areas which are enclosed by water tight doors are considered if the flood water leads to a high water level in the area." Please define the term "high water level" in this assumption and explain how it was implemented in the flooding models.

ANSWER:

"High water level" criterion is defined as approximately eight feet of water depth in the flood area. The criterion is established such that the flood water height is less than the height of the ventilation ducts, so that water will not propagate to other areas through the ventilation ducts.

In the internal flooding analysis, it is assumed that the flood water will propagate from the flood area to other areas through a ventilation duct or a water-tight door if a quantity of a flood water source in a flood area reaches to this specific height.

<u>Impact on DCD</u>

There is no impact on DCD.

<u>Impact on R-COLA and S-COLA</u>

There is no impact on R-COLA and S-COLA.

<u>Impact on PRA</u>

There is no impact on PRA.

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Docket No.52-021

RAI NO.:	**NO. 649-5123 REVISION 2**
SRP SECTION:	**19 – Probabilistic Risk Assessment and Severe Accident Evaluation**
APPLICATION SECTION:	**19.1.5.3**
DATE OF RAI ISSUE:	**10/13/2010**

QUESTION NO. : 19-485

The assumptions in Section 22.2.2 of the US-APWR PRA state that "The main control room is assumed to be a water tight compartment". Please describe the fluid-carrying systems in the main control room (i.e. sanitation system, fire suppression), if there are any. Also, demonstrate that no flood scenario is capable of significantly impacting the MCR including propagation through ventilation ducts. In addition, this appears to be a key assumption that should be included in the US-APWR DCD Table 19.1.5.3.1. Please include it in the DCD or explain why it is not a key assumption.

ANSWER:

The main control room (MCR) and the adjoined break room are separated from other areas with walls and water-tight doors. There are no fluid systems in the MCR (FA2-308-01). The adjoined break room (FA2-308-02) includes fluid-carrying systems such as fire suppression equipment. The MCR and the break room are separated by a wall and a door. The penetrations on the wall under the raised floor are sealed to prevent the propagation of leaked water in the break room or the MCR. The MCR ventilation systems are wholly contained within the MCR envelope and the MCR ventilation system ducts do not communicate with other areas which might be subject to flooding. Therefore, there is no flood propagation to the MCR from ventilation ducts.

The door between the MCR and the break room is not water-tight. If a flood has occurred in the break room, the water source will possibly propagate to the MCR through the door. However, the operators are in the MCR 24 hours a day; therefore, a flood in the break room would be recognized immediately and the leak would be isolated by the operator.

In the flood scenario of FA2-308-02, it is assumed that a general transient (manual trip) will occur. The CDF for the scenario is 1.73E-12/RY (1.4E-5(frequency) $\times$ 1.3E-7(CCDP) = 1.7E-12(/RY)).

The flood scenario of FA2-308-02 described in the PRA report MUAP-07030(R2) that assumed flood propagation to Class 1E I&C rooms will be eliminated.

The assumption no. c.16 in the PRA report MUAP-07030(R2) Section 22.2.2 will be revised as follows:

"A water leak in the break room that adjoins the MCR would be isolated immediately by the operators in the MCR."

This assumption is also to be included in DCD Chapter 19 Subsection 19.1.5.3.1.

<u>Impact on DCD</u>

DCD Chapter 19 Subsection 19.1.5.3.1 will be revised as follows.

(Add assumption "p" after the assumption "o" on page 19.1-93 of DCD Subsection 19.1.5.3.1)

p. A water leak in the break room that adjoins the MCR would be isolated immediately by the operators in the MCR.

<u>Impact on R-COLA and S-COLA</u>

There is no impact on R-COLA and S-COLA.

<u>Impact on PRA</u>

The PRA report MUAP-07030(R2) will be revised to include the above discussion.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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RAI NO.:	**NO. 649-5123 REVISION 2**
SRP SECTION:	**19 – Probabilistic Risk Assessment and Severe Accident Evaluation**
APPLICATION SECTION:	**19.1.5.3**
DATE OF RAI ISSUE:	**10/13/2010**

QUESTION NO. : 19-486

Table 22.3-1 in Chapter 22 of the US-APWR PRA indentifies the internal flooding areas considered in the flooding PRA. The NRC staff finds that flooding areas FA7-201, FA7-202, FA7-203 and FA7-204 are being excluded from the flooding assessment. Please provide explanation for the exclusion or include these flooding areas in the flooding PRA, as appropriate.

