



**Entergy**

Entergy Operations, Inc.  
1340 Echelon Parkway  
Jackson, Mississippi 39213-8298  
Tel: 601-368-5758

**John F. McCann**  
Director, Nuclear Safety & Licensing

CNRO-2007-00028

August 6, 2007

U. S. Nuclear Regulatory Commission  
Attn.: Document Control Desk  
Washington, DC 20555-0001

SUBJECT: Request for Alternative ANO2-R&R-004, Revision 1  
Response to NRC Request for Additional Information

Arkansas Nuclear One, Unit 2  
Docket No. 50-368  
License No. NPF-6

REFERENCE: Entergy Operations, Inc letter CNRO-2007-00015 to the NRC dated  
April 17, 2007

Dear Sir or Madam:

Per the referenced letter, Entergy Operations, Inc. (Entergy) submitted Request for Alternative ANO2-R&R-004, Rev. 1, which requested the NRC staff's authorization to implement a risk-informed safety classification (RISC) process for repair/replacement activities in Class 2 and 3 moderate energy systems at Arkansas Nuclear One, Unit 2 (ANO-2). In its review of the request, the NRC staff requested that Entergy provide a test case, or example, that demonstrates the RISC process. Entergy is providing the requested example in the enclosure to this letter to support the staff's review. Following approval of ANO2-R&R-004, Rev. 1, any specific application of this process to a plant system would be initiated and controlled in accordance with appropriate engineering programs.

In addition to submitting the requested example, Entergy revises the need date for ANO2-R&R-004, Rev. 1 to April 17, 2008. Should you have any questions regarding this submittal, please contact Guy Davant at (601) 368-5756.

This letter contains no commitments.

Very truly yours,

JFM/GHD/ghd

Enclosure: Application of Risk-Informed Safety Classification Process for  
Repair/Replacement Activities in Class 2 and 3 Moderate Energy Systems

A001

NRR

cc: Mr. J. S. Forbes (ECH)  
Mr. O. Limpas (WPO)  
Mr. T. G. Mitchell (ANO)

Dr. Bruce S. Mallett  
U. S. Nuclear Regulatory Commission  
Region IV  
611 Ryan Plaza Drive, Suite 400  
Arlington, TX 76011

U. S. Nuclear Regulatory Commission  
Attn: Mr. Alan Wang  
MS O-7D1  
Washington, DC 20555-0001

NRC Senior Resident Inspector  
Arkansas Nuclear One  
P. O. Box 310  
London, AR 72847

bcc: Mr. W. B. Abraham (G-ADM2-LIC)  
Mr. C. A. Bottemiller (G-ADM2-LIC)  
Mr. W. B. Brice (M-ECH-521)  
Mr. J. J. Costedio (K-JAF-H145)  
Mr. A. Y. Eng (K-WPO-12C)  
Ms. C. D. Faison (K-WPO-12C)  
Ms. S. T. Fontenot (W-GSB-318)  
Mr. B. S. Ford (M-ECH-521)  
Mr. K. W. Hall (M-ECH-36)  
Mr. D. E. James (N-GSB-64)  
Mr. R. S. Lewis (M-ECH-36)  
Mr. D. N. Lorfing (R-GSB-42)  
Ms. K. A. Maher (R-GSB-42)  
Mr. D. J. Mannai (V-VYP-103)  
Mr. R. J. Murillo (W-GSB-318)  
Mr. D. J. Ropson (K-WPO-11D)  
Ms. K. K. U. Tom ((K-JAF-H716)  
Ms. D. S. Waldron (N-GSB-64)  
Mr. R. W. Walpole (K-IP-GSB2E)  
Echelon Information Management File [ 54 ]

**ENCLOSURE**

**CNRO-2007-00028**

**APPLICATION OF RISK-INFORMED SAFETY CLASSIFICATION PROCESS FOR  
REPAIR/REPLACEMENT ACTIVITIES IN CLASS 2 AND 3  
MODERATE ENERGY SYSTEMS**

**APPLICATION OF RISK-INFORMED SAFETY CLASSIFICATION PROCESS  
FOR REPAIR/REPLACEMENT ACTIVITIES IN CLASS 2 AND 3  
MODERATE ENERGY PIPING SYSTEMS**

**I. OVERVIEW**

This document package contains an example application of the risk-informed safety classification (RISC) process to be applied to repair/replacement activities in Class 2 and 3 moderate energy piping systems. This process was submitted to the NRC staff for approval by Entergy Operations, Inc. (Entergy) as Request for Alternative ANO2-R&R-004, Rev. 1 via letter CNRO-2007-00015 dated April 17, 2007. The RISC process was developed by EPRI and is founded upon the EPRI risk-informed inservice inspection (RI-ISI) evaluation procedure (EPRI TR-106706, Rev B-A).

The NRC granted Arkansas Nuclear One, Unit 2 (ANO-2) approval to implement what is known as a full-scope RI-ISI program [i.e., Class 1, 2, and some 3 / non-nuclear safety (NNS) piping] using the EPRI RI-ISI procedure.<sup>1</sup> As such, the vast majority of the information necessary to support the repair/replacement relief request already exists.

The final piece of the process is what is termed "the additional considerations", which consists of a series of questions that supplement the consequence evaluation that was previously developed as part of the RI-ISI application. These additional considerations were addressed by developing draft responses and conducting an interdisciplinary review during a meeting held on July 12, 2007 at the ANO site.

**II. APPLICATION**

As requested by the NRC, Entergy has developed this example application of the RISC process by applying it to the Containment Spray System (CSS).<sup>2</sup> The CSS evaluation does not credit the Containment Cooling System (CCS), which provides another means of containment heat removal independent of CSS. As such, the consequence rank identified herein is conservative for a number of segments. However, the rank of high-ranked segments would not change since failure of these segments typically results in a loss of Emergency Core Cooling Systems (ECCS) and/or a containment bypass potential.

Table 1, below, is taken from the RI-ISI evaluation for CSS with one modification being to ID #s CSS-C-17A and -17B, which no longer credit CCS as available backup.<sup>3</sup> Figures 1 and 2, also taken from the RI-ISI evaluation, provide simplified piping diagrams of CSS.

---

<sup>1</sup> The NRC's approval is documented in a letter to ANO-2 dated December 29, 1998.

<sup>2</sup> Any specific application of this process to a plant system would be initiated and controlled in accordance with appropriate engineering programs.

<sup>3</sup> Entergy submitted the ANO-2 RI-ISI application, which included the Consequence Information Reports, to the NRC via letter 2CAN099706 dated September 30, 1997.

**TABLE 1**  
**CSS Consequence Assessment Summary**

ID	Description	Spatial Location	Configuration	Initiator	Isolation	System Impacts	Available Backup Trains	Containment	Exposure Time	Table Used (Note 1)	Rank
CSS-C-01	Common RWT suction outside	Outside	Demand	Assumed M	No	CSS, HPSI, LPSI	0	Unaffected	between test	2-2	HIGH
CSS-C-02	Common RWT suction inside	2040	Demand	Assumed M	No	CSS, HPSI, LPSI	0	Unaffected	between test	2-2	HIGH
CSS-C-03A	RWT suction A in 2040	2040	Demand	Assumed M	2CV-5630	ECCS A or all ECCS	1 (ECCS B or isolation)	Unaffected	between test	2-2	MEDIUM
CSS-C-03B	RWT suction B in 2040	2040	Demand	Assumed M	2CV-5631	all ECCS & CSS	0	Unaffected	between test	2-2	HIGH
CSS-C-04A	RWT suction A in 2014	2014	Demand	Assumed M	2CV-5630	ECCS A or all ECCS	1 (ECCS B or isolation)	Unaffected	between test	2-2	MEDIUM
CSS-C-04B	RWT suction B in 2007	2007	Demand	Assumed M	2CV-5631	ECCS B or all ECCS	1 (ECCS A or isolation)	Unaffected	between test	2-2	MEDIUM
CSS-C-05	RWT suction B in 2006	2006	Demand	Assumed M	2CV-5631	ECCS B or all ECCS	1 (ECCS A or isolation)	Unaffected	between test	2-2	MEDIUM
CSS-C-06A	Sump suction A in 2014	2014	Demand	Assumed M	2CV-5647	ECCS A or all ECCS	1 (ECCS B or isolation)	Bypass if Isol fails	all year	2-2	HIGH
CSS-C-06B	Sump suction B in 2007	2007	Demand	Assumed M	2CV-5648	ECCS B or all ECCS	1 (ECCS A or isolation)	Bypass if Isol fails	all year	2-2	HIGH
CSS-C-07A	2P-35A discharge to 2E35A	2014	Demand	Assumed M	Trip pump & 2CV-5630	ECCS A or all ECCS	1 (ECCS B or isolation)	Unaffected	between test	2-2	MEDIUM
CSS-C-07B	2P35B discharge to 2E35B	2007	Demand	Assumed M	Trip pump & 2CV-5631	ECCS B or all ECCS	1 (ECCS A or isolation)	Unaffected	between test	2-2	MEDIUM
CSS-C-08A	2P-35A mini flow	2014	Demand	Assumed M	Trip pump & 2CV-5630	CSS A	1 (CSS B)	Unaffected	between test	2-2	MEDIUM
CSS-C-08B	2P35B mini flow	2007	Demand	Assumed M	Trip pump & 2CV-5631	CSS B	1 (CSS A)	Unaffected	between test	2-2	MEDIUM

