Pacific Gas and
Electric Company

Lawrence F. Womack
Vice President
Nuclear Services

Diablo Canyon Power Plant
P.O. Box 56
Avila Beach, CA 93424

805.545.4600
Fax: 805.545.4234

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PG&E Letter DCL-01-072

U.S. Nuclear Regulatory Commission
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Docket No. 50-275, OL-DPR-80
Diablo Canyon Unit 1
PG&E Review of the Preliminary Accident Sequence Precursor Analysis of the May 15, 2000, Diablo Canyon Unit 1 12-kV Bus Failure Event

Dear Commissioners and Staff:

PG&E is providing comments on the preliminary Accident Sequence Precursor (ASP) analysis of the May 15, 2000, Diablo Canyon Power Plant (DCPP) Unit 1 12-KV bus failure event. The analysis was provided to PG&E for review and comment on April 27, 2001 (Reference 1). In providing the comments, PG&E has followed the guidance provided in Enclosure 2, "Guidance for Licensee Review of Preliminary ASP Analysis," of your letter.

The objective of this letter is to provide comments that will aid in performing a realistic analysis of the event and determining its risk significance. An effort was made to limit the comments to major elements of the ASP analysis that significantly impact the calculated conditional core damage probability (CCDP) for the event. For the purposes of this submittal, the terms "realistic" and "conservative" are used to mean accurate and bounding physical representation, respectively, of the plant response to the event. The term "unrealistic" means the physical occurence is not possible. The term "overly conservative" is meant to signify the impact of combining conservative estimates together.

The results of the PG&E review indicate that the NRC ASP analysis has provided an overly conservative, unrealistic evaluation of the significance of the event, as measured by the CCDP, due to the use of:

- generic and overly conservative failure probabilities (random and common cause failures) for the emergency diesel generators (EDGs),
- generic and overly conservative core uncovery time estimates,
- an unrealistic mission time for the EDGs, and
- an unrealistic treatment of the pressurizer power-operated relief valve challenge.

Enclosure 1 to this letter presents PG&E's detailed comments.

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Since the stated objective of the ASP analysis is "to provide as realistic an analysis of the significance of the event as possible," PG&E believes it is more appropriate to use the DCPP-specific information provided in the enclosure to this letter in lieu of generic data. PG&E estimates that the use of event-specific and DCPP-specific data will result in a CCDP in the range of 1.0E-5 to 5.0E-5.

Should you desire additional information, or wish to discuss these comments, please contact Mr. Kenneth Bych at (805) 545-4241.

Sincerely,

Lawrence F. Womack
Vice President, Nuclear Services

cc: Ellis W. Merschoff
David L. Proulx
Giriga S. Shulka
Diablo Distribution

Enclosure

PG&E Review of the Preliminary Accident Sequence Precursor Analysis of the May 15, 2000, Diablo Canyon Unit 1 12-kV Bus Failure Event

PG&E Review of the Preliminary Accident Sequence Precursor Analysis of the May 15, 2000, Diablo Canyon Unit 1 12-kV Bus Failure Event

The preliminary Accident Sequence Precursor (ASP) analysis of the DCPP Unit 1 12-kV bus failure event was provided to PG&E for review and comment. The purpose of providing PG&E with an opportunity to review the ASP analysis was to improve the realism of the results and to provide a review of the determination of the risk significance of the event.

From a probabilistic risk assessment (PRA) perspective, the ASP analysis provides an accurate description of the event. It does not, however, fully describe the initial response of the plant relative to the reactor coolant system (RCS) pressure profile. During the initial phase of the plant response, the condenser was available and RCS pressure decreased immediately. Operators took steps necessary to transfer the pressurizer heaters to their backup vital power supply (Reference 2). This action was taken to prevent further depressurization of the RCS (Reference 3). This is important because the action shows that the power-operated relief valves (PORVs) could not have been challenged due to RCS overpressurization (discussed in detail in the section below entitled "PORVs Contribution to CCDP").