ANSWER:

The flooding areas FA7-201, FA7-202, FA7-203 and FA7-204 are train A, B, C, and D essential service water pump areas, respectively.

These flood areas are not excluded from the flooding assessment, as shown in Table 22.5-3 (sheet 79) and Table 22.6-2 (sheet 7, 8 and 18) of the PRA report. However, Table 22.3-1 of the PRA report is missing the flood areas.

The information for flooding areas FA7-201, FA7-202, FA7-203 and FA7-204 will be included in Table 22.3-1 of the PRA report.

Impact on DCD

There is no impact on DCD.

Impact on R-COLA and S-COLA

There is no impact on R-COLA and S-COLA.

Impact on PRA

The PRA report MUAP-07030(R2) Chapter 22 Table 22.3-1 will be revised.

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SRP SECTION:	**19 – Probabilistic Risk Assessment and Severe Accident Evaluation**
APPLICATION SECTION:	**19.1.5.3**
DATE OF RAI ISSUE:	**10/13/2010**

QUESTION NO. : 19-487

Section 22.4 of the US-APWR PRA indicates that some flooding scenarios were screened out using the qualitative criteria of (a) no flood sources in the flood area and (b) no PRA components in the flood area and propagation areas. The staff cannot find the screened flooding areas (scenarios) as a result of this qualitative screening process. Please identify them and state the basis for screening.

ANSWER:

The qualitative criteria are (a) no flood sources in the flood area and (b) no PRA components in the flood area and propagation areas.

The auxiliary building and access building are screened out because there are no PRA components in these buildings (screening criteria (b).).

In the reactor building (R/B), the tendon gallery (FA2-123-01) and buttress shaft (FA2-207-01 and FA2-208-01) are screened out because there are no flood sources (screening criteria (a)) and no PRA components (screening criteria (b).)

<u>Impact on DCD</u>

There is no impact on DCD.

<u>Impact on R-COLA and S-COLA</u>

There is no impact on R-COLA and S-COLA.

<u>Impact on PRA</u>

The PRA report MUAP-07030(R2) will be revised to include the above information.

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RAI NO.:	**NO. 649-5123 REVISION 2**
SRP SECTION:	**19 – Probabilistic Risk Assessment and Severe Accident Evaluation**
APPLICATION SECTION:	**19.1.5.3**
DATE OF RAI ISSUE:	**10/13/2010**

QUESTION NO. : 19-488

US-APWR DCD, Table 19.1-72 shows the risk-significant contributors to the internal flooding CDF based on the RAW importance measure. The staff cannot distinguish between basis events "EPSCF4CBWR4I-ALL," "EPSCF4CBWR4I-124," and "EPSCF4CBWR4I-134" shown in this table since their descriptions are similar. Please provide the appropriate descriptions for these events and revise the US-APWR DCD accordingly.

ANSWER:

The differences of the basic events are due to a combination of circuit breaker common cause failures.

The revision of the basic event descriptions in Table 19.1-72 of the DCD will be as follows:

EPSCF4CBWR4I-ALL: Common cause failure of all four circuit breakers between 6.9 kV buses and 6.9 kV/480V safety power transformers - failure to remain closed.

EPSCF4CBWR4I-124: Common cause failure of A, B, and D train circuit breakers between 6.9 kV buses and 6.9 kV/480V safety power transformers - failure to remain closed.

EPSCF4CBWR4I-134: Common cause failure of A, C, and D train circuit breakers between 6.9 kV buses and 6.9 kV/480V safety power transformers - failure to remain closed.

Impact on DCD

Table 19.1-72 of DCD Chapter will be revised to include the above descriptions.

Impact on R-COLA and S-COLA

There is no impact on R-COLA and S-COLA.

Impact on PRA

There is no impact on PRA.

