NOTE:

The following slides were presented by representatives of Pacific Gas & Electric (PG&E) /Diablo Canyon Power Plant during a Regulatory Conference (a Category 1 Public Meeting) conducted in the NRC Region IV Office on November 15, 2016.

The purpose of the Regulatory Conference was to discuss an apparent violation related to inadequate procedures associated with the installation of external limit switches on motor operated valves as documented in NRC Inspection Report 05000275/2016010 and 05000323/2016010, issued on October 3, 2016.

Slide 19 of the presentation includes an embedded video file which is available to be viewed in this downloaded Adobe Acrobat PDF file. The video was presented at the Regulatory Conference to demonstrate the timeline and actions PG&E staff would have used to prepare and open a chamber in the auxiliary building in attempting to recover valve SI-8982 under certain accident conditions.

The events in the video were notional (i.e., were conducted as a drill) and the emergency events leading to the demonstrated actions did not actually occur at the Diablo Canyon Power Plant.

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Diablo Canyon Power Plant
NRC Regulatory Conference

Limit Switch Finding Significance

November 15, 2016

Opening Remarks

Jim Welsch
Vice President
Nuclear Generation

- Introduction

PG&E Representatives

Diablo Canyon Power Plant

Participants

- Jim Welsch - Vice President Nuclear Generation
- Jan Nimick - Senior Director Nuclear Services
- John Whetsler - Operations Shift Manager
- Bob Waltos - Assistant Director Engineering Services
- Nathan Barber - Senior PRA Analyst

Agenda

Topic	Presenter
Preliminary Finding	Jan Nimick
ECCS Operational Overview	John Whetsler
Plant Design	Bob Waltos
Condition Description	Bob Waltos
ECCS Operation with the Condition	John Whetsler
Capability to Recover ▪ Local Manual ▪ Remote Electrical ▪ Interlock Jumper	 John Whetsler John Whetsler Bob Waltos
SPAR Risk Significance	Nathan Barber
Summary and Conclusion	Jan Nimick

Preliminary Finding

Why are we here today?

Performance deficiency: Failure to provide instructions for limiting the travel of external limit switches installed on safety related motor operated valves.

Violation: of Technical Specification(TS) 5.4.1.a, "Procedures"

- Resulted in failure of an external closed limit switch for the Residual Heat Removal (RHR) Pump (PP) 2-2 Suction valve, RHR-2-8700B. This blocked control logic to open RHR PP 2-2 Containment Recirculation Sump Suction Valve SI-2-8982B.
- PG&E agrees with the performance deficiency
- NEW PG&E has identified new information that results in a change to Core Damage Frequency when entered into the plant-specific SPAR Model.

Preliminary Finding

What will you be hearing from PG&E?

New Information not considered in the NRC's Significance Determination Program Evaluation