Based on a review of the ASP preliminary report, the use of generic information in the analysis has resulted in conservative results in three areas:

- emergency diesel generator (EDG) failure probabilities relative to station blackout (SBO)
- core uncovery time estimates
- PORV challenges

The basis for this conclusion is provided below.

SBO Probability

The ASP analysis estimate of the SBO probability is overly conservative due to the following reasons:

I. EDG Failure Data - The failure data are overly conservative and/or unrealistic based on the following:

   A. The addition of a maintenance out-of-service (OOS) contribution to the total random failure probability is not appropriate since none of the EDGs were OOS when the event occurred. If there had been an OOS EDG, the impact should have been calculated by failing the EDG for the conditional core damage probability (CCDP) calculation.

B. The total random failure probability of each EDG is significantly increased by the OOS contribution (34 percent of the total for each EDG). If the maintenance OOS contribution must be included, the ASP analysis approach is incorrect since only one EDG could have been OOS at the time of the event, as DCPP Technical Specifications do not allow continued operation with more than one EDG OOS. Thus, the contribution of maintenance is overly conservative due to the inclusion of disallowed maintenance combinations (i.e., two or three EDGs assumed to be OOS).

C. The ASP analysis uses 24 hours (severe weather mission time) as the EDG mission time for calculating the EDG failure probability. This is unrealistic on the basis that even though during the actual event the EDGs ran for 33 hours, it has been established that offsite power could have been restored within 6.5 to 8 hours (Reference 2, page 22). Additionally, offsite power was not lost; only the capability to supply offsite power to the emergency buses was lost. Once this capability was reestablished, offsite power recovery was possible. Therefore, 8 hours should be used as the EDG mission time.

D. The ASP analysis uses NUREG/CR-5500 (Reference 4) data for assigning failure probability to the different failure modes of the EDGs. NUREG/CR-5500 data are estimated based on plant-specific events from 1987 to 1993. Based on a review of Tables 2, 6, and 7 in the NUREG, the use of EDG failure data as presented in NUREG/CR-5500 is unrealistic based on the following:

   1. The NUREG/CR-5500 failure probabilities for DCPP are estimated based on failure events that are reported in accordance with requirements in Regulatory Guide (RG) 1.108. This RG requires reporting of EDG operational anomalies that are not considered failures in a typical PRA model, especially for an SBO scenario. For example, the majority of reported DCPP EDG failures that occurred within the first hour of operation are due to failure of the EDGs to achieve stable voltage within 13 seconds of the start signal (Reference 5). These failures are not applicable to an SBO scenario.

   2. NUREG/CR 5500 reports a significantly higher failure probability for the Unit 1 EDGs during the first hour than for the Unit 2 EDGs (Reference 4, Table 6). However, all six of the EDGs at DCPP are the same, and therefore vulnerable to the same failure mechanisms (same hardware, maintenance and test procedures). Note that the NUREG reports very similar failure probabilities for the "fail to start" and the "fail to run after the first hour" failure modes. Thus, consistent with the DCPP PRA model, it is more

realistic to combine EDG failure events for both units and calculate a single set of failure probability values for both the Unit 1 and Unit 2 EDGs.

Table 1 of this letter provides the EDG failure probability estimates used in the ASP analysis and the DCPP PRA model (Reference 6). The DCPP PRA estimates are plant-specific and cover events up to 1997. It is recommended that the DCPP PRA model values be used in the ASP analysis.

II. Common Cause Failure (CCF) Factors - The ASP analysis uses the CCF factors provided in NUREG/CR-5497 (Reference 7). These factors are generic or average estimates and are conservative (Reference 4, page 2). The NUREG/CR-5497 CCF factors are calculated based on the NUREG/CR-6268 data (Reference 8). The generic CCF factors do not take into account plant-specific features or attributes that would reduce the CCF probability for a particular plant. For example, the DCPP EDGs are air-cooled and are therefore not susceptible to service water-cooling system failures. Since a review of the NUREG/CR-6268 data indicates that some of the EDG common cause failures are due to cooling water system failures, these CCFs are too conservative for the DCPP EDGs.