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RAI NO.:	**NO. 649-5123 REVISION 2**
SRP SECTION:	**19 – Probabilistic Risk Assessment and Severe Accident Evaluation**
APPLICATION SECTION:	**19.1.5.3**
DATE OF RAI ISSUE:	**10/13/2010**

QUESTION NO. : 19-489

The sensitivity analysis discussed in the US-APWR DCD Section 19.1.5.3.2 and Section 22.7.2 of the US-APWR PRA is not clearly presented. This first sensitivity study represents the difficulty of switching to alternate gas turbine generators for power supply to class 1E buses. In this case, loss of offsite power due to flooding in T/B was assumed to occur with a probability of 1.0. The resulting CDF was found to be 2.4E-06/yr. The staff is unable to follow this case and reproduce the values since the presented information is too limited. Please clearly describe in more detail how this sensitivity case was conducted and revise the US-APWR DCD accordingly.

ANSWER:

The base case of the internal flooding does not consider the occurrence of loss of offsite power (LOOP) due to turbine building flooding. Separation of the electrical rooms on the first floor and the second floor of the T/B is provided so that the electrical rooms will not be affected by a single flood or fire. This design feature reduces the risk from loss of offsite power caused by flooding in the T/B.

This sensitivity study was performed to assess the effects to risk if LOOP occurred due to turbine building flooding. The CDF and LRF of this scenario result in 1.1E-06/RY and 3.1E-08/RY, respectively, as described in DCD Section 19.1.5.3.2. This is because--in the case of LOOP--the operator can switch over the Class 1E bus power sources to the alternate gas turbine generators in the event where all Class 1E gas turbine generators have failed.

The total CDF from other flood scenarios is approximately the same as that for the base case flooding scenario (CDF of 1.4E-6/RY); however, if the loss of offsite power scenario is included, the total flooding CDF will increase to 2.4E-06/RY(rounded off to the nearest decimal). This result shows that this design feature is effective in reducing flooding risk.

<u>Impact on DCD</u>

DCD Chapter 19 Subsection 19.1.5.3.2 will be revised as follows:

(Revise the last paragraph on page 19.1-99 of DCD)

Separation of the electrical rooms on the first floor and the second floor of the T/B is provided so that the electrical rooms will not be affected by a single flood or fire. This design feature reduces the risk from loss of offsite power caused by flooding in the T/B. To assess the risk benefit of this design feature, a sensitivity analysis assuming that a flood in the T/B will result in loss of offsite power was performed. If the electrical room of the T/B is not separated into different flooding zones, flooding in the T/B followed by failure of all Class 1E gas turbine generators will result in a station blackout. The CDF and LRF of this scenario are 1.1E-06/RY and 3.1E-08/RY, respectively. The total CDF from other flood scenarios is approximately the same as that for the base case flooding scenario (CDF of 1.4E-6/RY); however, if the loss of offsite power scenario is included, the total flooding CDF will increase to 2.4E-06/RY. This result shows that this design feature is effective in reducing flooding risk.

<u>Impact on R-COLA and S-COLA</u>

There is no impact on R-COLA and S-COLA.

<u>Impact on PRA</u>

The PRA report, MUAP-07030(R2) Chapter 22 Section 22.7.2, will be revised to include the above discussion.

LOOP due to flooding in the turbine building has not been considered because of the separation of the electrical rooms. This sensitivity study was selected to determine the related effectiveness of the design measures in the turbine building in order to reduce the potential of LOOP.

The CDF and LRF results of this sensitivity study scenario are 1.1E-06/RY and 3.1E-08/RY, respectively. Considering that the total CDF from other flood scenarios are approximately the same with the base case flooding CDF (1.4E-06/RY), the flood risk when assuming no separation in the T/B electrical rooms will be increased to 2.4E-06/RY(rounded off to the nearest decimal). This significant increase in risk shows that this design feature is effective to reduce flooding risk.

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RAI NO.: **NO. 649-5123 REVISION 2**

SRP SECTION: **19 – Probabilistic Risk Assessment and Severe Accident Evaluation**

APPLICATION SECTION: **19.1.5.3**

DATE OF RAI ISSUE: **10/13/2010**

QUESTION NO. : 19-490

Section 19.1.5.3.2 of the US-APWR DCD states that "Uncertainties in the evaluation of different flood isolation strategies implicitly involve accounting for uncertainties in spill rate distributions, and the time to reach a critical flood volume." This statement is unclear.

a) Please provide an example of a flood isolation strategy. Does this apply to the entire plant or a specific area?

b) How are flooding isolation strategies applied in the uncertainty analysis? Please explain "spill rate distribution." What distribution is used for the spill rate and the reference used for this distribution?

c) What uncertainties are included when determining the time to reach a critical flood volume?

