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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

South Texas Project
Units 1 & 2
Docket No. STN 50-498 & 50-499
Preliminary ASP Analysis

Ref: Correspondence from Lawrence E. Kokajko, U. S. Nuclear Regulatory Commission(NRC) to William T. Cottle (HL&P), dated May 16, 1994 (ST-AE-HL-93819)

The referenced correspondence transmitted a preliminary Accident Sequence Precursor (ASP) Program analysis of an operational condition which was discovered at the South Texas Project, Unit 1, in January 1993. As required, HL&P has completed a review of this analysis.

A review of sequences as analyzed as part of the NRC's ASP program was performed by HL&P using insights gained from the South Texas Project Individual Plant Examination (IPE) model and actual conditions existing during the event. Although HL&P's analysis resulted in a conditional probability defined by the NRC as an accident sequence precursor, HL&P's conditional probability result was about an order of magnitude below the NRC's analysis result from the ASP Program. This is due to the mitigating effects of the TSC Diesel Generator and the Positive Displacement Pump (PDP). A description of HL&P's review of the NRC's accident sequence precursor analysis with the results of HL&P IPE analysis is provided in attachment 1 to this letter.

If you have any questions on this matter, please contact Mr. J. J. Sheppard at (512) 972-8757 or me at (512) 972-8434.

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Attachment 1: Review of NRC Accident Sequence Precursor Analysis

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REVIEW OF NRC ACCIDENT SEQUENCE PRECURSOR ANALYSIS

A review of the sequences leading to core damage as analyzed as part of the NRC's Accident Sequence Precursor (ASP) program was performed using insights gained from the STP Individual Plant Evaluation (IPE) models and actual plant conditions during the event. The NRC analysis identified three dominant sequences. These are:

1. An unrecovered loss of offsite power (LOOP) followed by an unrecovered loss of all emergency diesel generators (EDGs) and an unrecovered loss of the turbine driven auxiliary feedwater (TDAFW) pump. (ASP sequence 55)

2. A LOOP followed by a loss of all EDGs with the TDAFW pump successful (i.e. recovered) and a subsequent seal LOCA with no electric power recovery before the core becomes uncovered. (ASP sequence 53)

3. A LOOP followed by a loss of all EDGs with the TDAFW pump successful (i.e. recovered) and no seal LOCA and electric power is not recovered before the batteries deplete. (ASP sequence 54)

ASP sequence 55 is similar to the third ranking sequence from Table 3.5.1.1-2 of the IPE. ASP sequence 53 is similar to the 16th ranking sequence from Table 3.5.1.1-2 with the exception that the IPE credits the Positive Displacement Pump (PDP), which is powered from the Technical Support Center (TSC) Diesel Generator, for providing seal cooling when all other sources are unavailable. The sequences from Table 3.5.1.1-2 are shown in Table 1 of this attachment. ASP sequence 54 is similar to the case in which the PDP pump is successful in providing seal cooling and the TDAFW pump is also successful. The ASP analysis assumes that a core melt sequence occurs as a result of a loss of batteries. The IPE assumes the loss of battery power does not impact the success of this sequence because no seal LOCA will occur and the TDAFW pump will continue to operate without DC power (i.e. no core damage).

ASP sequences 53 and 55 were analyzed based on the conditions experienced during the event. Unavailabilities used in the IPE for the EDGs 11 and 12 (applicable for both ASP sequences) and the PDP pump and TSC Diesel Generator (applicable for ASP sequence 53) were adjusted to account for the fact that no maintenance was performed on this equipment during the 552 hour period when EDG 13 and the TDAFW pump were inoperable except for a 47 hour maintenance outage on the TSC diesel generator. Unavailabilities used in the IPE for the EDG 11 (applicable for both ASP sequences) and the PDP pump and TSC Diesel Generator (applicable for ASP sequence 53) were adjusted to account for the fact that no maintenance was performed on this equipment during the 61 hour period when EDGs 12 and 13 and the TDAFW pump were inoperable. The recovery factor for the TDAFW pump was adjusted for both periods to account for the actual conditions during the periods analyzed.