The DCPP CCF factors were calculated using the approach and data provided in NUREG/CR-6268 and are updated using plant-specific information. The CCF events are tailored to DCPP by taking into account plant-specific design features and current data. This is recognized by NUREG/CR-6268 to be the preferred approach for CCF analysis (Reference 8, Vol. 1, Page 9). Table 2a provides a list CCF alpha factors used in the ASP analysis and the corresponding factors from the DCPP PRA model (Reference 9). Table 2b presents the CCF probabilities using DCPP recommended failure probability data as compared to the probability data used in the ASP analysis.

Comparisons between the DCPP PRA model and the ASP model of the individual estimates for the EDG failure probabilities and the alpha factors used in the common cause analysis show that each of the ASP model numbers are conservative and the cumulative impact of conservatisms is significant.

Core Uncovery Time Window

The ASP analysis uses the Rhodes Model for estimating the failure probability of the reactor coolant pump (RCP) seals and the core uncovery time window. The NRC staff recognizes that the Rhodes model is conservative (Reference 10, page 4). The core uncovery time estimate is derived from the Westinghouse generic core uncovery analysis (Reference 11). Using generic consideration of plant response, the Westinghouse Model estimates core uncovery in 4 hours following an SBO-induced RCP Seal LOCA event without RCS cooling. However, it is recognized by the NRC Staff that the contribution of RCP seal failure to core damage frequency is very plant-specific (Reference 11, page 3). Therefore, to perform a realistic analysis, it is more appropriate to use plant-specific information with respect to the core uncovery times.

The DCPP PRA model uses plant-specific Modular Accident Analysis Program (MAAP) runs, taking into account plant-specific emergency operating procedures (EOPs), to calculate the core uncovery time. The DCPP MAAP model is realistic as compared to the conservative Westinghouse generic core uncovery analysis (Reference 12). A major difference between this generic model and the DCPP-specific model is the injection of the accumulators. The generic model assumes the RCS would be depressurized to approximately 600 psig, which prevents injection of the accumulators. The DCPP model, consistent with the DCPP EOPs (Reference 13), credits depressurization to approximately 300 psig, which allows for injection of inventory from all four accumulators. As a result, the DCPP MAAP runs indicate that, with RCS depressurization, the time to core uncovery is approximately 15 hours (Reference 14).

Therefore, for this event, the limiting condition for establishing the recovery of offsite power time window is the vital 125 Vdc battery life (8 hours) rather than the core uncovery time. This limiting time affects nonrecovery factors for sequences 18-05 through 18-17 of the ASP analysis.

PORVs Contribution to CCDP

The ASP analysis estimates at least a 4.2 percent contribution to CCDP from the stuck open PORV sequences (Reference 1, Table 1 and Figure 2). This contribution is unrealistic based on the following:

I. Possibility of PORV Being Challenged - The ASP analysis assumes that the PORV could have been challenged (Reference 1, page 3). This is not consistent with the event. The event was a turbine trip-initiating event with a subsequent complication of loss of offsite power to the vital 4-kV buses and some nonvital buses. Plant experience and generic analysis (Reference 15, Table II.1) have shown that the RCS pressure increase as a result of this type of event (even under the most conservative assumptions) would not be sufficient to challenge the PORVs. RCS pressure decreased immediately following the actual event (turbine trip, followed immediately by a reactor trip, with the RCPs and circulating water pumps running). Thus, there was no possibility for a pressure spike, and assigning a probability to an impossible event is unrealistic.

II. Validity of Stuck Open PORV Cutsets - The ASP analysis asserts that for a stuck open PORV following a loss of power scenario, high-pressure recirculation via the low-pressure injection pumps (piggy-back mode) must be recovered within 5 hours to prevent core damage. The ASP analysis states that this assertion is based on the DCPP Individual Plant Examination (IPE) study (Reference 1, page 3). This assertion is unrealistic and inconsistent with the current DCPP PRA model, which is an updated IPE model, based on the following:

A. The DCPP PRA model takes credit for refilling the refueling water storage tank (RWST) for small LOCA scenarios (Top Event MU on Page 3.1-43 and Split Fraction REP on page 3.1-73 of the DCPP IPE report [Reference 16]).