Please revise the DCD to clearly describe the meaning of this statement based on the responses to items a, b, and c above.

ANSWER:

The uncertainty analysis performed related to the uncertainty of flooding initiating events in EPRI-TR-1013141, and random failures modeled in the system analysis. The other uncertainties such as flooding isolation strategies, spill rate, and time to reach a critical flood volume, are not considered in the uncertainty analysis because the internal flooding assessment treated them as bounding conditions as follows:

a) Internal flooding assessment did not take credit for operator isolation actions. The only exception is the flooding isolation in the break room adjacent to the MCR.

b) Since flooding isolation is not credited, the flooding assessment is a bounding case, in terms of spill rate. The uncertainty of flooding isolation in the break room adjacent to the MCR is discussed in response to question 19-485.

c) Since the flooding assessment does not take credit for flooding isolation, it is assumed that the flood will reach the critical flood volume instantly if the flood source contains a sufficient amount of water. Accordingly it can be said that the flooding assessment establishes a bounding condition in terms of time to reach critical flood volume.

The DCD wording identified in the question was intended to say that those uncertainties would be covered in this bounding analysis.

The sentence will be revised to read "Flooding isolation is not credited in the flooding assessment except for a flood in the break room adjacent to the MCR. Accordingly, the flooding assessment bounds uncertainties due to flooding isolation, spill rate distributions, and the time to reach a critical flood volume."

Impact on DCD

DCD Chapter 19 Subsection 19.1.5.3.2 will be revised as follows.

(Revise the third sentence of the second paragraph on page 19.1-100 of DCD)

Flooding isolation is not credited in the flooding assessment except for a flood in the break room adjacent to the MCR. Accordingly, the flooding assessment bounds uncertainties due to flooding isolation, spill rate distributions, and the time to reach a critical flood volume.

Impact on R-COLA and S-COLA

There is no impact on R-COLA and S-COLA.

Impact on PRA

There is no impact on PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.:	**NO. 649-5123 REVISION 2**
SRP SECTION:	**19 – Probabilistic Risk Assessment and Severe Accident Evaluation**
APPLICATION SECTION:	**19.1.5.3**
DATE OF RAI ISSUE:	**10/13/2010**

QUESTION NO. : 19-491

As discussed in US-APWR DCD Section 19.1.5.3.2 and PRA Section 22.7, only two sensitivity studies were performed related to the internal flooding events. RG 1.206 Section C.I.19.6 states that:

"The objectives of the sensitivity studies are to (1) determine the sensitivity of the estimated risk to potential biases in numerical values, such as initiating event frequencies, failure probabilities, and equipment unavailabilities; (2) determine the impact of potential lack of modeling details on the estimated risk; and (3) determine the sensitivity of the estimated risk to previously raised issues."

To meet the above objectives (i.e., similar to the type of sensitivity studies performed for internal events and internal fires PRA), please perform additional sensitivity studies in conformance with the guidance provided in RG 1.206. Examples of additional sensitivity studies would be: (1) assume that the control room is not protected from flooding (e.g., ventilation ducts are not isolated), (2) assume no human actions are taken to protect risk significant flood areas from flooding, (3) etc.

ANSWER:

Two sensitivity studies have been performed to determine the effectiveness of the design features and the sensitivities of the water-tight door modeling in DCD Section 19.1.5.3.2.

- Impact if a loss of offsite power occurred in the turbine building.

This sensitivity study was performed to assess the effects to risk if LOOP occurred due to turbine building flooding. The CDF and LRF of this scenario result in 1.1E-06/RY and 3.1E-08/RY, respectively, as described in DCD Section 19.1.5.3.2. This is because--in the case of LOOP--the operator can switch over the Class 1E bus power sources to the alternate gas turbine generators in the event where all Class 1E gas turbine generators have failed.