ID	Description	Spatial Location	Configuration	Initiator	Isolation	System Impacts	Available Backup Trains	Containment	Exposure Time	Table Used (Note 1)	Rank
CSS-C-09A	Downstream of 2E35A in 2014	2014	Demand	Assumed M	Trip pump & 2CV-5630	ECCS A or all ECCS	1 (ECCS B or isolation)	Unaffected	between test	2-2	MEDIUM
CSS-C-09B	Downstream of 2E35B in 2007	2007	Demand	Assumed M	Trip pump & 2CV-5631	ECCS B or all ECCS	1 (ECCS A or isolation)	Unaffected	between test	2-2	MEDIUM
CSS-C-10A	2P-35A test return in 2011	2011	Demand	Assumed M	Trip pump & 2CV-5630	ECCS A or all ECCS	1 (ECCS B or isolation)	Unaffected	between test	2-2	MEDIUM
CSS-C-10B	2P35B test return in 2011	2011	Demand	Assumed M	Trip pump & 2CV-5631	ECCS B or all ECCS	1 (ECCS A or isolation)	Unaffected	between test	2-2	MEDIUM
CSS-C-11A	Downstream of 2E35A in 2055	2055	Demand	Assumed M	Trip pump & 2CV-5630	ECCS A or all ECCS	1 (ECCS B or isolation)	Unaffected	between test	2-2	MEDIUM
CSS-C-11B	Downstream of 2E35B in 2055	2055	Demand	Assumed M	Trip pump & 2CV-5631	ECCS B or all ECCS	1 (ECCS A or isolation)	Unaffected	between test	2-2	MEDIUM
CSS-C-12A	Upstream of 2CV-5612 in 2084	2084	Demand	Assumed M	Trip pump & 2CV-5630	ECCS A or all ECCS	1 (ECCS B or isolation)	Unaffected	between test	2-2	MEDIUM
CSS-C-12B	Upstream of 2CV-5613 in 2084	2084	Demand	Assumed M	Trip pump & 2CV-5631	ECCS B or all ECCS	1 (ECCS A or isolation)	Unaffected	between test	2-2	MEDIUM
CSS-C-13A	Downstream of 2CV-5612 in 2084	2084	Demand	Assumed M	Trip pump & 2CV-5612	CSS A or all ECCS	1 (CSS B or isolation)	2BS-5A inside	all year	2-2	MEDIUM
CSS-C-13B	Downstream of 2CV-5613 in 2084	2084	Demand	Assumed M	Trip pump & 2CV-5613	CSS B or all ECCS	1 (CSS A or isolation)	2BS-5B inside	all year	2-2	MEDIUM
CSS-C-14A	Downstream of 2CV-5612 in Containment	Containment	Demand	Assumed M	Trip pump & 2CV-5612	none	2	2CV-5612 and closed system outside	all year	2-2	LOW
CSS-C-14B	Downstream of 2CV-5613 in Containment	Containment	Demand	Assumed M	Trip pump & 2CV-5613	none	2	2CV-5613 and closed system outside	all year	2-2	LOW
CSS-C-15A	NaOH to Train A	2014	Demand	Assumed M	Trip pump & 2CV-5630	ECCS A	1 ECCS B	Unaffected	between test	2-2	MEDIUM

ID	Description	Spatial Location	Configuration	Initiator	Isolation	System Impacts	Available Backup Trains	Containment	Exposure Time	Table Used (Note 1)	Rank
CSS-C-15B	NaOH to Train B	2007	Demand	Assumed M	Trip pump & 2CV-5631	ECCS B	1 ECCS A	Unaffected	between test	2-2	MEDIUM
CSS-C-16	RWT to SFPP & charging	Outside 2040	Demand	Assumed M	No	None	All	Unaffected	all year	2-2	LOW
CSS-C-17A	Service air connection to Train A	2084	Demand	Assumed M	Trip pump & 2CV-5612	CSS A	2 ECCS, Cont Cooling	2BS-5A inside	all year	2-2	MEDIUM
CSS-C-17B	Service air connection to Train B	2084	Demand	Assumed M	Trip pump & 2CV-5613	CSS B	2 ECCS, Cont Cooling	2BS-5B inside	all year	2-2	MEDIUM
CSS-C-18A (Note 2)	Downstream of 2BS-5A in Containment	Containment	Demand	Assumed M	Trip pump & 2CV-5612	none	2	2CV-5612 and closed system outside	all year	2-2	LOW
CSS-C-18B (Note 2)	Downstream of 2BS-5B in Containment	Containment	Demand	Assumed M	Trip pump & 2CV-5613	none	2	2CV-5613 and closed system outside	all year	2-2	LOW

Note 1: Tables contained in Yankee Nuclear services Division Calculation No. NSD-018, Rev. 0, August 1997, *Consequence Evaluation of ANO-2 EFW, Containment Spray, and Main Steam and Feedwater System Piping, Arkansas Nuclear 1, Unit 2*

Note 2: Segments 18A and 18B were not part of the original RI-ISI application (i.e., not within ASME Section XI scope). Postulated failures of these segments have the same impact as segments 14A and 14B.



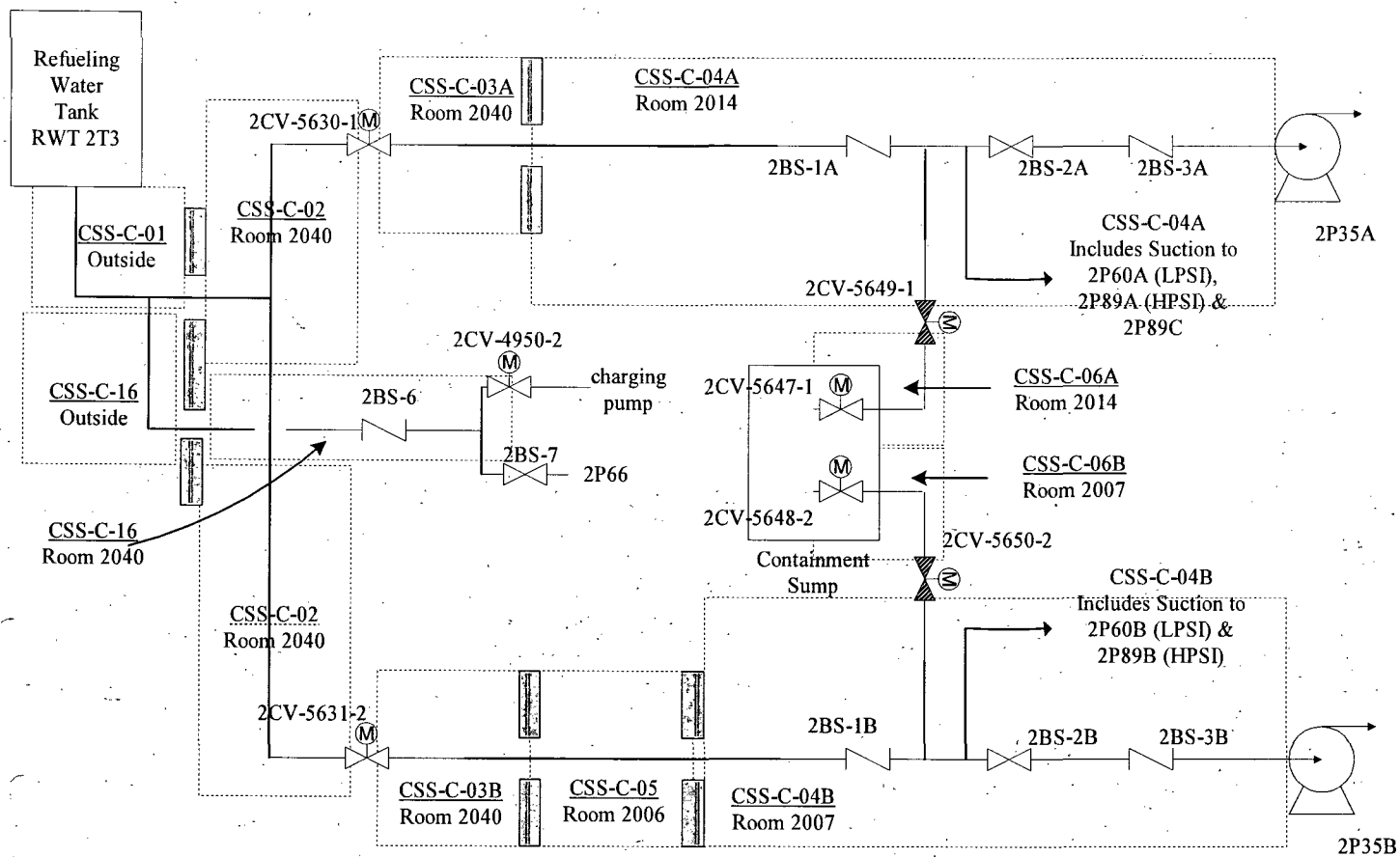


FIGURE 1

Containment Spray System (CSS) Suction

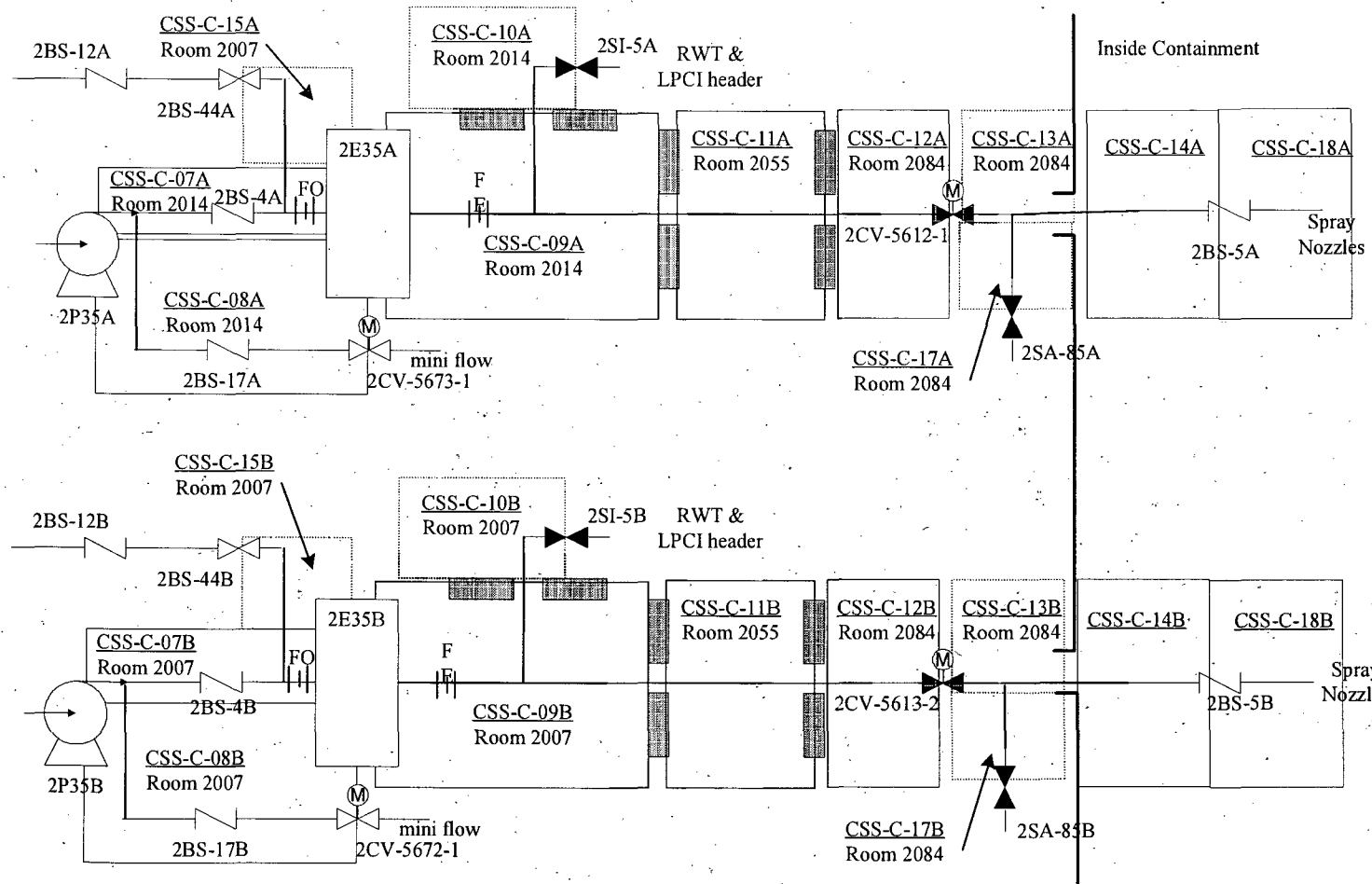


FIGURE 2

Containment Spray System (CSS) Discharge

### **III. ADDITIONAL CONSIDERATIONS**

Piping segments that were determined to be a "Medium", "Low", or "None" consequence category per the consequence evaluation are determined to be high safety significant (HSS) or low safety significant (LSS) by considering the information in Conditions (1) through (10), below.