B. The recovery time window of 5 hours is based on the analysis performed for a small LOCA event. The 5-hour time window in the IPE is the earliest that the switchover to high-pressure recirculation could occur and corresponds to the time when the RWST has approximately 30 percent inventory remaining. In calculating this 5-hour time window, the DCPP IPE analysis does not account for the remaining RWST inventory nor any RCS inventory. Because the remaining 30 percent volume in the RWST is not credited, this time window is unrealistically short for the scenario under consideration. Although a stuck open PORV event is normally treated similar to a small LOCA event, in reality the impact on the RCS is different. In the case of a stuck open PORV-induced LOCA, steam (as opposed to water) is released from the RCS. As a result, the RCS inventory mass loss rate for a stuck open PORV event is significantly less than that for a small LOCA event. Based on the DCPP-specific analyses, the time to core uncovery for a stuck open PORV-induced LOCA, with no emergency core cooling system injection and with auxiliary feedwater available, is 13 hours (Reference 17).

C. It is not clear why the second cutset for sequence 09 in the ASP analysis results in core damage. This sequence would not result in core damage in the DCPP PRA model.

Therefore, since the DCPP PRA model indicates that PORV opening as a consequence of the event was impossible, the PORV challenge should be eliminated from the ASP analysis. If the PORV challenge is not eliminated, the treatment of the stuck-open PORV event should be modified to reflect the corrections discussed above.

Calculation of Event Significance

Several sensitivity calculations were performed to estimate the risk significance of the event utilizing the recommendations suggested by this review. Tables 3, 4, and 5 present the results of these sensitivity studies.

Conclusion

PG&E believes that the ASP analysis methodology, other than the treatment of the PORV challenge, was appropriate. However, due to the use of generic and conservative failure probability and core uncovery time estimates, the ASP analysis of the 12-kV event at DCPP resulted in an overly conservative, unrealistic evaluation of the significance of the event. Comparisons between the DCPP PRA model and the ASP model of the individual estimates for the EDG failure probabilities and the alpha factors used in the common cause analysis show that each of the ASP model numbers are conservative and the cumulative impact of conservatisms is significant. Since the objective of the ASP analysis is "to provide as realistic an analysis of the significance of the event as possible," PG&E believes that the DCPP-specific probability estimates and results should be used. It is expected that by using plant-specific information, the resultant CCDP from a revised ASP analysis will be in the range of 1.0E-5 to 5.0E-5. These values are substantiated in Tables 3, 4, and 5.

References

1. "Diablo Canyon Power Plant, Unit 1 - Review of Preliminary Accident Sequence Precursor Analysis of Operational Event," Letter to Mr. Gregory M. Rueger from Girija S. Shukla, April 16, 2001.

2. "Summary of Findings, Diablo Canyon Nuclear Power Station, NRC Inspection Report 50-275/00-09; 50-323/00-09," Attachment to letter to Mr. Gregory M. Rueger from Ken E. Brockman, July 31, 2000.

3. PG&E Operations Incident Summary, "Unit 1 Aux 12-kV Buswork Electrical Fault, Reactor Trip and Subsequent Loss of Offsite Power to 4-kV Vital Buses," Original transmitted to RMS on October 14, 2000.

4. NUREG/CR-5500, "Reliability Study: Emergency Diesel Generator Power System, 1987-1993," Vol. 5, September 1999.

5. PG&E STP M-9I Log, Log for "Diesel Generator Start and Load Tracking"

6. PG&E calculation file H.1.5, "DCPRA Database Update for DCPP," Rev. 5, October 2000.

7. NUREG/CR-5497, "Common-Cause Failure Parameter Estimations," October 1998.

8. NUREG/CR-6268, "Common-Cause Failure Database and Analysis System" Volume 1 through 4, June 1998.

9. PG&E Calculation File H.1.3, "DCPRA Data Update, Evaluation of Alpha Factors," Rev. 1, 2000.

10. NRC Memorandum to William D. Travers from Ashok C. Thadani, Closure of Generic Safety Issue 23, "Reactor Coolant Pump Seal Failure," Number 8, 1999.