The total CDF from other flood scenarios is approximately the same as that for the base case flooding scenario (CDF of 1.4E-6/RY); however, if the loss of offsite power scenario is included, the total flooding CDF will increase to 2.4E-06/RY(rounded off to the nearest decimal). This result shows that this design feature is effective in reducing flooding risk.

- Impact if the water-tight doors are not effective.

The US-APWR provides water-tight doors in the reactor building (R/B) to prevent flooding propagation to an adjacent room or area. This sensitivity study has been selected to determine the effectiveness of the water-tight doors in reducing risk by modeling assuming the water-tight doors (except the water-tight doors between the east side and west side in the R/B) are not water-tight.

The total CDF resulting from this sensitivity study increases to 2.6E-06/RY from the CDF (1.4E-06/RY) of the base case. This result shows that this design feature is effective in reducing flooding risk.

Additionally, three sensitivity studies were performed to determine the important potential biases in numerical values and modeling.

(1) Biases of the flooding initiating frequencies

This sensitivity study is selected to determine the biases of flooding-initiating frequencies.

The pipe rupture frequencies for the internal flooding PRA used for the base case are based on EPRI-TR-1013141 Revision 1 Table 6-1. As a sensitivity analysis, case 7a in the Table 4-27 of the EPRI report (weekly leak inspection interval, ISI for wall thinning in 10 year interval, and limited coverage P_{FD} = .50) and corresponding inspection effectiveness factor (1.36E-01) are assumed in evaluating the pipe rupture frequencies.

The A-EFW pump (T/D) room (FA2-102-01) pipes and D-EFW pump (T/D) room (FA2-108-01) pipes which contributed to CDF (CDF is greater than 1.0E-08/RY) are selected as a subject for this sensitive study.

The total internal flooding CDF and LRF are 1.1E-06/RY and 2.3E-06/RY, respectively. This is 20% lower than the base case CDF of 1.4E-06/RY. This result shows that a development of an adequate inspection program would be effective in reducing flood risk.

(2) Impact of the modeling for flooding propagation to the MCR

A flooding propagation to the MCR is not considered in the base case because the MCR is protected from flooding as described in the answer to Question 19-486.

This sensitivity study is selected to determine the impact of modeling in the case of flooding propagation to the MCR. In this case, the operator actions in the MCR or the RSC are assumed as that for the fire event in the MCR. The modeling of this sensitivity study case is as follows:

- Quantification of the MCR event tree

The flooding scenario in the MCR is evaluated using the MCR event tree which has been developed for the MCR fire risk assessment. The MCR event tree is shown in Figure 1. The operator action from the remote shutdown console (RSC) has been considered in the fault trees as shown in Figure 2.

- Human error (basic event is MCROO01IFPSA) of the water source isolation in the break room (FA2-308-02) is considered. The following assumptions are used as input to quantify the HEP of MCROO01IFPSA operator action.

<u>EOP Type</u>: This action is no EOP
<u>Behavior Category</u>: Skill-based (because the operators in the MCR would be able to immediately notice the flood in the break room)
<u>Task Type</u>: Step by Step
<u>Stress Level</u>: Moderately High (Flood has no potential for harm operators)
<u>Recovery</u>: MCR - SRO-1 and SRO-2

The MCROO01IFPSA operator action HEP is quantified as follows:

Item No.	Subtask Description	Basic HEP	Recovery Factor		Modified HEP
		RO	SRO-1	SRO-2	
Cognition Aspects					
1	Operators notice that flood from fire suppression in the break room has occurred.	negligible			
Action Aspects					
1	Stop the running fire suppression pump.	0.02	0.2	0.2	8.0E-04
2	Close the fire suppression system isolation valve.	0.02	0.2	0.2	8.0E-04
Total HEP = Item 1 + Item 2					1.6E-03 (EF=5)
Total HEP (Mean)					2.6E-03 (EF=5)

- Procedure to switch over the plant control functions from the MCR to the RSC.

Both transfer switches are required for transferring control of the plant from MCR to RSC. One of the transfer switches is furnished on the "MCR/RSR Transfer Panel (1)," which is installed in the Remote Shutdown Console Room (FA2-504-01). The other is furnished on the "MCR/RSR Transfer Panel (2)," which is installed in the FA2-501-01 Non-Radioactive Zone Westside Corridor (FA2-501-11).