**Note:** Although a large pressure-boundary leak is not always assumed, it was during the RI-ISI evaluations. Also, credit may be taken for plant features and operator actions to the extent these would not be affected by failure of the segment under consideration. If plant features and operator actions are credited, they shall be consistent with those credited in the previous consequence evaluations.

- (1) Failure of the pressure-retaining function of the segment will not directly or indirectly (e.g., through spatial effects) fail a basic safety function.

#### **Response**

*Per Table 1 above, any segment classified as "Medium" or "Low" will have at least one train unaffected by the postulated break. Per the glossary, loss of a single train would typically not constitute loss of a basic function.*

- (2) Failure of the pressure-retaining function of the segment will not prevent the plant from reaching or maintaining safe shutdown conditions; and the pressure-retaining function is not significant to safety during mode changes or shutdown. Assume that the plant would be unable to reach or maintain safe shutdown conditions if a pressure boundary failure results in the need for actions outside of plant procedures or available backup plant mitigative features.

#### **Response**

*Although the CSS can be used to support shutdown [e.g., as an alternative to Low Pressure Safety Injection (LPSI) pumps, the Reactor Water Tank (RWT) provides inventory for filling the refueling canal], the CSS is typically not used to support mode changes or shutdown cooling. Per the consequence evaluations conducted above, any segment classified as "Medium" or "Low" will have at least one train unaffected by the postulated break. In addition, the consequence evaluation methodology includes an assessment of piping failure during shutdown evolutions.*

- (3) The pressure-retaining function of the segment is not called out or relied upon in the plant Emergency/Abnormal Operating Procedures (EOPs) or similar guidance as the sole means for successfully performing operator actions required to mitigate an accident or transient.

#### **Response**

*While CSS is credited in the EOPs, per the consequence evaluations conducted above, any segment classified as "Medium" or "Low" will have at least one train unaffected by the postulated break. As such, these segments (i.e., those categorized as "Medium" or*

*"Low") are not the sole means for successfully performing operator actions required to mitigate an accident or transient.*

- (4) The pressure-retaining function of the segment is not called out or relied upon in the plant EOPs or similar guidance as the sole means for assuring long-term containment integrity, monitoring of post-accident conditions, or offsite emergency planning activities.

**Response**

*While CSS is credited in the EOPs, per the consequence evaluations conducted above, any segment classified as "Medium" or "Low" will have at least one train unaffected by the postulated break. As such, these segments (i.e., those categorized as "Medium" or "Low") are not the sole means for assuring long-term containment integrity. Additionally, the containment coolers provide an alternate means of containment cooling and the CSS does not provide a post-accident monitoring function or offsite emergency planning function.*

- (5) Failure of the pressure-retaining function of the segment will not result in an unintentional release of radioactive material that would result in implementing offsite radiological protective actions.

**Response**

*Failure of the CSS will not cause such events. Rather, the function of the CSS is to respond to such events (e.g., LOCAs). Additionally, per the consequence evaluations conducted above, any segment classified as "Medium" or "Low" will have at least one train unaffected by the postulated break. As such, the design basis function of the CSS will still be fulfilled.*

The RISC process shall demonstrate that the defense-in-depth philosophy is maintained. Defense-in-depth is maintained if:

- (6) Reasonable balance is preserved among prevention of core damage, prevention of containment failure or bypass, and mitigation of an offsite release.

**Response**

*This balance is preserved as there is no change to the design, design basis, or operation of the CSS by this change. The CSS is still required to reliably perform its safety-related function.*

- (7) There is no over-reliance on programmatic activities and operator actions to compensate for weaknesses in the plant design.

**Response**

*The consequence evaluation conducted reflects the as-operated/as-designed plant. This evaluation does not increase the reliance on programmatic activities or operator actions. Operator actions, when credited, are credited consistent with the approved RI-ISI consequence evaluation methodology.*

- (8) System redundancy, independence, and diversity are preserved commensurate with the expected frequency of challenges, consequences of failure of the system, and associated uncertainties in determining these parameters.

**Response**

*System redundancy, independence, and diversity are preserved since there is no change to the design, design basis, or operation of the CSS by this change. The CSS will still be required to reliably perform its safety-related function.*

- (9) Potential for common cause failures is taken into account in the risk analysis categorization.

**Response**

*Yes, "common cause" is a fundamental aspect of the consequence evaluation methodology and, therefore, is taken into account (e.g., see Table I-2 of ANO2-R&R-004, Rev. 1).*

- (10) Independence of fission-product barriers is not degraded.

**Response**

*Independence of fission barrier is not degraded since no new dependencies have been created. The CSS is still required to reliably perform its safety-related function.*

If any of the above ten (10) conditions are not true, then HSS shall be assigned. Otherwise, LSS is assigned.

Based upon the above, segments assigned to "Medium" or "Low" consequence rank do not have to be moved into the high consequence rank and can be assigned as "LSS" provided "safety margin" is adequately addressed below.

**IV. SAFETY MARGINS**

As a final step, the RISC process verifies that there are sufficient safety margins to account for uncertainty in the engineering analysis and in the supporting data. Safety margin is incorporated when determining performance characteristics and parameters; e.g., piping segment, system, and plant capability or success criteria. The amount of margin should depend on the uncertainty associated with the performance parameters in question, the availability of alternatives to compensate for adverse performance, and the consequences of failure to meet the performance goals. Sufficient safety margins are maintained by ensuring that safety analysis acceptance criteria in the plant licensing basis are met, or proposed revisions account for analysis and data uncertainty.

**Response**

*Since the safety analysis acceptance criteria in the plant licensing basis are not changed, safety margins remain unchanged and, therefore, acceptable.*

Based upon all the preceding factors a final RISC for the CSS has been determined. These results are provided in Table 2.

**TABLE 2**  
**Final RISC Assignments**

<b>ID</b>	<b>Description</b>	<b>Spatial Location</b>	<b>Rank</b>
CSS-C-01	Common RWT suction outside	Outside	HIGH
CSS-C-02	Common RWT suction inside	2040	HIGH
CSS-C-03A	RWT suction A in 2040	2040	LOW
CSS-C-03B	RWT suction B in 2040	2040	HIGH
CSS-C-04A	RWT suction A in 2014	2014	LOW
CSS-C-04B	RWT suction B in 2007	2007	LOW
CSS-C-05	RWT suction B in 2006	2006	LOW
CSS-C-06A	Sump suction A in 2014	2014	HIGH
CSS-C-06B	Sump suction B in 2007	2007	HIGH
CSS-C-07A	2P-35A discharge to 2E35A	2014	LOW
CSS-C-07B	2P35B discharge to 2E35B	2007	LOW
CSS-C-08A	2P-35A mini flow	2014	LOW
CSS-C-08B	2P35B mini flow	2007	LOW
CSS-C-09A	Downstream of 2E35A in 2014	2014	LOW
CSS-C-09B	Downstream of 2E35B in 2007	2007	LOW
CSS-C-10A	2P-35A test return in 2011	2011	LOW
CSS-C-10B	2P35B test return in 2011	2011	LOW
CSS-C-11A	Downstream of 2E35A in 2055	2055	LOW
CSS-C-11B	Downstream of 2E35B in 2055	2055	LOW
CSS-C-12A	Upstream of 2CV-5612 in 2084	2084	LOW
CSS-C-12B	Upstream of 2CV-5613 in 2084	2084	LOW
CSS-C-13A	Downstream of 2CV-5612 in 2084	2084	LOW
CSS-C-13B	Downstream of 2CV-5613 in 2084	2084	LOW
CSS-C-14A	Downstream of 2CV-5612 in Containment	Containment	LOW
CSS-C-14B	Downstream of 2CV-5613 in Containment	Containment	LOW
CSS-C-15A	NaOH to Train A	2014	LOW
CSS-C-15B	NaOH to Train B	2007	LOW
CSS-C-16	RWT to SFPP & charging	Outside 2040	LOW
CSS-C-17A	Service air connection to Train A	2084	LOW

ID	Description	Spatial Location	Rank
CSS-C-17B	Service air connection to Train B	2084	LOW
CSS-C-18A	Downstream of 2BS-5A in Containment	Containment	LOW
CSS-C-18B	Downstream of 2BS-5B in Containment	Containment	LOW

## V. CONSEQUENCE INFORMATION REPORTS

The Consequence Information Reports, which were developed for the ANO-2 RI-ISI program, summarize the consequence evaluation process.<sup>4</sup> As noted earlier, the CSS evaluation did not credit the Containment Cooling System (CCS). As such, the consequence rank identified herein is conservative for a number of segments. However, the rank for high-ranked segments would not change since failure of these segments typically results in a loss of all ECCS and / or a containment bypass potential.

### **FMECA - Consequence Information Report** 14-Sep-9

*Calculation No. A-PENG-CALC-015, Rev. 00*  
*Page A2 of A31*

**Consequence ID:** CSS-C-01

**Consequence Description:** Degradation of common RWT suction outside auxiliary building during an independent demand (line 2HCB-24 outside)

**Break Size:** Large

**Isolability of Break:** No

**ISO Comments:** Unisolable.

**Spatial Effects:** Local

**Effectuated Location:** Outside

**Spatial Effects Comments:** The common RWT suction piping outside the auxiliary building (near the RWT) can not propagate to the auxiliary building and impact safety equipment.