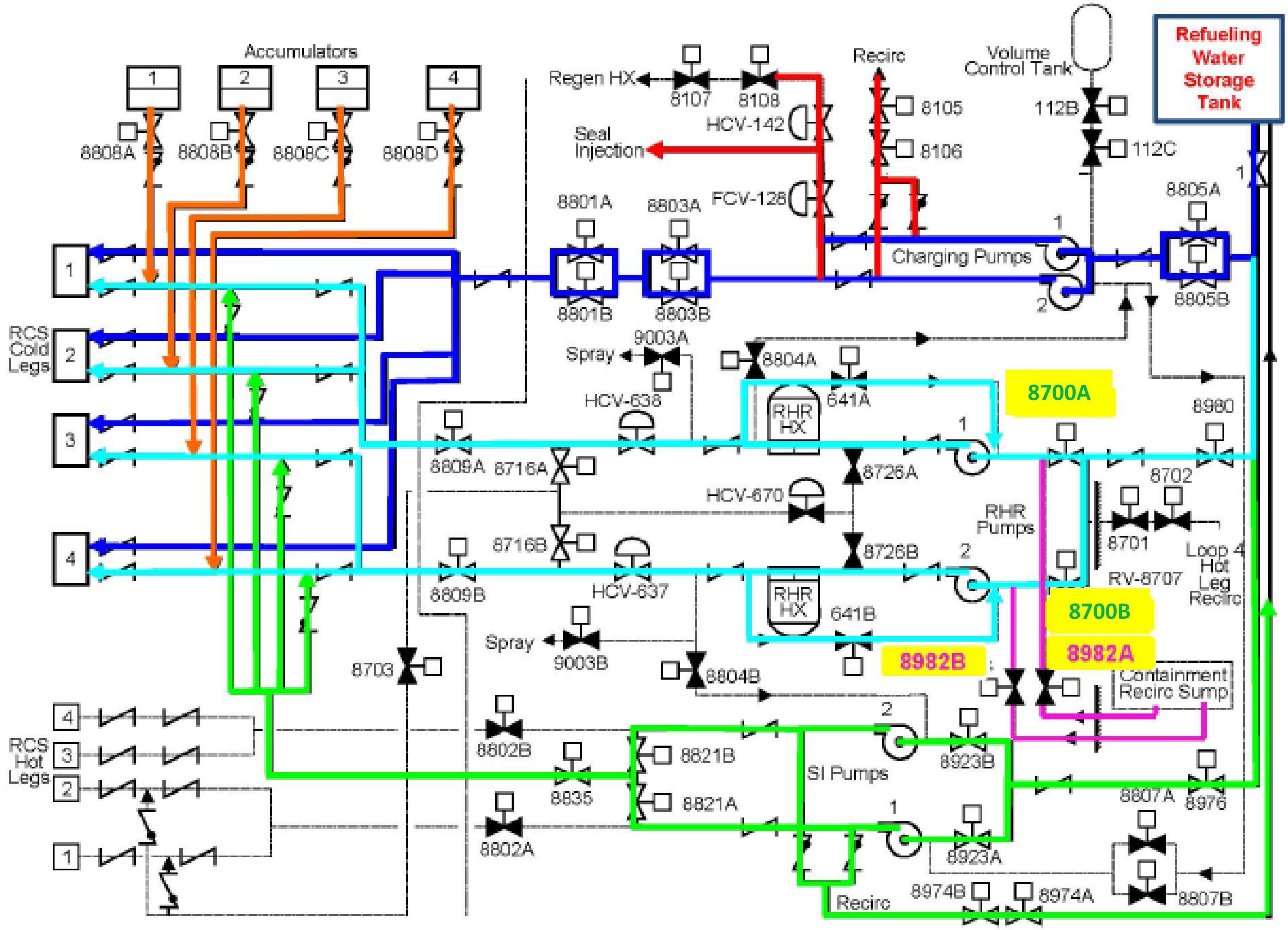
NEW

Three primary areas of new information affecting the safety significance:

- Contribution of medium break Loss of Coolant Accidents
- Operational strategies improving time to recover
- Robust and reliable recovery methods

Emergency Core Cooling System (ECCS) Operational Overview

ECCS Operation and Switchover to Recirculation



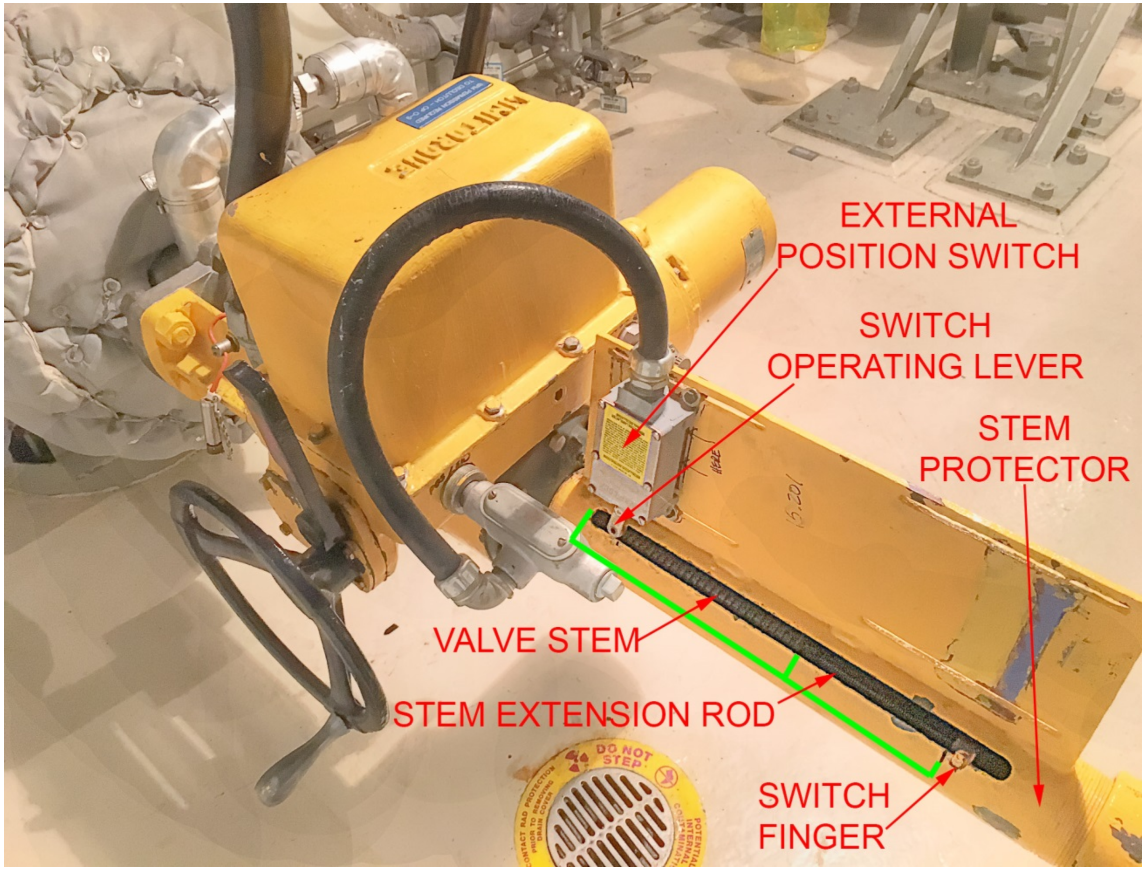
Plant Design

RHR Pump Suction Valve from Containment Recirculation Sump (SI-8982)

- Located within the Recirc Chamber beneath the RHR Containment Sump
- Unobstructed access to valve via 36" manway opening
- Chamber is opened every refueling outage
- Valve is operated from the Control Room to initiate Cold Leg Recirculation

Plant Design

RHR Pump 2-2 Suction Valve from the Refueling Water Storage Tank (RHR-2-8700B)



NEW

- Valve is located in an easily accessible uncontaminated area in the Auxiliary Building
- External position switch performs an interlock function with SI-2-8982B

NEW

- Access to the position switch, switch contacts, motor, gear box and valve are unobstructed