- Operator actions from the RSC and the HEPs

The HEPs of operator actions have been set to 0.1.

The CDF resulting from this sensitivity study scenario is 2.4E-12/RY (1.4E-5(frequency) × 1.7E-7(CCDP) = 2.4E-12 (/RY)). The LRF is 5.3E-13/RY. This result shows that an adequate operator action in the MCR and RSC is effective in reducing the internal flooding risk even though the MCR is not protected from flooding.

(3) Biases of the switching-over actions of the emergency feed water (EFW) pit

A significant contributor for flooding risk is the failure of switching over from the EFW pit to the intact EFW trains. This is because each EFW pit has a water source of 50% to perform cold shutdown. The switching-over of the EFW pit to the intact EFW lines is required in the case of severe flooding scenarios which affect two trains of EFW systems. This sensitivity study is selected to determine the sensitivity of the estimated risk if such an action is not required. If each EFW pit has a water source of 100% capacity for cold shutdown performance, the switching-over of the EFW pit is not needed in the case of severe flooding events. This is a similar sensitivity study for internal events sensitivity study of Case 11 (DCD page 19.1-44).

The total CDF and LRF resulting from this sensitivity study are 2.5E-07/RY and 1.4E-07/RY, respectively. The CDF is significantly lower than the CDF (1.4E-06/RY) of the base case. This result shows that this operator action is sensitive for internal flooding and a development of an adequate plant-specific procedure would be effective in reducing flood risk.

<u>Impact on DCD</u>

DCD Chapter 19 Subsection 19.1.5.3.2 will be revised to include discussion of the additional sensitivity studies as follows:

(Add the following paragraph after the first paragraphs on page 19.1-100 of DCD)

The pipe rupture frequencies for internal flooding PRA used for the base case are based on EPRI-TR-1013141 Revision1 Table 6-1. As a sensitivity analysis, case 7a in the Table 4-27of the EPRI report and corresponding inspection effectiveness factor are assumed in evaluating the pipe rupture frequencies. The A-EFW pump (T/D) room (FA2-102-01) pipes and D-EFW pump (T/D) room (FA2-108-01) pipes which contributed to CDF (CDF is greater than 1.0E-08/RY) are selected as a subject for this sensitive study. The total internal flooding CDF and LRF are 1.1E-06/RY and 2.3E-06/RY, respectively. This result shows that a development of an adequate inspection program would be effective in reducing flood risk.

A flooding propagation to the MCR is not considered in the base case. A sensitivity study was performed to identify the effectiveness of mitigation actions in the MCR and the RSC in the case of flood propagation to the MCR. The CDF and LRF resulting from this sensitivity study scenario are 2.4E-12/RY and 5.3E-13/RY, respectively. This result shows that an adequate operator action in the MCR and RSC is effective in reducing the internal flooding risk even though the MCR is not protected from flooding.