**Initiating Event:** N

**Initiating Event ID:** N/A

**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping. This is conservative since pipe break during normal standby may be just as likely (i.e., demand stress of RWT head is not significantly different during demand).

**Loss of System:** SM-3

**System IPE ID:** CSS, HPSI, LPSI

**System Recovery:** Loss of RWT (flow diversion) results in common cause failure of all ECCS.

**Loss of Train:** N

**Train ID:** N/A

**Train Recovery:** N/A

**Consequence Comment:** Consequence is "High" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and no backup trains). No impact on containment isolation.

**Consequence Category:** HIGH

☐

**Consequence Rank**

☐

<sup>4</sup> Entergy submitted the ANO-2 RI-ISI application, which included the Consequence Information Reports, to the NRC via letter 2CAN099706 dated September 30, 1997.

---

**FMECA - Consequence Information Report**

14-Sep-9

Calculation No. A-PENG-CALC-015, Rev. 00

Page A3 of A31

---

**Consequence ID:** CSS-C-02

**Consequence Description:** Degradation of common RWT suction upstream of 2CV-5630 & 5631 in auxiliary building during an independent demand (line 2HCB-24 in auxiliary building)

**Break Size:** Large

**Isolability of Break:** No

**ISO Comments:** Unisolable.

**Spatial Effects:** Propagation

**Effected Location:** Room 2040

**Spatial Effects Comments:** The common RWT suction piping will likely fail MCC 2B52 in the corridor at El 335 (Room 2040) and propagate to El 317 (Rooms 2006 & 2011) through floor drains and the east stairway. Also, El 317 will fill up and propagate into the ECCS rooms (2007, 2010, & 2014). Detection is provided by auxiliary building sump high level alarm and the ECCS room flood alarms in the control room, but this is irrelevant since the break is unisolable.

**Initiating Event:** N

**Initiating Event ID:** N/A

**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping. This is conservative since pipe break during normal standby may be just as likely (i.e., demand stress of RWT head is not significantly different during demand).

**Loss of System:** SM-3

**System IPE ID:** CSS, HPSI, LPSI

**System Recovery:** Loss of RWT (flow diversion) results in common cause failure of all ECCS.

**Loss of Train:** N

**Train ID:** N/A

**Train Recovery:** N/A

**Consequence Comment:** Consequence is "High" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and no backup trains). No impact on containment isolation.

**Consequence Category:** HIGH



**Consequence Rank**





---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A4 of A31*

---

**Consequence ID:** CSS-C-03A**Consequence Description:** Degradation of RWT suction A downstream of 2CV-5630 in Room 2040 during an independent demand (line 2HCB-26 in Room 2040)**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** 2CV-5630-1 can be closed from the control room. Detection is based on auxiliary building sump high level alarm and CSS low flow alarm if the break is large enough. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.**Spatial Effects:** Propagation**Effectuated Location:** Room 2040**Spatial Effects Comments:** RWT suction piping will likely fail MCC 2B52 in the corridor at El 335 (Room 2040) and propagate to El 317 (Rooms 2006 & 2011) through floor drains and the east stairway. MCC 2B52 contains breakers for normally closed CSS valves 2CV-5612-1 and 5649-1 (containment sump recirculation A). If unisolated, El 317 will fill up and propagate into the ECCS rooms (2007, 2010, & 2014) failing all ECCS. Detection is provided by auxiliary building sump high level and ECCS room flood alarms in the control room.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping. This is conservative since pipe break during normal standby may be just as likely (i.e., demand stress of RWT head is not significantly different during demand).**Loss of System:** SM-3**System IPE ID:** CSS, HPSI, LPSI**System Recovery:** Isolation failure is assumed to fail all ECCS either due to flow diversion or insufficient RWT inventory in the containment sump to support recirculation.**Loss of Train:** TM-3**Train ID:** CSS A, HPSI A, LPSI A**Train Recovery:** Isolation success leads to loss of ECCS train A.**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train - ECCS train B). The failure to isolate case is a "Medium" based on 1 backup train (isolation). No impact on containment isolation.**Consequence Category:** MEDIUM☐**Consequence Rank**☐

---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A5 of A31*

---

**Consequence ID:** CSS-C-03B**Consequence Description:** Degradation of RWT suction B downstream of 2CV-5631 in Room 2040 during an independent demand (line 2HCB-27 in Room 2040)**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** 2CV-5631-2 can be closed from the control room. Detection is based on auxiliary building sump high level alarm and CSS low flow alarm if the break is large enough. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.**Spatial Effects:** Propagation**Effected Location:** Room 2040**Spatial Effects Comments:** RWT suction piping will likely fail MCC 2B52 in the corridor at EI 335 (Room 2040) and propagate to EI 317 (Rooms 2006 & 2011) through floor drains and the east stairway. MCC 2B52 contains breakers for normally closed CSS valves 2CV-5612-1 and 5649-1 (containment sump recirculation A). If unisolated, EI 317 will fill up and propagate into the ECCS rooms (2007, 2010, & 2014) failing all ECCS. Detection is provided by auxiliary building sump high level and ECCS room flood alarms in the control room.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping. This is conservative since pipe break during normal standby may be just as likely (i.e., demand stress of RWT head is not significantly different during demand).**Loss of System:** SM-3**System IPE ID:** CSS, HPSI, LPSI**System Recovery:** Isolation failure is assumed to fail all ECCS either due to flow diversion or insufficient RWT inventory in the containment sump to support recirculation. Isolation success also leads to loss of both CSS trains due to assumed impact on MCC 2B52 before isolation. Normally closed 2CV-5612-1 can not fully open for train A success due to flood impact on its breaker in MCC2B52.**Loss of Train:** TM-2**Train ID:** HPSI B, LPSI B**Train Recovery:** Isolation success leads to loss of ECCS train B and both trains of CSS as shown above.**Consequence Comment:** Consequence is "High" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and no backup train). No impact on containment isolation.**Consequence Category:** HIGH**Consequence Rank**

---

**FMECA - Consequence Information Report**

14-Sep-9

Calculation No. A-PENG-CALC-015, Rev. 00

Page A6 of A31

---

**Consequence ID:** CSS-C-04A

**Consequence Description:** Degradation of Suction A downstream of 2CV-5630 & 2CV-5649 in Room 2014 during an independent demand (lines 2HCB-26 and 2HCB-15 downstream of 2CV-5649 in Room 2014)

**Break Size:** Large

**Isolability of Break:** Yes

**ISO Comments:** 2CV-5630-1 can be closed from the control room (break is assumed to occur during RWT injection phase). Detection is based on Room 2014 flood alarm, auxiliary building sump high level alarm, and CSS low flow alarm if the break is large enough. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.

**Spatial Effects:** Propagation

**Effectuated Location:** Room 2014

**Spatial Effects Comments:** RWT suction piping will likely flood ECCS train A in Room 2014 before isolation. Failure to isolate is assumed to propagate into Rooms 2006 & 2011 through ventilation openings, but the RWT can not flood Room 2007 (ECCS train B). However, failure to isolate can be assumed to result in loss of sufficient RWT inventory to fail containment sump recirculation. Detection is provided by ECCS room flood and auxiliary building sump high level alarms in the control room.

**Initiating Event:** N

**Initiating Event ID:** N/A

**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping. This is conservative since pipe break during normal standby may be just as likely (i.e., demand stress of RWT head is not significantly different during demand).

**Loss of System:** SM-3

**System IPE ID:** CSS, HPSI, LPSI

**System Recovery:** Isolation failure is assumed to fail all ECCS either due to flow diversion or insufficient RWT inventory in the containment sump to support recirculation.

**Loss of Train:** TM-3

**Train ID:** CSS A, HPSI A, LPSI A

**Train Recovery:** Isolation success leads to loss of ECCS train A.

**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train - ECCS train B). The failure to isolate case is a "Medium" based on 1 backup train (isolation). No impact on containment isolation.

**Consequence Category:** MEDIUM



**Consequence Rank**



---

**FMECA - Consequence Information Report**  
14-Sep-9

Calculation No. A-PENG-CALC-015, Rev. 00

Page A7 of A31

---

**Consequence ID:** CSS-C-04B

**Consequence Description:** Degradation of Suction B downstream of 2CV-5631 & 2CV-5650 in Room 2007 during an independent demand (lines 2HCB-27 and 2HCB-13 downstream of 2CV-5650 in Room 2007)

**Break Size:** Large

**Isolability of Break:** Yes

**ISO Comments:** 2CV-5631-2 can be closed from the control room (break is assumed to occur during RWT injection phase). Detection is based on Room 2007 flood alarm, auxiliary building sump high level alarm, and CSS low flow alarm if the break is large enough. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.

**Spatial Effects:** Propagation

**Effected Location:** Room 2007

**Spatial Effects Comments:** RWT suction piping will likely flood ECCS train B in Room 2007 before isolation. Failure to isolate is assumed to propagate into Rooms 2006 & 2011 through ventilation openings, but the RWT can not flood Room 2014 (ECCS train A). However, failure to isolate can be assumed to result in loss of sufficient RWT inventory to fail containment sump recirculation. Detection is provided by ECCS room flood and auxiliary building sump high level alarms in the control room.

**Initiating Event:** N

**Initiating Event ID:** N/A

**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping. This is conservative since pipe break during normal standby may be just as likely (i.e., demand stress of RWT head is not significantly different during demand).

**Loss of System:** SM-3

**System IPE ID:** CSS, HPSI, LPSI

**System Recovery:** Isolation failure is assumed to fail all ECCS either due to flow diversion or insufficient RWT inventory in the containment sump to support recirculation.

**Loss of Train:** TM-3

**Train ID:** CSS B, HPSI B, LPSI B

**Train Recovery:** Isolation success leads to loss of ECCS train B.

**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train - ECCS train A). The failure to isolate case is a "Medium" based on 1 backup train (isolation). No impact on containment isolation.