11. NUREG-CR-5167, "Cost Benefit Analysis for Generic Letter 23: Reactor Coolant Pump Seal Failure," April 1991.

12. PG&E Memorandum, "Comments on DCPRA Pump Seal LOCA Calculations, Letter No. 90000453," March 15, 1990 (RMS # 147169).

13. PG&E Emergency Operating Procedure ECA-0.0, "Loss of All Vital AC Power," Rev. 13, Step 16d.

14. PG&E Memorandum, "MAAP Analyses of Pump LOCAs, Letter No. 88000911," April 22, 1988 (RMS # 111456).

15. WCAP-9804, "Probabilistic Analysis and Operational Data in Response to NUREG-0737, Item II.K.3.2 For Westinghouse NSSS Plants," April 1, 1981.

16. PG&E Report, "Diablo Canyon Power Plant Units 1 and 2 Individual Plant Examination Report," April 14, 1992.

17. PG&E Calculation File 9111101-0, "MAAP Simulation of Key Plant Damage State HAYDI," January 30, 1992.

18. PG&E Calculation File D.2.1.5, "Diesel Generator System- PRA System Analysis," Rev. 8, November 2000.

Table 1 - ASP Failure Rate versus DCPP Failure Rate for EDGs			
Failure Mode	**ASP Mean Prob. (hr^{-1})**	**DCPP Mean Prob. (hr^{-1})**	**Notes**
Maintenance out of service (while not shutdown)	3.1E-02	1.3E-2	Ref. 18, Sheet 86, ALIGNH. Assigning out-of-service (OOS) probability is not appropriate
Failure to start (FTS)	9.0E-3	4.15E-3	Ref. 6, Sheet 28, (S3DGSS)
Failure to recover FTS	1.0E-00	Not used	
Failure to run (FTR)-short (<30 min)	7.20E-2	3.0E-3	Ref. 6, Sheet 28, (S3DGS1)
FTR-mid (0.5 - 14hrs)	1.0E-03	1.5E-3	Ref. 6, Sheet 28, (S3DGS2)
FTR-long (14-24 hrs)	2.5E-03	Not used	
Failure to recover FTR	1.0E+00	1.0E+00	
Total	9.2E-2 (MT)=24) 8.4E-2 (MT=8) 5.25E-2 (MT=8 & no Maintenance)	5.4E-2 (MT=24) 3.1E-2 (MT=8) 1.7E-2 (MT=8 & no Maintenance)	A 24-hour mission time (MT) for EDGs is not appropriate. The mission time should be 8 hours.

Table 2a - ASP CCF Alpha Factors versus DCPP PRA Model Alpha Factors			
Failure Mode	**ASP Factor**	**DCPP Factor**	**Comments**
FTS	1.66E-2	3*2.77E-3	Ref. 9, Table 7, (T3GSS)
FTR (< 30 minutes)	2.11E-2	3*5.87E-3	Ref. 9, Table 7, (T3GS1)
FTR (> 30 minutes)	2.11E-2	3*5.87E-3	Ref. 9. Table 7, (T3GS2)
FTR (long term)	2.11E-2	Not used	Not used since the offsite power had not failed during the event and recovery was possible in less than 8 hours (6.5 to 8 hours)

Table 2b - ASP CCF Estimates versus DCPP PRA Model CCF Estimates			
Failure Mode	**ASP CCF Prob. (hr^{-1})**	**DCPP CCF Prob. (hr^{-1})**	**Comments**
FTS	1.5E-4	3.45E-5	Note 1
FTR (< 30 minutes)	7.6E-4	2.64E-5	Note 1
FTR (> 30 minutes)	3.0E-4	1.98E-4	Note 1
FTR (long term)	5.3E-5	0	Note 1
Total	1.3E-3	2.6E-4 (MT = 8 hrs) 6.8E-4 (MT = 24 hrs)	24 hr mission time is not used and is provided for comparison only.