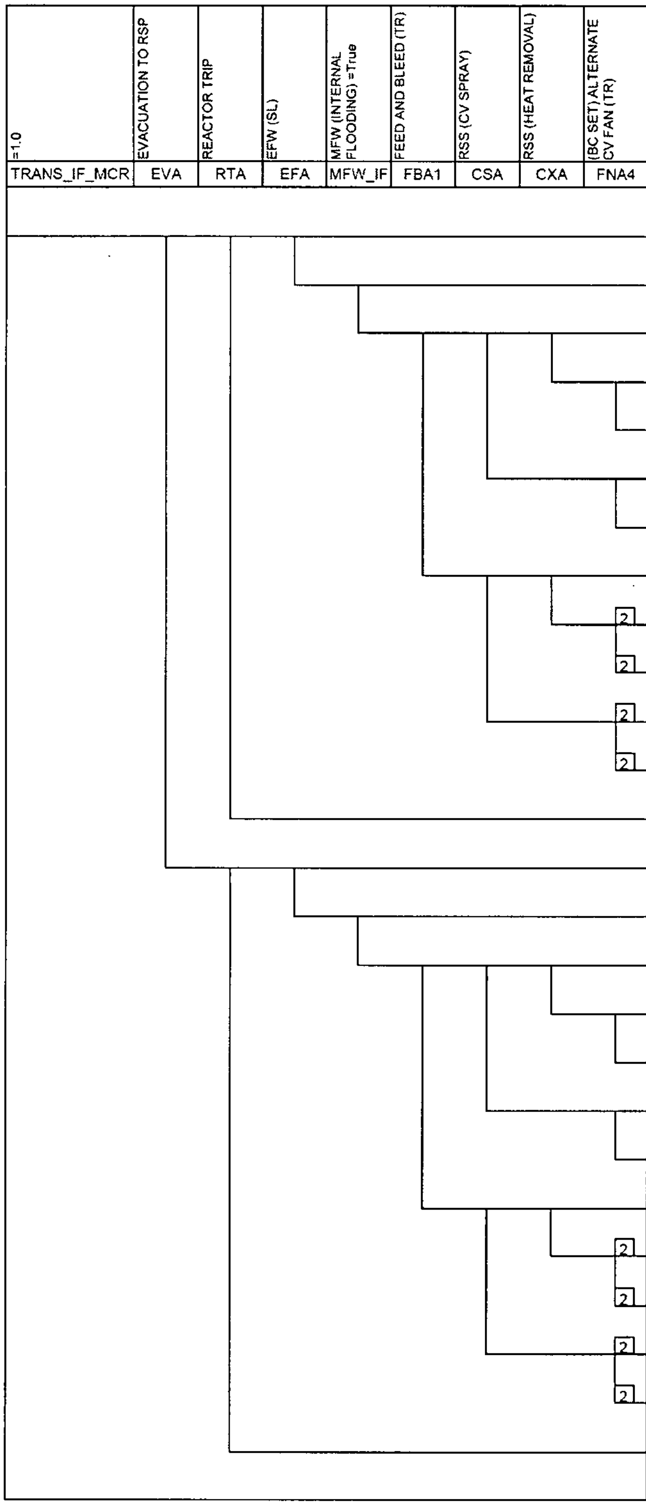
A significant contributor for flooding risk is the failure of switching over from the EFW pit to the intact emergency feed water trains. This is because each EFW pit has a water source of 50% to perform cold shutdown. This sensitivity study is selected to determine the sensitivity of the estimated risk if such an action is not required. If each EFW pit has water source of 100%, the switching over of the EFW pit is not needed in the case of severe flooding events. The total CDF and LRF resulting from this sensitivity study are reduced to 2.5E-07/RY and 1.4E-07/RY, respectively. This result shows that this operator action is sensitive for internal flooding and a development of an adequate plant-specific procedure would be effective in reducing flood risk.

Impact on R-COLA and S-COLA

There is no impact on R-COLA and S-COLA.

Impact on PRA

The PRA report MUAP-07030(R2) Chapter 22 Section 22.7.2 “Sensitivity Analysis” will be revised to include the above discussion.



No.	Freq.	Conseq.	Code
1		OK	
2		OK	EFA
3		OK	EFA-MFW_IF
4		OK	EFA-MFW_IF-CXA
5		CD, SLC	EFA-MFW_IF-CXA-FNA4
6		OK	EFA-MFW_IF-CSA
7		CD, SLC	EFA-MFW_IF-CSA-FNA4
8		CD, TEI	EFA-MFW_IF-FBA1
9		CD, TEHS	EFA-MFW_IF-FBA1-CXA
10		CD, TES	EFA-MFW_IF-FBA1-CXA-FNA4
11		CD, TEF	EFA-MFW_IF-FBA1-CSA
12		CD, TED	EFA-MFW_IF-FBA1-CSA-FNA4
13		ATWS	RTA
14		OK	EVA
15		OK	EVA-EFA
16		OK	EVA-EFA-MFW_IF
17		OK	EVA-EFA-MFW_IF-CXA
18		CD, SLC	EVA-EFA-MFW_IF-CXA-FNA4
19		OK	EVA-EFA-MFW_IF-CSA
20		CD, SLC	EVA-EFA-MFW_IF-CSA-FNA4
21		CD, TEI	EVA-EFA-MFW_IF-FBA1
22		CD, TEHS	EVA-EFA-MFW_IF-FBA1-CXA
23		CD, TES	EVA-EFA-MFW_IF-FBA1-CXA-FNA4
24		CD, TEF	EVA-EFA-MFW_IF-FBA1-CSA
25		CD, TED	EVA-EFA-MFW_IF-FBA1-CSA-FNA4
26		ATWS	EVA-RTA