ECCS Operation with the Condition

ECCS Operation and Switchover to Recirculation

If BOTH Recirculation Sump Suction Valves (SI-2-8982A & B) fail to open, Operators transition to the “Loss of Emergency Coolant Recirculation,” procedure and:

- Initiate continuous actions to restore ECCS recirculation from the sump

NEW
- Initiate makeup water to the RWST to add inventory

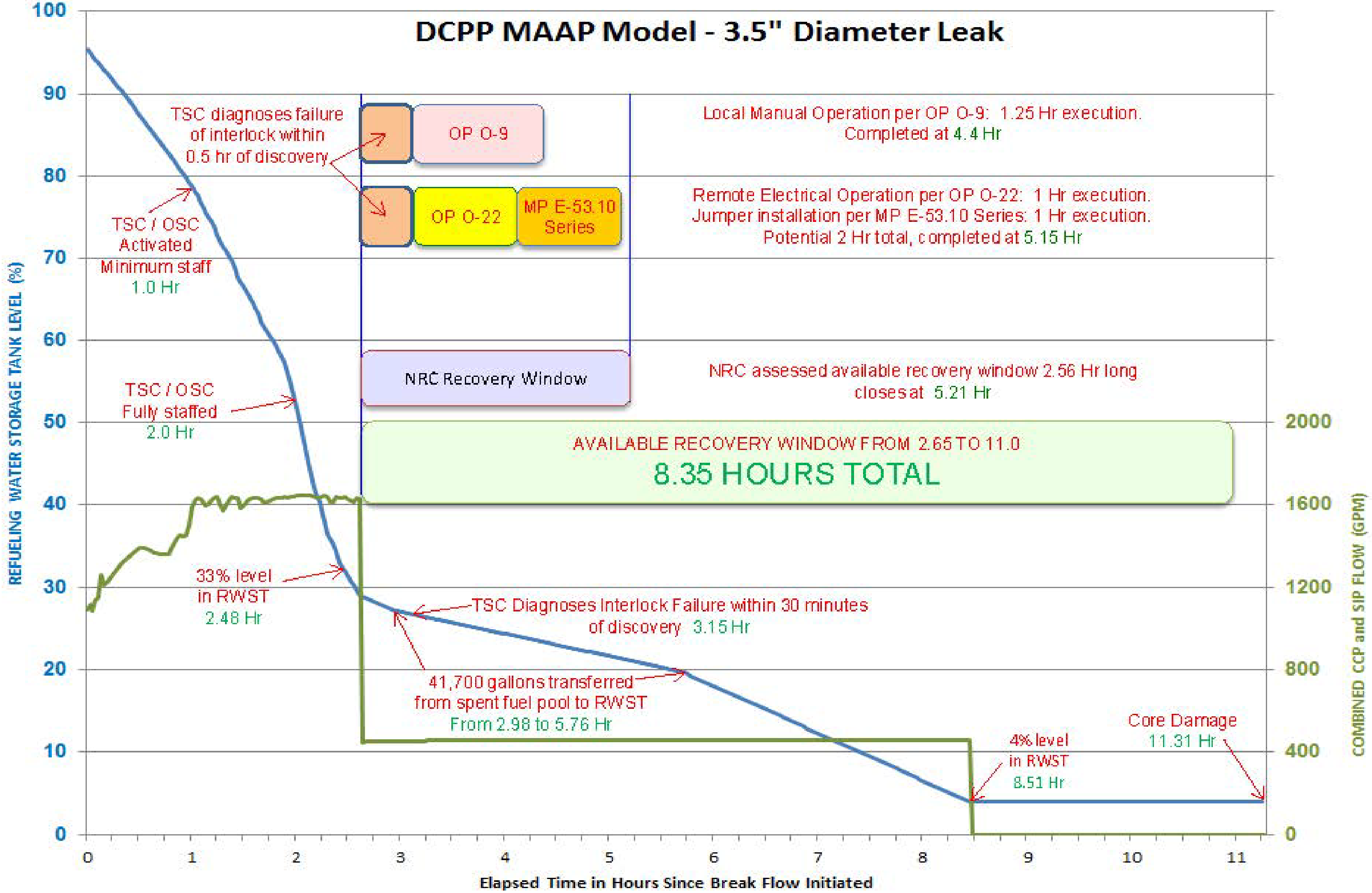
NEW
- Minimize SIP/CCP injection to match the decay heat load and further preserve inventory

NEW
- Depressurize the Steam Generators to cool down and depressurize the RCS

ECCS Operation with the Condition

NEW

Condition Timeline (MAAP 3.5" LOCA)



ECCS Operation with the Condition

Plant Specific SPAR Model

Medium LOCA (MLOCA) Modeling

- NRC analysis distributed the total MLOCA initiating event frequency linearly based on break size range.

- NUREG-1829 shows that the relationship between frequency and break size is logarithmic.

NEW

- Use of NUREG-1829 data results in a break frequency for 3.5” to 6” of ~8E-06 per year, lower than the NRC estimate of ~1E-04.