The results of the HL&P evaluation of the ASP sequences are shown below for both periods analyzed by the NRC. The conditional probabilities shown are the incremental risk associated with the events, calculated in a manner similar to that provided by the NRC in its ASP analysis of the STP events described in Section A.1.4 (page A-6) of enclosure 5 of the NRC's letter.

Period 1, 552 hours, EDG 13 and the TDAFW pump inoperable

	IPE Sequences	ASP Sequences
ASP sequence 55 conditional probability =	1.0E-6	4.9E-6
ASP sequence 53 conditional probability =	2.2E-7	1.4E-6
ASP sequence 54 conditional probability =	N/A	4.9E-7
Total sequences conditional probability =	1.2E-6	6.9E-6

Period 2, 61 hours, EDGs 12 and 13 and the TDAFW pump inoperable

	IPE Sequences	ASP Sequences
ASP sequence 55 conditional probability =	2.1E-6	9.6E-6
ASP sequence 53 conditional probability =	2.0E-7	3.7E-6
ASP sequence 54 conditional probability =	N/A	1.3E-6
Total sequences conditiona, ,bability =	2.3E-6	1.5E-5

The total incremental conditional probability of core damage from the HL&P analysis using the IPE models is 3.5E-6 versus 2.2E-5 for the ASP program analysis. From the above comparisons of individual sequences, it can be seen that the IPE predicts a lower probability of core damage for all sequences using the IPE models when the actual conditions that existed are used. A detailed comparison shows that the IPE uses a more conservative LOOP probability and a more conservative EDG failure probability than the ASP program. In addition, the use of STP-specific recovery rates for the TDAFW pump and electric power, and the inclusion of the Positive Displacement Pump and the TSC Diesel Generator in the event sequences, results in a significantly lower incremental probability of core damage for STP than the ASP program (by a factor of over 6).

The recovery factor for the TDAFW pump was set to the operator error rate for failure to recover the TDAFW pump (0.07). The failure mode experienced by the TDAFW pump during the periods considered was due to water intrusion into the

TDAFW pump turbine. The water intrusion was estimated to take at least two hours to build up to the point where an overspeed trip condition resulted. The TDAFW pump must be restored before the steam generators boil dry following a station blackout, which gives a time window of less than one hour. Therefore, this failure mode would not have been experienced during the recovery of the TDAFW pump. Also, no other failure modes were present during the periods considered, so human error is the only component that needs to be considered for the failure to recover the TDAFW pump.

The IPE electric power recovery models are based on a time dependent analysis using insights gained from the NRC review of the STP Probabilistic Safety Analysis (PSA), from NRC sponsored work on the station blackout issue, and from utilization of recovery factors dependent on the number of EDGs available for recovery. The ASP program appears to assume only one recovery factor which is not dependent on the number of diesels available for recovery. For the 552 hour period it was assumed that two EDGs were available for recovery, and for the 61 hour period it was assumed that only one EDG was available for recovery. It should also be pointed out that the IPE recovery factors assume that recovery of an EDG is dependent on available DC electric power for starting the EDG. The IPE assumes, with load shedding, that the batteries will last for 8 hours whereas the ASP program assumes 2 to 4 hours.

For the sequences in which the TDAFW pump is successful (i.e. recovered), the IPE conditional core damage probabilities are significantly lower than the ASP values due in part to the PDP being available for seal injection since it is powered by the TSC Diesel Generator. This feature is an important mitigating factor in station blackout events for STP and should be considered in the ASP analysis.

The mitigating factor discussed in the previous paragraph should be credited in the analysis for the following reasons. The TSC Diesel Generator and PDP characteristics are documented in the USFAR in section 8.3.4.2.8, page 8.3-43 and in section 9.3.4.1.2.5, page 9.3-35 respectively. This factor is accounted for in the IPE as stated above. Plant procedures OPOP05-EO-EC00, "Loss of All AC Power", and OPOP02-DB-0005, "Technical Support Diesel Generator", existed at the time of the event for recovery of the TDAFW pump and for establishing RCP seal cooling using the PDP. Plant operators had been trained in the use of the TSC diesel and recovery of a tripped TDAFW pump through Job Performance Measure JPM027.02, "Start and Load the TSC Diesel Generator"; Nuclear Training Department Lesson Plan LP.NO.:RP0400.11.LP, "Auxiliary Feedwater System"; and Qualification Checkout Card D56/D43, "Auxiliary Feedwater". Power distribution for the PDP is documented in electrical drawing, 9-E-PFBC-01, #1, Rev 14. Power distribution for the TSC diesel is documented in electrical drawing O-3-AAAA-01, Rev 14. The flow path for

RCP seal cooling provided by the PDP is documented in P&ID 5R179F05007 & 5R179F05005.