Figure 1 MCR Event Tree

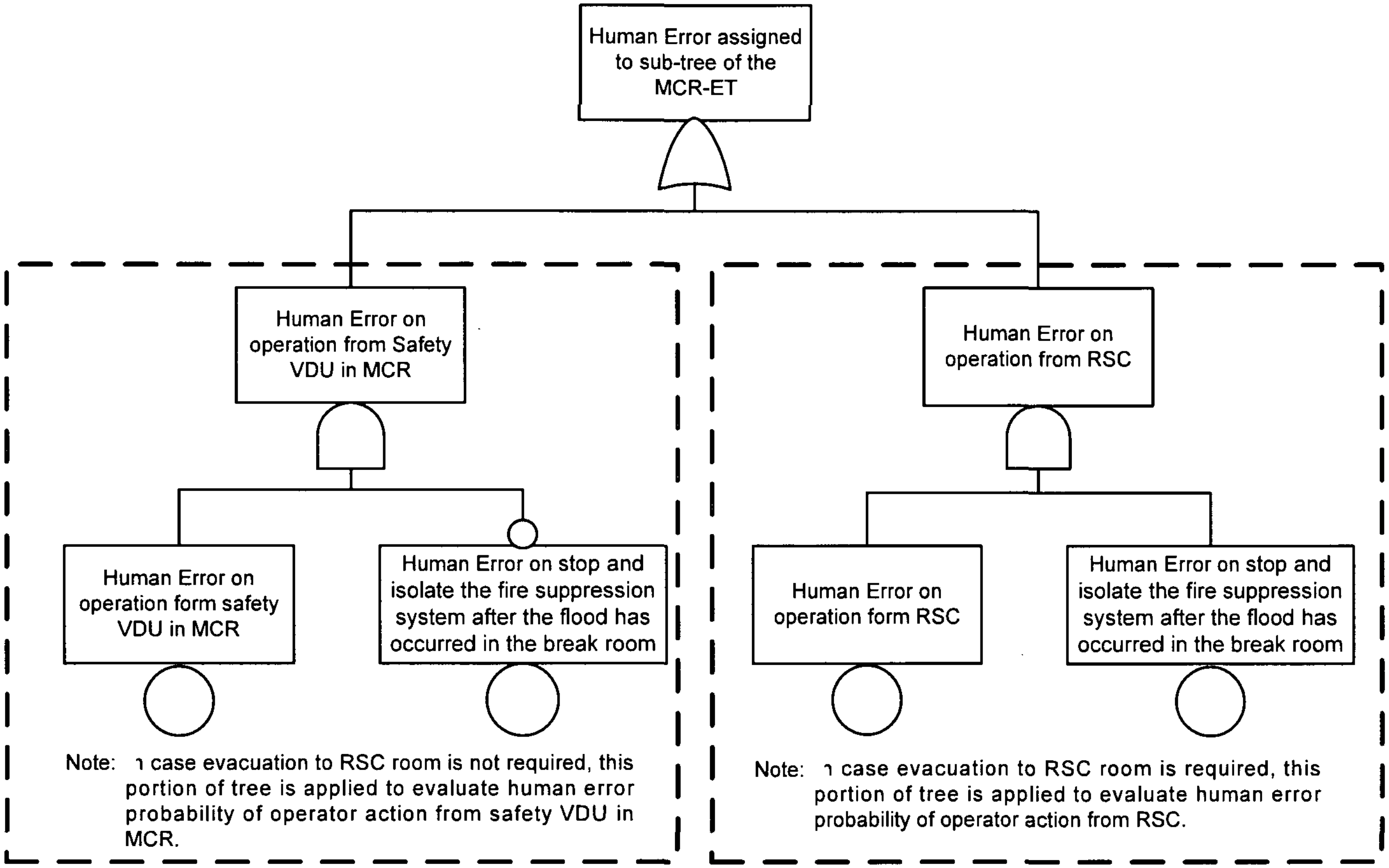


Figure 2 Human Error Probability assignment sub-tree for MCR Event Tree