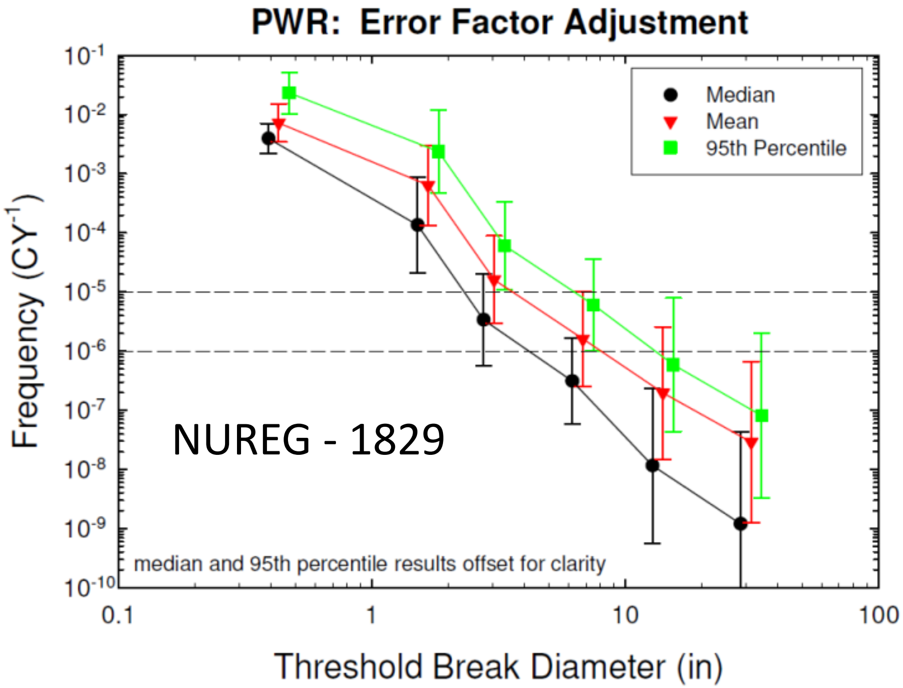
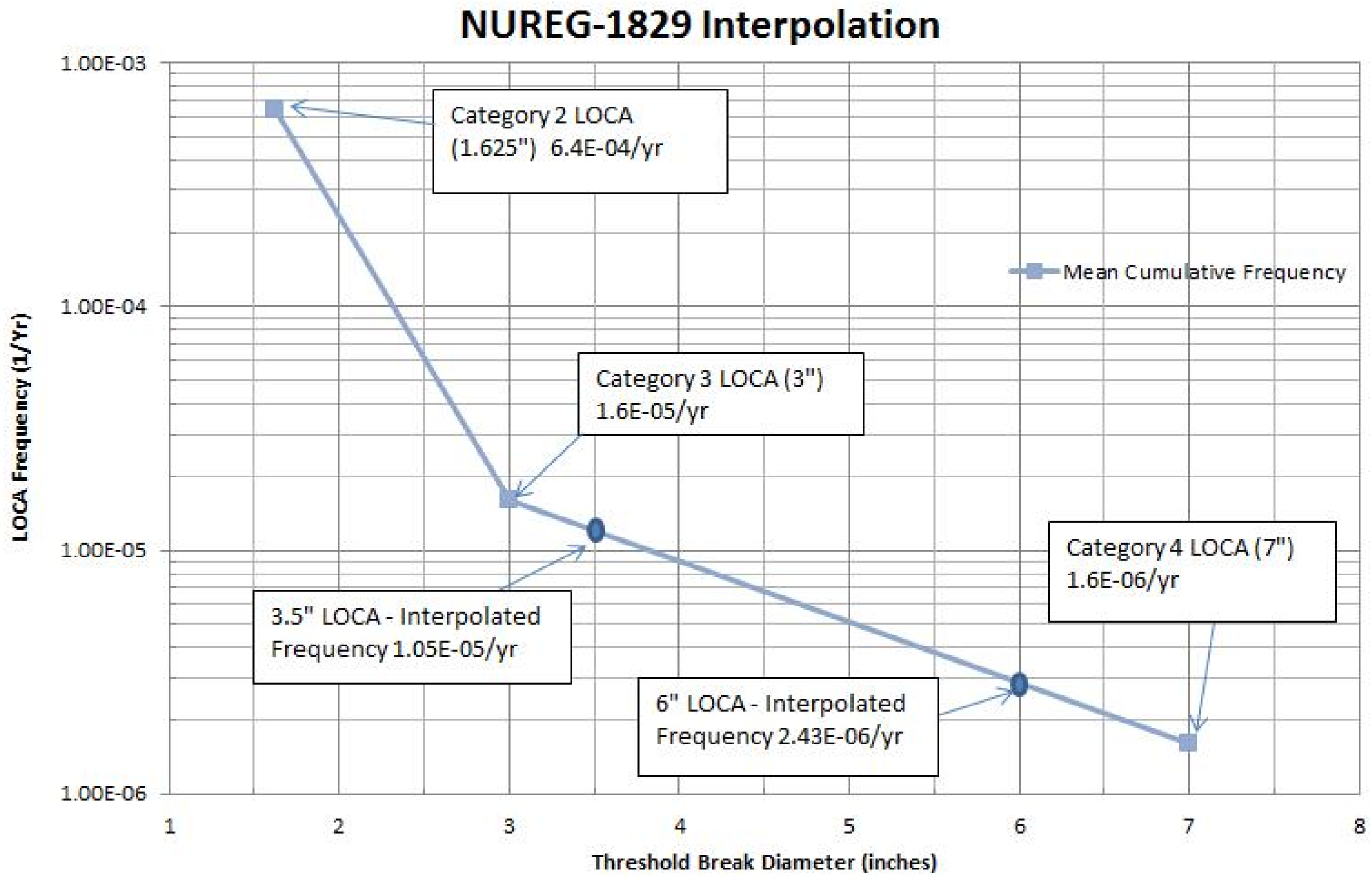


Figure 1 BWR and PWR Error-Factor Adjusted LOCA Frequency Estimates

ECCS Operation with the Condition

Frequency and Break Size Interpolation



NEW

- Use of NUREG-1829 data results in a break frequency for 3.5” to 6” of ~8E-06 per year, lower than the NRC estimate of ~1E-04.