Notes: 1) Values represent CCF Alpha Factor * Failure Rate (Table 2a * Table 1)

Table 3 - ASP Model Using DCPP Failure Probability Values for EDGs + DCPP Seal LOCA Core Uncovery Time

Sequence	Cut Sets							CCDP	Totals
18-08	EPS-DGN-CF-ALL	RCS-MDP-LK-SEALS	/PPR-SRV-CO-SBO	LOOP-18-08-NREC	**OEP-XHE-NOREC-BD**				
	2.59E-04	2.20E-01	0.96	5.00E-01	**5.00E-02**			1.39E-6	
	RCS-MDP-LK-SEALS	EPS-DGN-FC-1A	EPS-DGN-FC-1B	EPS-DGN-FC-1C	/PPR-SRV-CO-SBO	LOOP-18-08-NREC	**OEP-XHE-NOREC-BD**		
	2.20E-01	1.70E-02	1.70E-02	1.70E-02	0.96	5.00E-01	**5.00E-02**	2.59E-08	1.39E-6
18-22	OEP-XHE-NOREC-ST	EPS-DGN-CF-ALL	AFW-TDP-FC-1A	LOOP-18-22-NREC					
	1	2.59E-04	3.50E-02	4.10E-01				3.72E-06	
	OEP-XHE-NOREC-ST	AFW-TDP-FC-1A	EPS-DGN-FC-1A	EPS-DGN-FC-1B	EPS-DGN-FC-1C	LOOP-18-22-NREC			
	1	3.50E-02	1.70E-02	1.70E-02	1.70E-02	0.41		7.05E-08	3.79E-06
18-02	EPS-DGN-CF-ALL	OEP-XHE-NOREC-BD	/RCS-MDP-LK-SEAL	/PPR-SRV-CO-SBO	LOOP-18-02-NREC				
	2.59E-04	5.00E-02	0.78	0.96	2.50E-01			2.42E-6	
	OEP-XHE-NOREC-BD	/RCS-MDP-LK-SEAL	EPS-DGN-FC-1A	EPS-DGN-FC-1B	EPS-DGN-FC-1C	/PPR-SRV-CO-SBO	LOOP-18-02-NREC		
	5.00E-02	0.78	1.70E-02	1.70E-02	1.70E-02	0.96	2.50E-01	4.60E-08	2.47E-6
09	OEP-XHE-NOREC-2H	PPR-SRV-CO-L	EPS-DGN-FC-1A	EPS-DGN-FC-1B	PPR-SRV-OO-2	LOOP-09-NREC			
	1	4.00E-02	1.70E-02	1.70E-02	3.00E-02	0.4		1.39E-07	
	OEP-XHE-NOREC-2H	PPR-SRV-CO-L	EPS-DGN-FC-1B	EPS-DGN-FC-1C	PPR-SRV-OO-2	LOOP-09-NREC			
	1	4.00E-02	1.70E-02	1.70E-02	3.00E-02	0.4		1.39E-07	
	OEP-XHE-NOREC-2H	PPR-SRV-CO-L	EPS-DGN-FC-1A	EPS-DGN-FC-1B	PPR-SRV-OO-1	LOOP-09-NREC			
	1	4.00E-02	1.70E-02	1.70E-02	3.00E-02	0.4		1.39E-07	4.16E-07

Total from above sequences	5.60E-06
Total from the rest	6.75E-06
Grand Total	1.23E-05

Notes for Table 3:

Table 3 presents the results when only the DCPP-specific EDG failure data and RCP Seal LOCA core uncovery time window are used in the ASP model. The impact of the DCPP-specific EDG failure probabilities on the results is estimated by replacing the recommended EDG failure probabilities in the cutsets for the 18-08, 18-22, 18-02, and 09 sequences. The impact of DCPP-specific core uncovery time on the results is estimated by adding the OEP-XHE-NOREC-BD basic event (Reference 1, Table 4) to the sequence 18-08 cutsets. This is considered to be the most realistic analysis of the significance of the event (within the limitation of SPAR model). The CCDP is estimated at 1.23E-5. The following should be noted:

I. The probability of PORV challenge is not eliminated from the sequences.

II. The contribution from the "other sequences" is divided by four to account for:

   A. Not eliminating the PORV challenge probability.

   B. The impact of the change in EDG failure probability values on the remaining sequences.

   C. The impact of the change in the core uncovery time window on the remaining sequences in which most of the nonrecovery factors drop by an order of magnitude.