**Consequence Category:** MEDIUM



**Consequence Rank**



---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A8 of A31*

---

**Consequence ID:** CSS-C-05**Consequence Description:** Degradation of RWT suction B downstream of 2CV-5631 in Room 2006 during an independent demand (line 2HCB-27 in Room 2006)**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** 2CV-5631-2 can be closed from the control room. Detection is based on auxiliary building sump high level alarm and CSS low flow alarm if the break is large enough. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.**Spatial Effects:** Propagation**Effected Location:** Room 2006**Spatial Effects Comments:** Failure to isolate is assumed to propagate into ECCS Rooms 2007, 2010, & 2014 through ventilation openings even if they do isolate automatically on an SI signal. Also, failure to isolate can be assumed to result in loss of sufficient RWT inventory to fail containment sump recirculation. Detection is provided by auxiliary building sump high level alarm in the control room.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping. This is conservative since pipe break during normal standby may be just as likely (i.e., demand stress of RWT head is not significantly different during demand).**Loss of System:** SM-3**System IPE ID:** CSS, HPSI, LPSI**System Recovery:** Isolation failure is assumed to fail all ECCS either due to flow diversion, flooding, or insufficient RWT inventory in the containment sump to support recirculation.**Loss of Train:** TM-3**Train ID:** CSS B, HPSI B, LPSI B**Train Recovery:** Isolation success leads to loss of ECCS train B.**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train - ECCS train A). The failure to isolate case is a "Medium" based on 1 backup train (isolation). No impact on containment isolation.**Consequence Category:** MEDIUM**Consequence Rank**

---

**FMECA - Consequence Information Report***Calculation No: A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A9 of A31*

---

**Consequence ID:** CSS-C-06A**Consequence Description:** Degradation of containment sump suction A upstream of 2CV-5649 during an independent demand (line 2HCB-15 from containment sump to 2CV-5649)**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** 2CV-5647-1 can be closed from the control room. Detection is based on Room 2014 flood alarm and auxiliary building sump level.**Spatial Effects:** Propagation**Effectuated Location:** Room 2014**Spatial Effects Comments:** Containment sump suction piping will likely flood ECCS train A in Room 2014 before isolation. Failure to isolate is assumed to propagate into Rooms 2006 & 2011 through ventilation openings and draining the sump into the auxiliary building. Detection is provided by Room 2014 flood and auxiliary building sump high level alarms in the control room.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.**Loss of System:** SM-3**System IPE ID:** CSS, HPSI, LPSI**System Recovery:** Isolation failure case is assumed to lead to loss of containment sump (common cause failure of ECCS recirculation).**Loss of Train:** TM-3**Train ID:** CSS A, HPSI A, LPSI A**Train Recovery:** Isolation success leads to loss of ECCS train A recirculation.**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, all year exposure, and 1 backup train - ECCS train B). The failure to isolate case is a "Medium" based on 1 backup train (isolation). The consequence is upgraded to "High" because piping failure together with failure to isolate (MOV 2CV-5647-1 failure to close) can result in containment bypass (Table 2-4 of Ref. 9.18)**Consequence Category:** HIGH**Consequence Rank**

---

**FMECA - Consequence Information Report**  
14-Sep-9

---

Calculation No. A-PENG-CALC-015, Rev. 00  
Page A10 of A31

**Consequence ID:** CSS-C-06B

**Consequence Description:** Degradation of containment sump suction B upstream of 2CV-5650 during an independent demand (line 2HCB-13 from containment sump to 2CV-5650)

**Break Size:** Large

**Isolability of Break:** Yes

**ISO Comments:** 2CV-5648-2 can be closed from the control room. Detection is based on Room 2007 flood alarm and auxiliary building sump level.

**Spatial Effects:** Propagation

**Effected Location:** Room 2007

**Spatial Effects Comments:** Containment sump suction piping will likely flood ECCS train B in Room 2007 before isolation. Failure to isolate is assumed to propagate into Rooms 2006 & 2011 through ventilation openings and draining the sump into the auxiliary building. Detection is provided by Room 2007 flood and auxiliary building sump high level alarms in the control room.

**Initiating Event:** N

**Initiating Event ID:** N/A

**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.

**Loss of System:** SM-3

**System IPE ID:** CSS, HPSI, LPSI

**System Recovery:** Isolation failure case is assumed to lead to loss of containment sump (common cause failure of ECCS recirculation).

**Loss of Train:** TM-3

**Train ID:** CSS B, HPSI B, LPSI B

**Train Recovery:** Isolation success leads to loss of ECCS train B recirculation.

**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, all year exposure, and 1 backup train - ECCS train A). The failure to isolate case is a "Medium" based on 1 backup train (isolation). The consequence is upgraded to "High" because piping failure together with failure to isolate (MOV 2CV-5648-2 failure to close) can result in containment bypass (Table 2-4 of Ref. 9.18).

**Consequence Category:** HIGH



**Consequence Rank**



---

**FMECA - Consequence Information Report**  
14-Sep-9

Calculation No. A-PENG-CALC-015, Rev. 00  
Page A11 of A31

---

**Consequence ID:** CSS-C-07A

**Consequence Description:** Degradation of Pump 2P35A discharge to heat exchanger 2E35A during an independent demand (line 2GCB-10)

**Break Size:** Large

**Isolability of Break:** Yes

**ISO Comments:** Tripping the pump and closing suction MOV 2CV-5630 may be required to prevent gravity draining through pump 2P35A from the RWT (break is assumed to occur during RWT injection phase). Detection is based on Room 2014 flood alarm, auxiliary building sump high level alarm, and CSS low flow alarm if the break is large enough. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.

**Spatial Effects:** Propagation

**Effected Location:** Room 2014

**Spatial Effects Comments:** Flooding is assumed to affect train A ECCS in Room 2014 before isolation can occur. Failure to isolate is assumed to propagate into Rooms 2006 & 2011 through ventilation openings, but the RWT can not flood 2007 (ECCS train B). However, failure to isolate can be assumed to result in loss of sufficient RWT inventory to fail containment sump recirculation. Detection is provided by ECCS room flood and auxiliary building sump high level alarms in the control room.

**Initiating Event:** N

**Initiating Event ID:** N/A

**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.

**Loss of System:** SM-3

**System IPE ID:** CSS, HPSI, LPSI

**System Recovery:** Isolation failure is assumed to fail all ECCS due to insufficient RWT inventory in the containment sump to support recirculation.

**Loss of Train:** TM-3

**Train ID:** CSS A, HPSI A, LPSI A

**Train Recovery:** Isolation success leads to loss of ECCS train A due to flooding in the room before isolation.

**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train - ECCS train B). The failure to isolate case is a "Medium" consequence based on 1 backup train (isolation).

**Consequence Category:** MEDIUM



**Consequence Rank**





---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A12 of A31*

---

**Consequence ID:** CSS-C-07B**Consequence Description:** Degradation of Pump 2P35B discharge to heat exchanger 2E35B during an independent demand (line 2GCB-11)**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** Tripping the pump and closing suction MOV 2CV-5631 may be required to prevent gravity draining through pump 2P35B from the RWT (break is assumed to occur during RWT injection phase). Detection is based on Room 2007 flood alarm, auxiliary building sump high level alarm, and CSS low flow alarm if the break is large enough. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.**Spatial Effects:** Propagation**Effectuated Location:** Room 2007**Spatial Effects Comments:** Flooding is assumed to affect train A ECCS in Room 2007 before isolation can occur. Failure to isolate is assumed to propagate into Rooms 2006 & 2011 through ventilation openings, but the RWT can not flood 2014 (ECCS train A). However, failure to isolate can be assumed to result in loss of sufficient RWT inventory to fail containment sump recirculation. Detection is provided by ECCS room flood and auxiliary building sump high level alarms in the control room.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.**Loss of System:** SM-3**System IPE ID:** CSS, HPSI, LPSI**System Recovery:** Isolation failure is assumed to fail all ECCS due to insufficient RWT inventory in containment sump to support recirculation.**Loss of Train:** TM-3**Train ID:** CSS B, HPSI B, LPSI B**Train Recovery:** Isolation success leads to loss of ECCS train B due to flooding in the room before isolation.**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train - ECCS train A). The failure to isolate case is a "Medium" consequence based on 1 backup train (isolation).**Consequence Category:** MEDIUM☐**Consequence Rank**☐

---

---

**FMECA - Consequence Information Report**  
14-Sep-9

Calculation No. A-PENG-CALC-015, Rev. 00  
Page A13 of A31

---

**Consequence ID:** CSS-C-08A

**Consequence Description:** Degradation of Pump 2P35A mini flow in Room 2014 during an independent demand (line 2GCB-35 and line 2DCB-11 upstream of 2CV-5673 in Room 2014)

**Break Size:** Large

**Isolability of Break:** Yes

**ISO Comments:** Tripping the pump and closing suction MOV 2CV-5630 is not assumed necessary to allow successful injection of the RWT into the containment (this is only a 2 inch pipe). If needed, it is assumed this train would be operated and not isolated during the RWT injection phase. Also, CSS could be isolated locally by closing 2BS-2A in Room 2014 which would allow operation of HPSI A and LPSI A without further leakage into the room. Detection is based on Room 2014 flood alarm and auxiliary building sump high level alarm.

**Spatial Effects:** Propagation

**Effected Location:** Room 2014

**Spatial Effects Comments:** Flooding is assumed to affect train A ECCS in Room 2014 if not isolated. Another opportunity to recognize the need for isolation is assumed to occur during recirculation actuation. Failure to isolate during the second opportunity by closing 2CV-5647 or 2CV-5649 (may be flooded) is assumed to fail the recirculation phase of inventory control and heat removal. Failure to isolate is assumed to propagate into Rooms 2006 & 2011 through ventilation openings. Detection is provided by ECCS room flood and auxiliary building sump high level alarms in the control room.

**Initiating Event:** N

**Initiating Event ID:** N/A

**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.

**Loss of System:** SM-3

**System IPE ID:** CSS, HPSI, LPSI

**System Recovery:** Isolation failure case (2 failures) is assumed to lead to loss of containment sump (common cause failure of ECCS recirculation).

**Loss of Train:** TM-3

**Train ID:** CSS A, HPSI A, LPSI A

**Train Recovery:** Isolation success leads to loss of only CSS train A. Failure to isolate before recirculation (1 failure) is assumed to lead to failure of ECCS train A due to flooding in the room.

**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup trains - CSS B in recirculation). The failure to isolate cases are "Low" consequence based on 2 backup trains (isolation and ECCS B or 2 isolations).

**Consequence Category:** MEDIUM



**Consequence Rank**



---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A14 of A31*

---

**Consequence ID:** CSS-C-08B**Consequence Description:** Degradation of Pump 2P35B mini flow in Room 2007 during an independent demand (line 2GCB-34 and line 2DCB-13 upstream of 2CV-5672 in Room 2007)**Break Size:** Large**Isolability of Break:** Yes

**ISO Comments:** Tripping the pump and closing suction MOV 2CV-5631 is not assumed necessary to allow successful injection of the RWT into the containment (this is only a 2 inch pipe). If needed, it is assumed this train would be operated and not isolated during the RWT injection phase. Also, CSS could be isolated locally by closing 2BS-2B in Room 2007 which would allow operation of HPSI B and LPSI B without further leakage into the room. Detection is based on Room 2007 flood alarm and auxiliary building sump high level alarm.