ECCS Operation with the Condition

Effect on ΔCDF

LOCA Frequencies

Initiator	Break Diameter Range	NRC IR Freq. (/yr)	NUREG-1829 Freq. (/yr)	% of total (NRC IR)	% of total (NUREG - 1829)
Small MLOCA	2"-3.5"	5.6E-05	1.28E-04	37.5%	94%
Large MLOCA	3.5"-6"	9.4E-05	8.09E-06	62.5%	6%

Plant-Specific SPAR Model

Model Input	Decrease in ΔCDF	Internal ΔCDF
• NRC Baseline Internal ΔCDF		7.10E-06
NEW • MLOCA Modeling	2.17E-06	4.93E-06

ECCS Operation with the Condition

Plant Specific SPAR Model

Common Cause Factor (CCF)

- Current NRC SPAR model for DCPP uses alpha factors from the 2010 parameter update

NEW

- Updated alpha factors from 2013 are lower (alpha2 is 1.77E-02 vs. 1.92E-02)
- Replaced 2010 MOV alpha factors with 2013 values
- Reduction in CDF is most pronounced for large MLOCA

ECCS Operation with the Condition

Effect on ΔCDF

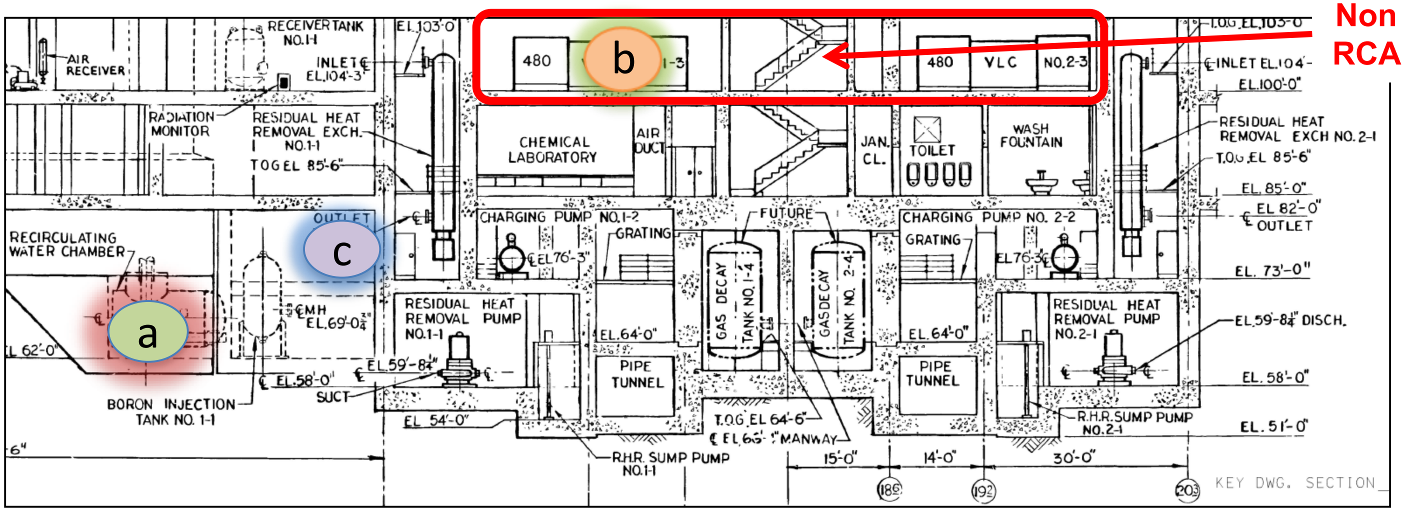
Plant Specific SPAR Model

Model Input	Decrease in ΔCDF	Internal ΔCDF
● NRC Baseline Internal CDF		7.10E-06
NEW ● MLOCA Modeling	2.17E-06	4.93E-06
NEW ● CCF Alpha Factor Update	1.08E-07	4.82E-06

Capability to Recover

Recovery a) Local Manual Operation
Recovery b) Remote Electrical Opening
Recovery c) Interlock Jumper

Work Locations Within the Auxiliary Building



Non RCA

Radiologically Controlled Area (RCA)

The condition would be revealed during implementation of EOP's when transferring to cold leg recirculation

- The control room would contact the TSC to request assistance in opening valve SI-2-8982B
- Three independent recoveries would be available:
  a) Manually open the SI-2-8982B valve using the handwheel
  b) Electrically open the SI-2-8982B valve at the switchgear
  New c) Make-up the failed interlock on valve RHR-2-8700B using a jumper

Capability to Recover

Local Manual Operation of the Recirculation Sump Suction Valve (SI-2-8982)

NEW

- 8982 chamber is an uncongested area accessed every refueling outage.

NEW

- Expected post accident ambient temperatures would be ≈ 83 F.

NEW

- Operating experience substantiates that the chamber will not be contaminated or require a respirator.

NEW

- Chamber access instructions are readily available to personnel in the Operations Support Center.

Time to start of valve opening was 50 min from start of pre-job brief.