Table 3 uses EDG failure probability estimates that are calculated by eliminating the OOS contribution of EDGs to the total failure probability and assigning an 8-hour mission time for the EDGs.

Table 4 - ASP Model Using DCPP Failure Probability Values for EDGs

Sequence	Cut Sets							CCDP	Totals
18-08	EPS-DGN-CF-ALL	RCS-MDP-LK-SEALS	/PPR-SRV-CO-SBO	LOOP-18-08-NREC					
	2.59E-04	2.20E-01	0.96	5.00E-01				2.74E-5	
	RCS-MDP-LK-SEALS	EPS-DGN-FC-1A	EPS-DGN-FC-1B	EPS-DGN-FC-1C	/PPR-SRV-CO-SBO	LOOP-18-08-NREC			
	2.20E-01	1.70E-02	1.70E-02	1.70E-02	0.96	5.00E-01		5.19E-07	2.79E-05
18-22	OEP-XHE-NOREC-ST	EPS-DGN-CF-ALL	AFW-TDP-FC-1A	LOOP-18-22-NREC					
	1	2.59E-04	3.50E-02	4.10E-01				3.72E-06	
	OEP-XHE-NOREC-ST	AFW-TDP-FC-1A	EPS-DGN-FC-1A	EPS-DGN-FC-1B	EPS-DGN-FC-1C	LOOP-18-22-NREC			
	1	3.50E-02	1.70E-02	1.70E-02	1.70E-02	0.41		7.05E-08	3.79E-06
18-02	EPS-DGN-CF-ALL	OEP-XHE-NOREC-BD	/RCS-MDP-LK-SEAL	/PPR-SRV-CO-SBO	LOOP-18-02-NREC				
	2.59E-04	5.00E-02	0.78	0.96	2.50E-01			2.42E-06	
	OEP-XHE-NOREC-BD	/RCS-MDP-LK-SEAL	EPS-DGN-FC-1A	EPS-DGN-FC-1B	EPS-DGN-FC-1C	/PPR-SRV-CO-SBO	LOOP-18-02-NREC		
	5.00E-02	0.78	1.70E-02	1.70E-02	1.70E-02	0.96	2.50E-01	4.60E-08	2.47E-06
09	OEP-XHE-NOREC-2H	PPR-SRV-CO-L	EPS-DGN-FC-1A	EPS-DGN-FC-1B	PPR-SRV-OO-2	LOOP-09-NREC			
	1	4.00E-02	1.70E-02	1.70E-02	3.00E-02	0.4		1.39E-07	
	OEP-XHE-NOREC-2H	PPR-SRV-CO-L	EPS-DGN-FC-1B	EPS-DGN-FC-1C	PPR-SRV-OO-2	LOOP-09-NREC			
	1	4.00E-02	1.70E-02	1.70E-02	3.00E-02	0.4		1.39E-07	
	OEP-XHE-NOREC-2H	4.00E-02	EPS-DGN-FC-1A	EPS-DGN-FC-1B	PPR-SRV-OO-1	LOOP-09-NREC			
	1	4.00E-02	1.70E-02	1.70E-02	3.00E-02	0.4		1.39E-07	4.16E-07

Total from above sequences	3.21E-05
Total from the rest	1.35E-05
Grand Total	4.56E-05

Notes for Table 4:

Table 4 presents the results when only the DCPP-specific EDG failure data are used in the ASP model. The impact of the DCPP-specific EDG failure probabilities on the results is estimated by replacing the recommended EDG failure probabilities in the cutsets for the 18-08, 18-22, 18-02, and 09 sequences. The CCDP is estimated at 4.56E-5. The following should be noted:

I. The probability of PORV challenge is not eliminated from the sequences.

II. The contribution from the "other sequences" is halved to account for:

   A. Not eliminating the PORV challenge probability.

   B. The impact of the change in EDG failure probability values on the remaining sequences.

Table 4 uses EDG failure probability estimates that are calculated by eliminating the OOS contribution of EDGs to the total failure probability and assigning an 8-hour mission time for the EDGs.