**Spatial Effects:** Propagation**Effected Location:** Room 2007

**Spatial Effects Comments:** Flooding is assumed to affect train B ECCS in Room 2007 if not isolated. Another opportunity to recognize the need for isolation is assumed to occur during recirculation actuation. Failure to isolate during the second opportunity by closing 2CV-5648 or 2CV-5650 (may be flooded) is assumed to fail the recirculation phase of inventory control and heat removal. Failure to isolate is assumed to propagate into Rooms 2006 & 2011 through ventilation openings. Detection is provided by ECCS room flood and auxiliary building sump high level alarms in the control room.

**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.**Loss of System:** SM-3**System IPE ID:** CSS, HPSI, LPSI

**System Recovery:** Isolation failure case (2 failures) is assumed to lead to loss of containment sump (common cause failure of ECCS recirculation).

**Loss of Train:** TM-3**Train ID:** CSS B, HPSI B, LPSI B

**Train Recovery:** Isolation success leads to loss of only CSS train B. Failure to isolate before recirculation (1 failure) is assumed to lead to failure of ECCS train B due to flooding in the room.

**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup trains - CSS A in recirculation). The failure to isolate cases are "Low" consequence based on 2 backup trains (isolation and ECCS A or 2 isolations).

**Consequence Category:** MEDIUM**Consequence Rank**

---

**FMECA - Consequence Information Report**  
14-Sep-9

Calculation No. A-PENG-CALC-015, Rev. 00  
Page A15 of A31

---

**Consequence ID:** CSS-C-09A

**Consequence Description:** Degradation of Pump 2P35A discharge downstream of heat exchanger 2E35A in Room 2014 during an independent demand (line 2GCB-16 in Room 2014)

**Break Size:** Large

**Isolability of Break:** Yes

**ISO Comments:** Tripping the pump and closing suction MOV 2CV-5630 may be required to prevent gravity draining through pump 2P35A from the RWT (break is assumed to occur during RWT injection phase). Detection is based on Room 2014 flood alarm, auxiliary building sump high level alarm, and CSS low flow alarm if the break is large enough and upstream of flow element. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.

**Spatial Effects:** Propagation

**Effected Location:** Room 2014

**Spatial Effects Comments:** Flooding is assumed to affect train A ECCS in Room 2014 before isolation can occur. Failure to isolate is assumed to propagate into Rooms 2006 & 2011 through ventilation openings, but the RWT can not flood 2007 (ECCS train B). However, failure to isolate can be assumed to result in loss of sufficient RWT inventory to fail containment sump recirculation. Detection is provided by ECCS room flood and auxiliary building sump high level alarms in the control room.

**Initiating Event:** N

**Initiating Event ID:** N/A

**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.

**Loss of System:** SM-3

**System IPE ID:** CSS, HPSI, LPSI

**System Recovery:** Isolation failure is assumed to fail all ECCS due to insufficient RWT inventory in the containment sump to support recirculation.

**Loss of Train:** TM-3

**Train ID:** CSS A, HPSI A, LPSI A

**Train Recovery:** Isolation success leads to loss of ECCS train A due to flooding in the room before isolation.

**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train - ECCS train B). The failure to isolate case is a "Medium" consequence based on 1 backup train (isolation).

**Consequence Category:** MEDIUM ☐

**Consequence Rank** ☐

---

---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A16 of A31*

---

**Consequence ID:** CSS-C-09B**Consequence Description:** Degradation of Pump 2P35B discharge downstream of heat exchanger 2E35B in Room 2007 during an independent demand (line 2GCB-17 in Room 2007)**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** Tripping the pump and closing suction MOV 2CV-5631 may be required to prevent gravity draining through pump 2P35B from the RWT (break is assumed to occur during RWT injection phase). Detection is based on Room 2007 flood alarm, auxiliary building sump high level alarm, and CSS low flow alarm if the break is large enough and upstream of flow element. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.**Spatial Effects:** Propagation**Effected Location:** Room 2007**Spatial Effects Comments:** Flooding is assumed to affect train B ECCS in Room 2007 before isolation can occur. Failure to isolate is assumed to propagate into Rooms 2006 & 2011 through ventilation openings, but the RWT can not flood 2014 (ECCS train A). However, failure to isolate can be assumed to result in loss of sufficient RWT inventory to fail containment sump recirculation. Detection is provided by ECCS room flood and auxiliary building sump high level alarms in the control room.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.**Loss of System:** SM-3**System IPE ID:** CSS, HPSI, LPSI**System Recovery:** Isolation failure is assumed to fail all ECCS due to insufficient RWT inventory in the containment sump to support recirculation.**Loss of Train:** TM-3**Train ID:** CSS B, HPSI B, LPSI B**Train Recovery:** Isolation success leads to loss of ECCS train B due to flooding in the room before isolation.**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train - ECCS train A). The failure to isolate case is a "Medium" consequence based on 1 backup train (isolation).**Consequence Category:** MEDIUM**Consequence Rank**

---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00***14-Sep-9***Page A17 of A31*

---

**Consequence ID:** CSS-C-10A**Consequence Description:** Degradation of Pump 2P35A discharge test return upstream of 2SI-5A in Room 2011 during an independent demand (line 2GCB-16 in Room 2011)**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** Tripping the pump and closing suction MOV 2CV-5630 may be required to prevent gravity draining through pump 2P35A from the RWT (break is assumed to occur during RWT injection phase). Detection is based on auxiliary building sump high level alarm. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.**Spatial Effects:** Propagation**Effected Location:** Room 2011**Spatial Effects Comments:** Failure to isolate is assumed to propagate into Rooms 2007, 2010, & 2014 through ventilation openings even if they do isolate automatically on a SI signal. Also, failure to isolate can be assumed to result in loss of sufficient RWT inventory to fail containment sump recirculation. Detection is provided by auxiliary building sump high level alarm in the control room.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.**Loss of System:** SM-3**System IPE ID:** CSS, HPSI, LPSI**System Recovery:** Isolation failure is assumed to fail all ECCS due to insufficient RWT inventory in the containment sump to support recirculation.**Loss of Train:** TM-3**Train ID:** CSS A, HPSI A, LPSI A**Train Recovery:** Isolation success leads to loss of ECCS train A.**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train - ECCS train B). The failure to isolate case is a "Medium" consequence based on 1 backup train (isolation).**Consequence Category:** MEDIUM☐**Consequence Rank**☐

---

---

**FMECA - Consequence Information Report**  
14-Sep-9

Calculation No. A-PENG-CALC-015, Rev. 00  
Page A18 of A31

---

**Consequence ID:** CSS-C-10B

**Consequence Description:** Degradation of Pump 2P35B discharge test return upstream of 2SI-5B in Room 2011 during an independent demand (line 2GCB-17 in Room 2011)

**Break Size:** Large

**Isolability of Break:** Yes

**ISO Comments:** Tripping the pump and closing suction MOV 2CV-5631 may be required to prevent gravity draining through pump 2P35B from the RWT (break is assumed to occur during RWT injection phase). Detection is based on auxiliary building sump high level alarm. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.

**Spatial Effects:** Propagation

**Effected Location:** Room 2011

**Spatial Effects Comments:** Failure to isolate is assumed to propagate into Rooms 2007, 2010, & 2014 through ventilation openings even if they do isolate automatically on a SI signal. Also, failure to isolate can be assumed to result in loss of sufficient RWT inventory to fail containment sump recirculation. Detection is provided by auxiliary building sump high level alarm in the control room.

**Initiating Event:** N

**Initiating Event ID:** N/A

**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.

**Loss of System:** SM-3

**System IPE ID:** CSS, HPSI, LPSI

**System Recovery:** Isolation failure is assumed to fail all ECCS due to insufficient RWT inventory in the containment sump to support recirculation.

**Loss of Train:** TM-3

**Train ID:** CSS B, HPSI B, LPSI B

**Train Recovery:** Isolation success leads to loss of ECCS train B.

**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train - ECCS train A). The failure to isolate case is a "Medium" consequence based on 1 backup train (isolation).

**Consequence Category:** MEDIUM ☐

**Consequence Rank** ☐

---

---

**FMECA - Consequence Information Report**  
14-Sep-9

Calculation No. A-PENG-CALC-015, Rev. 00  
Page A19 of A31

---

**Consequence ID:** CSS-C-11A

**Consequence Description:** Degradation of Pump 2P35A discharge downstream of heat exchanger 2E35A in Room 2055 during an independent demand (line 2GCB-16 in Room 2055)

**Break Size:** Large

**Isolability of Break:** Yes

**ISO Comments:** Tripping the pump and closing suction MOV 2CV-5630 may be required to prevent gravity draining through pump 2P35A from the RWT (break is assumed to occur during RWT injection phase). Detection is based on auxiliary building sump high level alarm. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.

**Spatial Effects:** Propagation

**Effectuated Location:** Room 2055

**Spatial Effects Comments:** There are no impacts in Room 2055, but propagation is into Room 2040 where MCC 2B52 is located. Isolation failure is assumed to affect this MCC. Room 2040 propagates to EI 317 (Rooms 2006 & 2011) through floor drains and the east stair well. MCC 2B52 contains breakers for normally closed CSS valves 2CV-5612-1 and 5649-1 (containment sump recirculation A). If unisolated, EI 317 will fill up and propagate into the ECCS rooms (2007, 2010, & 2014) failing all ECCS. Detection is provided by auxiliary building sump high level and ECCS room flood alarms in the control room.

**Initiating Event:** N

**Initiating Event ID:** N/A

**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.

**Loss of System:** SM-3

**System IPE ID:** CSS, HPSI, LPSI

**System Recovery:** Isolation failure is assumed to fail all ECCS due to insufficient RWT inventory in the containment sump to support recirculation.

**Loss of Train:** TM-3

**Train ID:** CSS A, HPSI A, LPSI A

**Train Recovery:** Isolation success leads to loss of ECCS train A.

**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train - ECCS train B). The failure to isolate case is a "Medium" based on 1 backup train (isolation). No impact on containment isolation.