Capability to Recover

Video - Opening SI-8982 Chamber

Capability to Recover

Plant Specific SPAR Model

Local Manual Recovery

The Human Error Probability (HEP) for local manual recovery using SPAR-H was updated based on new information:

NEW

- Increase in time available for action. **Time Available - Extra**
  - Time required for action reduced based on actual hatch operation timing test.

NEW

- Based on new information, ergonomics reassessed. No need for respirator or ladder, and the space is expansive. **Ergonomics - Nominal**

NEW

- Operators are trained on manual operation of similar MOVs. **Experience/Training – Nominal**

A change in these PSFs results in a significant reduction in the human error probability for manual valve operation.

Capability to Recover

Effect on ΔCDF

Plant Specific SPAR Model

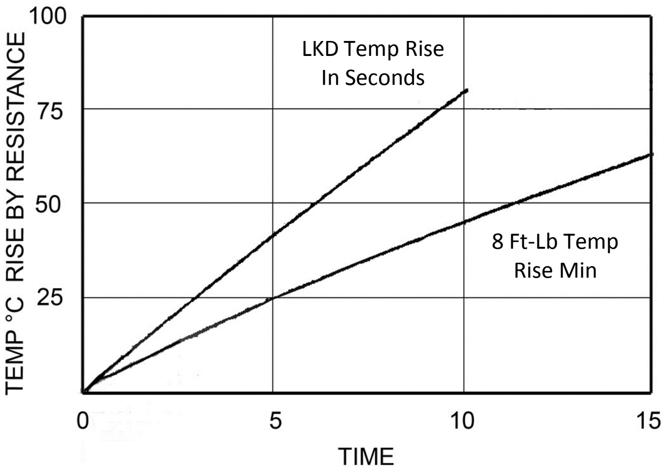
Model Input	Decrease in ΔCDF	Internal ΔCDF
• NRC Baseline Internal CDF		7.10E-06
NEW • MLOCA Modeling	2.17E-06	4.93E-06
NEW • CCF Alpha Factor Update	1.08E-07	4.82E-06
NEW • Open 8982 Manually	4.28E-06	5.42E-07

Capability to Recover

Opening 8982 MOV at Switchgear

Remote Electrical Operation

- Procedure OP O-22, training, and Task Performance Evaluation ensure operators are familiar with requirements to open or close MOVs by actuating the motor contactor at the 480V breaker.
- OP O-22 instructions ensure timely identification and correction of wrong contactor use.
- NEW Motor curve predicts no damage from Locked Rotor Amps, up to 10 seconds



Reliance Electric AC Motor Performance Curve M4635

Capability to Recover

Plant Specific SPAR Model

Remote Electrical Recovery

The HEP for remote electrical recovery was updated:

NEW

- Increase in time available for diagnosis. **Time Available – Expansive**

NEW

- A change in the action PSF for procedures is warranted based on the availability of procedures (OP O-22).
  - OP O-22 contains a diagram of a typical layout. **Procedure – Available, but Poor**

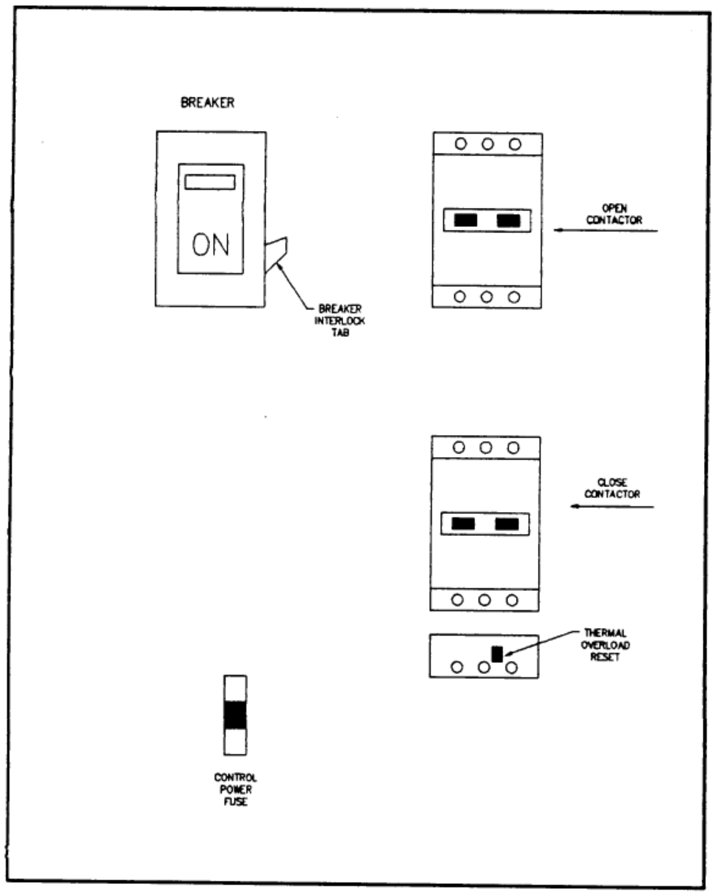


Diagram provided for 52-2G-24 (SI-2-8835). Layout is typical for most vital 480V MOVs