Table 5 - ASP Model Using ADCPP Seal LOCA Core Uncovery Time

Sequence	Cut Sets							CCDP	Totals
18-08	EPS-DGN-CF-ALL	RCS-MDP-LK-SEALS	/PPR-SRV-CO-SBO	LOOP-18-08-NREC	**OEP-XHE-NOREC-BD**				
	1.30E-03	2.20E-01	0.96	5.00E-01	**5.00E-02**			6.86E-06	
	RCS-MDP-LK-SEALS	EPS-DGN-FC-1A	EPS-DGN-FC-1B	EPS-DGN-FC-1C	/PPR-SRV-CO-SBO	LOOP-18-08-NREC	**OEP-XHE-NOREC-BD**		
	2.20E-01	9.20E-02	9.20E-02	9.20E-02	0.96	5.00E-01	**5.00E-02**	4.11E-06	1.10E-05
18-22	OEP-XHE-NOREC-ST	EPS-DGN-CF-ALL	AFW-TDP-FC-1A	LOOP-18-22-NREC					
	1	1.30E-03	3.50E-02	4.10E-01				1.87E-05	
	OEP-XHE-NOREC-ST	AFW-TDP-FC-1A	EPS-DGN-FC-1A	EPS-DGN-FC-1B	EPS-DGN-FC-1C	LOOP-18-22-NREC			
	1	3.50E-02	9.20E-02	9.20E-02	9.20E-02	0.41		1.12E-05	2.98E-05
18-02	EPS-DGN-CF-ALL	OEP-XHE-NOREC-BD	/RCS-MDP-LK-SEAL	/PPR-SRV-CO-SBO	LOOP-18-02-NREC				
	1.30E-03	5.00E-02	0.78	0.96	2.50E-01			1.22E-05	
	OEP-XHE-NOREC-BD	/RCS-MDP-LK-SEAL	EPS-DGN-FC-1A	EPS-DGN-FC-1B	EPS-DGN-FC-1C	/PPR-SRV-CO-SBO	LOOP-18-02-NREC		
	5.00E-02	0.78	9.20E-02	9.20E-02	9.20E-02	0.96	2.50E-01	7.29E-06	1.95E-05
09	OEP-XHE-NOREC-2H	PPR-SRV-CO-L	EPS-DGN-FC-1A	EPS-DGN-FC-1B	PPR-SRV-OO-2	LOOP-09-NREC			
	1	4.00E-02	9.20E-02	9.20E-02	3.00E-02	0.4		4.06E-06	
	OEP-XHE-NOREC-2H	PPR-SRV-CO-L	EPS-DGN-FC-1B	EPS-DGN-FC-1C	PPR-SRV-OO-2	LOOP-09-NREC			
	1	4.00E-02	9.20E-02	9.20E-02	3.00E-02	0.4		4.06E-06	
	OEP-XHE-NOREC-2H	PPR-SRV-CO-L	EPS-DGN-FC-1A	EPS-DGN-FC-1B	PPR-SRV-OO-1	LOOP-09-NREC			
	1	4.00E-02	9.20E-02	9.20E-02	3.00E-02	0.4		4.06E-06	1.22E-05

Total from above sequences	7.24E-05
Total from the rest	9.00E-06
Grand Total	8.14E-05

Notes for Table 5

Table 5 presents the results when only the DCPP-specific RCP seal LOCA core uncovery time window is used in the ASP model. The impact of DCPP-specific core uncovery time on the results is estimated by adding the OEP-XHE-NOREC-BD basic event (Reference 1, Table 4) to the sequence 18-08 cutsets. The CCDP is estimated at 8.1E-5. The following should be noted:

I. The probability of PORV challenge is not eliminated from the sequences.

II. The contribution from the "other sequences" is divided by three to account for:

   A. Not eliminating the PORV challenge probability.

   B. The impact of the change in the core uncovery time window on the remaining sequences when most of the nonrecovery factors drop by an order of magnitude.