**Consequence Category:** MEDIUM

☐

**Consequence Rank**

☐



---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A20 of A31*

---

**Consequence ID:** CSS-C-11B**Consequence Description:** Degradation of Pump 2P35B discharge downstream of heat exchanger 2E35B in Room 2055 during an independent demand (line 2GCB-17 in Room 2055)**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** Tripping the pump and closing suction MOV 2CV-5631 may be required to prevent gravity draining through pump 2P35B from the RWT (break is assumed to occur during RWT injection phase). Detection is based on auxiliary building sump high level alarm. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.**Spatial Effects:** Propagation**Effected Location:** Room 2055**Spatial Effects Comments:** There are no impacts in Room 2055, but propagation is into Room 2040 where MCC 2B52 is located. Isolation failure is assumed to be affected by this MCC. Room 2040 propagates to EI 317 (Rooms 2006 & 2011) through floor drains and the east stair well. MCC 2B52 contains breakers for normally closed CSS valves 2CV-5612-1 and 5649-1 (containment sump recirculation A). If unisolated, EI 317 will fill up and propagate into the ECCS rooms (2007, 2010, & 2014) failing all ECCS. Detection is provided by auxiliary building sump high level and ECCS room flood alarms in the control room.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.**Loss of System:** SM-3**System IPE ID:** CSS, HPSI, LPSI**System Recovery:** Isolation failure is assumed to fail all ECCS due to insufficient RWT inventory in the containment sump to support recirculation. Isolation success also leads to loss of both CSS trains due to the assumed impact on MCC 2B52 before isolation, but containment cooling provides backup train.**Loss of Train:** TM-3**Train ID:** CSS B, HPSI B, LPSI B**Train Recovery:** Isolation success leads to loss of ECCS train B and both trains of CSS as described above.**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and one backup train). The failure to isolate case is a "Medium" based on one backup train (isolation). No impact on containment isolation.**Consequence Category:** MEDIUM ☐**Consequence Rank** ☐

---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A21 of A31*

---

**Consequence ID:** CSS-C-12A**Consequence Description:** Degradation of Pump 2P35A discharge upstream of 2CV-5612 in Room 2084 during an independent demand (line 2GCB-16 in Room 2084)**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** Tripping the pump and closing suction MOV 2CV-5630 may be required to prevent gravity draining through pump 2P35A from the RWT (break is assumed to occur during RWT injection phase). Detection is based on auxiliary building sump high level alarm. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.**Spatial Effects:** Propagation**Effectuated Location:** Room 2084**Spatial Effects Comments:** In Room 2084, the potential exists for spray impacts on HPSI and LPSI discharge valves. It is assumed there is sufficient separation between trains as with the CSS valves in this room. Propagation is into Room 2073 (EL 354) where MCC 2B62 is located, but flooding of the MCC is unlikely. From Room 2073 propagation continues easily to EI 335 (Room 2040) through floor grating and the east stairway. Propagation into Room 2040 where MCC 2B52 is located in the corridor. Isolation failure is assumed to affect this MCC. Room 2040 propagates to EI 317 (Rooms 2006 & 2011) through floor drains and east stairway. MCC 2B52 contains breakers for normally closed CSS valves 2CV-5612-1 and 5649-1 (containment sump recirculation A). MCC 2B62 contains breakers for normally closed CSS valves 2CV-5613-2 and 5650-1 (containment sump recirculation B). If unisolated, EI 317 will fill up and propagate into the ECCS rooms (2007, 2010, & 2014) failing all ECCS. Detection is provided by auxiliary building sump high level and ECCS room flood alarms in the control room.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.**Loss of System:** SM-3**System IPE ID:** CSS, HPSI, LPSI**System Recovery:** Isolation failure is assumed to fail all ECCS due to insufficient RWT inventory in the containment sump to support recirculation.**Loss of Train:** TM-3**Train ID:** CSS A, HPSI A, LPSI A**Train Recovery:** Isolation success leads to loss of ECCS train A.**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train). The failure to isolate case is a "Medium" based on 1 backup train (isolation). No impact on containment isolation.**Consequence Category:** MEDIUM**Consequence Rank**

---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A22 of A31*

---

**Consequence ID:** CSS-C-12B**Consequence Description:** Degradation of Pump 2P35B discharge upstream of 2CV-5613 in Room 2084 during an independent demand (line 2GCB-17 in Room 2084)**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** Tripping the pump and closing suction MOV 2CV-5631 may be required to prevent gravity draining through pump 2P35B from the RWT (break is assumed to occur during RWT injection phase). Detection is based on auxiliary building sump high level alarm. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.**Spatial Effects:** Propagation**Effected Location:** Room 2084**Spatial Effects Comments:** In Room 2084, the potential exists for spray impacts on HPSI and LPSI discharge valves. It is assumed there is sufficient separation between trains as with the CSS valves in this room. Propagation is into Room 2073 (EL 354) where MCC 2B62 is located, but flooding of the MCC is judged unlikely. From Room 2073 propagation continues easily to EI 335 (Room 2040) through floor grating and the east stairway. Propagation is into Room 2040 where MCC 2B52 is located in the corridor. Isolation failure is assumed to affect this MCC. Room 2040 propagates to EI 317 (Rooms 2006 & 2011) through floor drains and east stairway. MCC 2B52 contains breakers for normally closed CSS valves 2CV-5612-1 and 5649-1 (containment sump recirculation A). MCC 2B62 contains breakers for normally closed CSS valves 2CV-5613-2 and 5650-1 (containment sump recirculation B). If unisolated, EI 317 will fill up and propagate into the ECCS rooms (2007, 2010, & 2014) failing all ECCS. Detection is provided by auxiliary building sump high level and ECCS room flood alarms in the control room.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.**Loss of System:** SM-3**System IPE ID:** CSS, HPSI, LPSI**System Recovery:** Isolation failure is assumed to fail all ECCS due to insufficient RWT inventory in the containment sump to support recirculation.**Loss of Train:** TM-3**Train ID:** CSS B, HPSI B, LPSI B**Train Recovery:** Isolation success leads to loss of ECCS train B.**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train). The failure to isolate case is "Medium" based on 1 backup train (isolation). No impact on containment isolation.**Consequence Category:** MEDIUM ☐**Consequence Rank** ☐

---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A23 of A31*

---

**Consequence ID:** CSS-C-13A**Consequence Description:** Degradation of Pump 2P35A discharge downstream of 2CV-5612 in Room 2084 during an independent demand (line 2HCB-20)**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** Trip pump 2P35A or close MOV 2CV-5612 (break is assumed to occur during RWT injection phase). Detection is based on auxiliary building sump high level alarm. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.**Spatial Effects:** Propagation**Effected Location:** Room 2084**Spatial Effects Comments:** In Room 2084, the potential exists for spray impacts on HPSI and LPSI discharge valves. It is assumed there is sufficient separation between trains as with the CSS valves in this room. Propagation is into Room 2073 (EL 354) where MCC 2B62 is located, but flooding of the MCC is judged unlikely. From Room 2073 propagation continues easily to EI 335 (Room 2040) through floor grating and the east stairway. Propagation is into Room 2040 where MCC 2B52 is located in the corridor. Isolation failure is assumed to affect this MCC. Room 2040 propagates to EI 317 (Rooms 2006 & 2011) through floor drains and east stairway. MCC 2B52 contains breakers for normally closed CSS valves 2CV-5612-1 and 5649-1 (containment sump recirculation A). MCC 2B62 contains breakers for normally closed CSS valves 2CV-5613-2 and 5650-1 (containment sump recirculation B). If unisolated, EI 317 will fill up and propagate into the ECCS rooms (2007, 2010, & 2014) failing all ECCS. Detection is provided by auxiliary building sump high level and ECCS room flood alarms in the control room.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.**Loss of System:** SM-3**System IPE ID:** CSS, HPSI, LPSI**System Recovery:** Isolation failure is assumed to fail all ECCS due to insufficient RWT inventory in the containment sump to support recirculation. Isolation success also leads to loss of both CSS trains in recirculation due to assumed impact on MCC 2B62 before isolation (discharge MOV 2CV-5613 is assumed to open prior to impact on MCC).**Loss of Train:** TM-1**Train ID:** CSS A**Train Recovery:** Isolation success leads to loss of CSS train A, but containment cooling provides backup.**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, all year exposure, and one backup train (isolation)) for failure to isolate case. The successful isolation case is a "Low" consequence with two backup trains counting containment cooling. 2BS-5A provides containment isolation inside containment.**Consequence Category:** MEDIUM**Consequence Rank**

---

**FMECA - Consequence Information Report**  
14-Sep-9

Calculation No. A-PENG-CALC-015, Rev. 00  
Page A24 of A31

---

**Consequence ID:** CSS-C-13B

**Consequence Description:** Degradation of Pump 2P35B discharge downstream of 2CV-5613 in Room 2084 during an independent demand (line 2HCB-21)

**Break Size:** Large

**Isolability of Break:** Yes

**ISO Comments:** Trip pump 2P35B or close MOV 2CV-5613 (break is assumed to occur during RWT injection phase). Detection is based on auxiliary building sump high level alarm. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.

**Spatial Effects:** Propagation

**Effected Location:** Room 2084

**Spatial Effects Comments:** In Room 2084, the potential exists for spray impacts on HPSI and LPSI discharge valves. It is assumed there is sufficient separation between trains as with the CSS valves in this room. Propagation is into Room 2073 (EL 354) where MCC 2B62 is located, but flooding of the MCC is judged unlikely. From Room 2073 propagation continues easily to EI 335 (Room 2040) through floor grating and the east stairway. Propagation is into Room 2040 where MCC 2B52 is located in the corridor. Isolation failure is assumed to affect this MCC. Room 2040 propagates to EI 317 (Rooms 2006 & 2011) through floor drains and east stairway. MCC 2B52 contains breakers for normally closed CSS valves 2CV-5612-1 and 5649-1 (containment sump recirculation A). MCC 2B62 contains breakers for normally closed CSS valves 2CV-5613-2 and 5650-1 (containment sump recirculation B). If unisolated, EI 317 will fill up and propagate into the ECCS rooms (2007, 2010, & 2014) failing all ECCS. Detection is provided by auxiliary building sump high level and ECCS room flood alarms in the control room.

**Initiating Event:** N

**Initiating Event ID:** N/A

**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.

**Loss of System:** SM-3

**System IPE ID:** CSS, HPSI, LPSI

**System Recovery:** Isolation failure is assumed to fail all ECCS due to insufficient RWT inventory in the containment sump to support recirculation.

**Loss of Train:** TM-1

**Train ID:** CSS B

**Train Recovery:** Isolation success leads to loss of CSS train B, but containment cooling provides backup.

**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, all year exposure, and 1 backup train for failure to isolate). The successful isolation case is a "Low" consequence with two backup trains counting containment cooling. 2BS-5B provides containment isolation inside containment.