OP O-22 Diagram

Capability to Recover

Effect on ΔCDF

Plant Specific SPAR Model

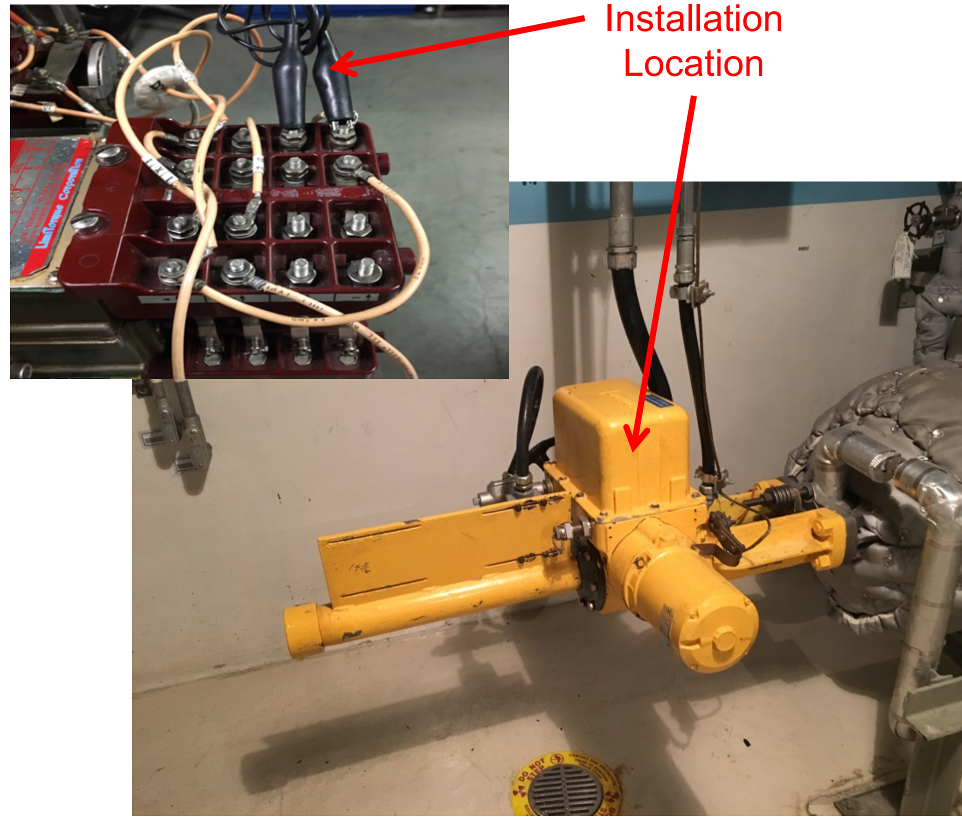
Model Input	Decrease in ΔCDF	Internal ΔCDF
● NRC Baseline Internal CDF		7.10E-06
NEW ● MLOCA Modeling	2.17E-06	4.93E-06
NEW ● CCF Alpha Factor Update	1.08E-07	4.82E-06
NEW ● Open 8982 Manually	4.28E-06	5.42E-07
NEW ● Open 8982 from Switchgear	5.64E-08	4.86E-07

Capability to Recover

NEW

Install Interlock Jumper on 8700B Actuator to allow Opening 8982B from the Control Room

- Maintenance Procedure would be used to jumper the position switch contacts on 8700B.
- Installation would be at the valve actuator, removing the actuator housing and jumpering across the switch contacts on the actuator rotors.



Unobstructed Access to RWST Suction Valve (8700B) and Actuator

Capability to Recover

Plant Specific SPAR Model

NEW

Install Interlock Jumper on 8700 MOV and Open 8982 From the Control Room

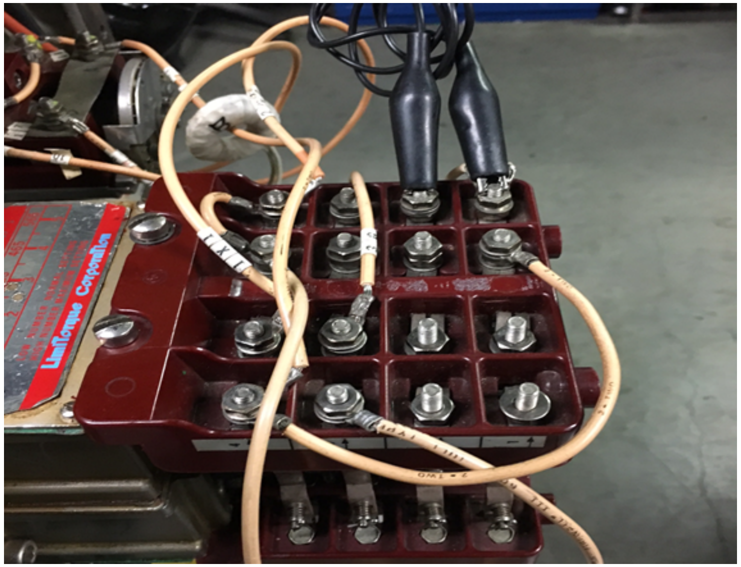
- MP E-53.10A has instructions on jumpering 8982B interlocks including wire IDs. Procedure provides specific instructions for landing jumper.
  Procedure – Available but Poor

- Jumpers would be installed at 8700B – valve is easily accessible.
  Ergonomics – Nominal

- Electrical technicians are trained on how to install jumpers.
  Experience – Nominal