**Consequence Category:** MEDIUM ☐

**Consequence Rank** ☐

---

---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A25 of A31*

---

**Consequence ID:** CSS-C-14A**Consequence Description:** Degradation of Pump 2P35A discharge downstream of 2CV-5612 inside containment during an independent demand (line 2HCB-3 upstream of 2BS-5A)**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** Trip pump 2P35A or close MOV 2CV-5612, but this is not necessary to prevent additional impacts since the RWT is being pumped to the containment (the pipe break affects spray effectiveness, but not the heat removal function). Not easy to detect except containment pressure may not reduced as fast as expected and train B is still available.**Spatial Effects:** Containment**Effected Location:** Containment Building**Spatial Effects Comments:** Equipment inside containment is qualified for this event.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.**Loss of System:** N**System IPE ID:** N/A**System Recovery:** N/A**Loss of Train:** N**Train ID:** N/A**Train Recovery:** Loss of CSS train A occurs only if the train is isolated by the operators. The train is still capable of performing its containment heat removal function.**Consequence Comment:** Consequence is "Low" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, all year exposure, and 2 backup trains - CSS A & B and ECCS A & B). 2CV-5612 and closed system outside provide containment isolation.**Consequence Category:** LOW**Consequence Rank**

---

**FMECA - Consequence Information Report**  
14-Sep-9

Calculation No. A-PENG-CALC-015, Rev. 00  
Page A26 of A31

---

**Consequence ID:** CSS-C-14B

**Consequence Description:** Degradation of Pump 2P35B discharge downstream of 2CV-5613 inside containment during an independent demand (line 2HCB-4 upstream of 2BS-5B)

**Break Size:** Large

**Isolability of Break:** Yes

**ISO Comments:** Trip pump 2P35B or close MOV 2CV-5613, but this is not necessary to prevent additional impacts since the RWT is being pumped to the containment (the pipe break affects spray effectiveness, but not the heat removal function). Not easy to detect except containment pressure may not reduced as fast as expected and train A is still available.

**Spatial Effects:** Containment

**Effected Location:** Containment Building

**Spatial Effects Comments:** Equipment inside containment is qualified for this event.

**Initiating Event:** N

**Initiating Event ID:** N/A

**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.

**Loss of System:** N

**System IPE ID:** N/A

**System Recovery:** N/A

**Loss of Train:** N

**Train ID:** N/A

**Train Recovery:** Loss of CSS train B occurs only if the train is isolated by the operators. The train is still capable of performing its containment heat removal function.

**Consequence Comment:** Consequence is "Low" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, all year exposure, and 2 backup trains - CSS A & B and ECCS A & B). 2CV-5613 and closed system outside provide containment isolation.

**Consequence Category:** LOW



**Consequence Rank**



---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A27 of A31*

---

**Consequence ID:** CSS-C-15A**Consequence Description:** Degradation of NAOH line to Train A (line 2GCB-70) during an independent demand.**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** Tripping the pump and closing suction MOV 2CV-5630 may be required to prevent gravity draining through pump 2P35A from the RWT (break is assumed to occur during RWT injection phase). Detection is based on Room 2014 flood alarm and auxiliary building sump high level alarm. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.**Spatial Effects:** Propagation**Effected Location:** Room 2014**Spatial Effects Comments:** Since this is a small line (2 inch diameter), flooding of ECCS train A in Room 2014 is assumed only if isolation fails. Also, flow diversion impacts are not assumed. Failure to isolate is not assumed to propagate into Rooms 2006 & 2011 during injection phase due to break size. Detection is provided by ECCS room flood and auxiliary building sump high level alarms in the control room. Loss of train A must be assumed during the recirculation phase due to isolation, otherwise, the containment sump would be emptied into the ECCS room.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.**Loss of System:** N**System IPE ID:** N/A**System Recovery:** Loss of all ECCS during recirculation phase is possible if the containment sump was pumped to the auxiliary building. This is judged to be equivalent to 2 isolation failures (2 backup trains).**Loss of Train:** TM-3**Train ID:** CSS A, HPSI A, LPSI A**Train Recovery:** Isolation of ECCS train during recirculation is required. No credit is allowed for local isolation of CSS, thus, allowing recovery of HPSI and LPSI.**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train - ECCS B). Containment isolation is unaffected.**Consequence Category:** MEDIUM**Consequence Rank**



---

**FMECA - Consequence Information Report**  
14-Sep-9

Calculation No. A-PENG-CALC-015, Rev. 00  
Page A28 of A31

---

**Consequence ID:** CSS-C-15B

**Consequence Description:** Degradation of NAOH line to Train B (line 2GCB-69) during an independent demand.

**Break Size:** Large

**Isolability of Break:** Yes

**ISO Comments:** Tripping the pump and closing suction MOV 2CV-5631 may be required to prevent gravity draining through pump 2P35B from the RWT (break is assumed to occur during RWT injection phase). Detection is based on Room 2007 flood alarm and auxiliary building sump high level alarm. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.

**Spatial Effects:** Propagation

**Effected Location:** Room 2007

**Spatial Effects Comments:** Since this is a small line (2 inch diameter), flooding of ECCS train B in Room 2007 is assumed only if isolation fails. Also, flow diversion impacts are not assumed. Failure to isolate is not assumed to propagate into Rooms 2006 & 2011 during injection phase due to break size. Detection is provided by ECCS room flood and auxiliary building sump high level alarms in the control room. Loss of train B must be assumed during the recirculation phase due to isolation, otherwise, the containment sump would be emptied into the ECCS room.

**Initiating Event:** N

**Initiating Event ID:** N/A

**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.

**Loss of System:** N

**System IPE ID:** N/A

**System Recovery:** Loss of all ECCS during recirculation phase is possible if the containment sump was pumped to the auxiliary building. This is judged to be equivalent to 2 isolation failures (2 backup trains).

**Loss of Train:** - TM-3

**Train ID:** CSS B, HPSI B, LPSI B

**Train Recovery:** Isolation of ECCS train during recirculation is required. No credit is allowed for local isolation of CSS, thus, allowing recovery of HPSI and LPSI.

**Consequence Comment:** Consequence is "Medium" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, between test exposure, and 1 backup train - ECCS A). Containment isolation is unaffected.

**Consequence Category:** MEDIUM

☐

**Consequence Rank**

☐

---

**FMECA - Consequence Information Report**

*Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A29 of A31*

---

**Consequence ID:** CSS-C-16

**Consequence Description:** Degradation of RWT suction to SFPP and charging (line 2HCB-7) during an independent demand.

**Break Size:** Large

**Isolability of Break:** No

**ISO Comments:** Unisolable.

**Spatial Effects:** Propagation

**Effectuated Location:** Outside

**Spatial Effects Comments:** This piping is located both outside near the RWT and in Room 2040. Propagation from Room 2040 is down to EI 317 (Rooms 2006 & 2011) through floor drains and east stairway. Detection is provided by auxiliary building sump high level alarm, but this is irrelevant since the break is unisolable. This line is judged too small (3 inch diameter) to divert enough of the RWT to cause flow diversion or loss of ECCS.

**Initiating Event:** N

**Initiating Event ID:** N/A

**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.

**Loss of System:** N

**System IPE ID:** N/A

**System Recovery:** Pipe size is assumed too small to cause flow diversion or loss of ECCS.

**Loss of Train:** N

**Train ID:** N/A

**Train Recovery:** N/A

**Consequence Comment:** Consequence is "Low" base on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, all year exposure, and 2 backup trains - CSS A & B and ECCS A & B). Containment isolation is unaffected.

**Consequence Category:** LOW



**Consequence Rank**



---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A30 of A31*

---

**Consequence ID:** CSS-C-17A**Consequence Description:** Degradation of service air connection to Train A (line 2HCB-93) during an independent demand.**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** Trip pump 2P35A or close MOV 2CV-5612 (break is assumed to occur during RWT injection phase). Detection is based on auxiliary building sump high level alarm. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.**Spatial Effects:** Propagation**Effectuated Location:** Room 2084**Spatial Effects Comments:** Since this is a small line (2 inch diameter), flooding impact is not assumed. Also, flow diversion impacts are not assumed. Detection is provided by auxiliary building sump high level alarms in the control room. Loss of train CSS A must be assumed during the recirculation phase due to isolation, otherwise, the containment sump would be emptied into the auxiliary building.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.**Loss of System:** N**System IPE ID:** N/A**System Recovery:** Loss of all ECCS during recirculation phase is possible if the containment sump was pumped to the auxiliary building. This is judged to be equivalent to 2 isolation failures (2 backup trains).**Loss of Train:** T**Train ID:** CSS A**Train Recovery:** Isolation of CSS train during recirculation is required (2CV-5612). This allows HPSI A & LPSI A success. Also, containment cooling system can replace CSS A.**Consequence Comment:** Consequence is "Low" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, all year exposure, and 2 backup trains; HPSI, LPSI, CSS B, and containment cooling). 2BS-5A provides containment isolation inside containment.**Consequence Category:** LOW**Consequence Rank**

---

**FMECA - Consequence Information Report***Calculation No. A-PENG-CALC-015, Rev. 00*

14-Sep-9

*Page A31 of A31*

---

**Consequence ID:** CSS-C-17B**Consequence Description:** Degradation of service air connection to Train B (line 2HCB-94) during an independent demand.**Break Size:** Large**Isolability of Break:** Yes**ISO Comments:** Trip pump 2P35B or close MOV 2CV-5613 (break is assumed to occur during RWT injection phase). Detection is based on auxiliary building sump high level alarm. A low RWT level alarm will also occur, but it could be associated with the assumed LOCA condition.**Spatial Effects:** Propagation**Effectuated Location:** Room 2084**Spatial Effects Comments:** Since this is a small line (2 inch diameter), flooding impact is not assumed. Also, flow diversion impacts are not assumed. Detection is provided by auxiliary building sump high level alarms in the control room. Loss of train CSS B must be assumed during the recirculation phase due to isolation, otherwise, the containment sump would be emptied into the auxiliary building.**Initiating Event:** N**Initiating Event ID:** N/A**Initiating Event Recovery:** A medium LOCA (M) initiator is assumed to challenge this piping.**Loss of System:** N**System IPE ID:** N/A**System Recovery:** Loss of all ECCS during recirculation phase is possible if the containment sump was pumped to the auxiliary building. This is judged to be equivalent to 2 isolation failures (2 backup trains).**Loss of Train:** T**Train ID:** CSS B**Train Recovery:** Isolation of CSS train during recirculation is required (2CV-5613). This allows HPSI B & LPSI B success. Also, containment cooling system can replace CSS B.**Consequence Comment:** Consequence is "Low" based on Table 2-2 of Ref. 9.18 (unexpected frequency of challenge, all year exposure, and 2 backup trains; HPSI, LPSI, CSS A, and containment cooling). 2BS-5B provides containment isolation inside containment.**Consequence Category:** LOW**Consequence Rank**