- Very low ambiguity in execution.
  Complexity – Moderately Complex

- Action time available.
  Time Available - Nominal



Typical MOV Limit Switch finger base with Jumper

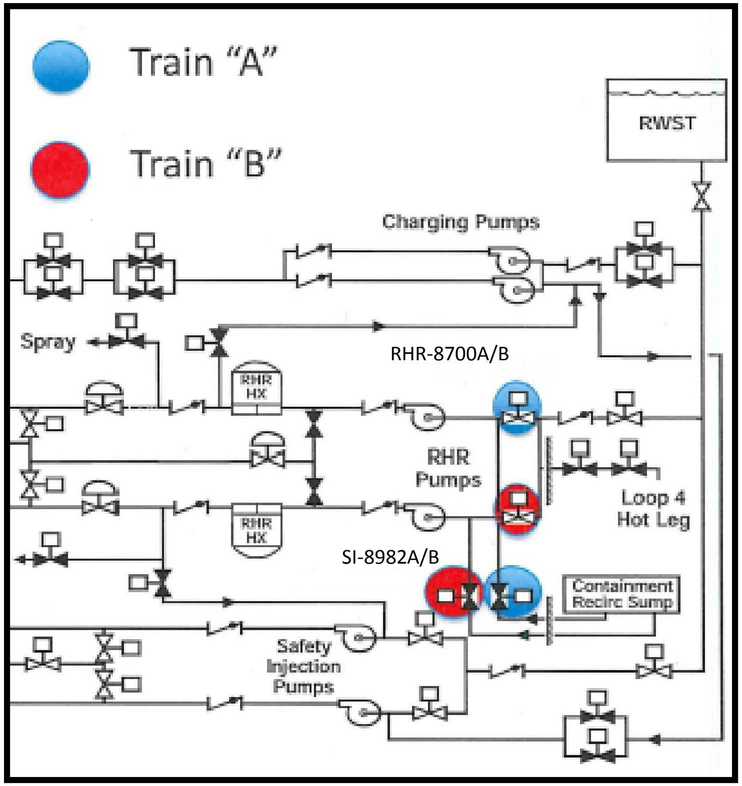
Capability to Recover

Plant Specific SPAR Model

Recovery of common cause valve SI-2-8982A failure to open

NEW

- Dominant scenarios include common cause failure of 8982A
- A failure of 8982A due to the same procedure deficiency would allow the same recovery actions to be applied
- Given the large amount of time available for recovery, sufficient time is available to attempt recovery of A train following failure of B train actions.



Capability to Recover

Plant Specific SPAR Model

Calculation of Internal and External CDF

PG&E used the current NRC SPAR model to assess ΔCDF given the previously discussed new inputs

- Internal ΔCDF = 4.86E-07.
- Reduction in Large MLOCA frequency reduces contribution from breaks >3.5”.
- ΔCDF for Small LOCAs and Small MLOCAs (≤3.5”) is reduced due to changes in SPAR-H PSFs.
- Additional recovery actions are appropriate given substantial increase in the time available.

NEW

- External ΔCDF values were calculated by applying the updated recovery actions to the ΔCDF from the inspection report. After crediting recovery, external ΔCDF was reduced to 4.56E-08.

SPAR Risk Significance

Effect on ΔCDF

Plant Specific SPAR Model

NEW

Final Results

Model Input	NRC ΔCDF	PG&E ΔCDF
Total Internal ΔCDF	7.10E-06	4.86E-07
Total External ΔCDF	5.40E-07	4.56E-08
Total ΔCDF	**7.64E-06**	**5.32E-07**

SPAR Risk Significance

Plant Specific SPAR Model

PRA Conservative Inputs NOT Modeled

NEW

- LOCA must be >4.5” to actuate containment spray. No recovery from breaks >3.5” and <4.5” was credited.
- Recovery time for all SLOCAs used the shorter 3.5” LOCA time. No credit for very long recovery times provided by small LOCAs.
- Recovery of Train A recirculation sump suction valve common cause failure was not credited.
- Credible procedural operator actions in timeline not taken:
  - Refilling RWST from Liquid Holdup Tanks
  - Normal charging from the Volume Control Tank and Boric Acid Blender makeup after RWST reaches 4% level.
  - Action to refill the Spent Fuel Pool.

The inputs listed above are currently being evaluated to determine their significance.

Note that different combinations of input values may change their individual contribution to Core Damage Frequency which would warrant inclusion of the above inputs into the final assessment and require further analysis.

SPAR Risk Significance

Effect on ΔCDF

Plant Specific SPAR Model Sensitivities

MLOCA Frequency Sensitivities

Sensitivity	Large MLOCA Δ CDF
Use of 4.5" LOCA category from NUREG-1829. Large MLOCA = 2.88E-06 /Small MLOCA = 1.34E-04	1.20E-07
Use of 3" LOCA category from NUREG-1829. Large MLOCA = 1.36E-05 /Small MLOCA = 1.23E-04	6.67E-07

Recovery Action Sensitivities

Sensitivity	Internal Δ CDF
Electrical and Manual Recovery (1.30E-03)	4.86E-07
Jumper and Electrical Recovery (2.12E-02)	8.50E-07
Manual with Poor Ergonomics plus Electrical (1.82E-03)	4.95E-07
Manual with Poor Ergonomics (1.29E-02)	6.97E-07

Summary and Conclusions

SUMMARY

- The preliminary significance documented in IR 2016-010 is a conservative and bounding assessment of condition significance.
- The new information presented by PG&E today, using the NRC's SPAR model, provides a robust revision of the assessment of condition significance.

CONCLUSION

A robust revision of the assessment of this condition demonstrates a total ΔCDF of 5.32E-07/yr.

Closing Remarks

Jim Welsch
Vice President
Nuclear Generation