In summary, the IPE credits the PDP being powered from the TSC Diesel Generator for seal cooling when all other sources are unavailable. Therefore, the PDP and TSC Diesel Generator play a large mitigating role that isn't accounted for in the ASP analysis and result in a conditional probability of core damage about an order of magnitude below the ASP analysis.

TABLE 1 - STP IPE Sequences Similar to Those in the ASP Analysis
(From Table 3.5.1.1-2 of the IPE)

MODEL Name: STPEGS

Top-Ranking Sequences Contributing to Group : PDS Frequency
PDS = ALL INITIATORS AND PDS

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Rank No.	Events: Sequence Description	Events: Guaranteed Events/Comments	End State	Frequency (per year)	Percent
3	LOSS OF OFFSITE POWER	- OFFSITE GRID	SXNNI	2.57E-06	7.31
	- EMERGENCY DIESEL GENERATOR 11	- ESSENTIAL COOLING WATER TRAIN A			
	- EMERGENCY DIESEL GENERATOR 12	- ESSENTIAL COOLING WATER TRAIN B			
	- EMERGENCY DIESEL GENERATOR 13	- ESSENTIAL COOLING WATER TRAIN C			
	- ONE OR MORE AFW TRAINS	- EAB HVAC TRAIN A			
	- RECOVERY	- EAB HVAC TRAIN B			
		- EAB HVAC TRAIN C			
		- COOLDOWN W/AFW AND ASSOCIATED SG PORV			
		- OPERATOR INITIATES BLEED AND FEED			
		- ONE OF THREE HHSI PUMPS OPERATE			
		- CONTAINMENT FAN COOLERS - 2 OF 6 (RCFC'S)			
		- ECCS RECIRCULATION SWITCHOVER TRAIN A			
		- ECCS RECIRCULATION SWITCHOVER TRAIN B			
		- ECCS RECIRCULATION SWITCHOVER TRAIN C			
		- CONTAINMENT SPRAY - 2 OF 3 (AUTO)			
		- CONTAINMENT ISOLATION			
		- CONTAINMENT SPRAY - 1 OF 3 (MANUAL)			
16	LOSS OF OFFSITE POWER	- OFFSITE GRID	HANNI	3.89E-07	1.11
	- EMERGENCY DIESEL GENERATOR 1`	- ESSENTIAL COOLING WATER TRAIN A			
	- EMERGENCY DIESEL GENERATOR 12	- ESSENTIAL COOLING WATER TRAIN B			
	- EMERGENCY DIESEL GENERATOR 13	- ESSENTIAL COOLING WATER TRAIN C			
	- POSITIVE DISPLACEMENT CHARGING PUMP	- EAB HVAC TRAIN A			
	- RECOVERY	- EAB HVAC TRAIN B			
		- EAB HVAC TRAIN C			
		- COOLDOWN W/AFW AND ASSOCIATED SG PORV			
		- SG SAFETY VALVES (2 OF 5)			
		- NORMAL CHARGING PUMPS			
		- LETDOWN/SEAL RETURN ISOLATION			
		- HIGH HEAD INJECTION TRAIN A			
		- HIGH HEAD INJECTION TRAIN B			
		- HIGH HEAD INJECTION TRAIN C			
		- ONE OF THREE HHSI PUMPS OPERATE			
		- CONTAINMENT FAN COOLERS - 2 OF 6 (RCFC'S)			
		- ECCS RECIRCULATION SWITCHOVER TRAIN A			
		- ECCS RECIRCULATION SWITCHOVER TRAIN B			
		- ECCS RECIRCULATION SWITCHOVER TRAIN C			
		- CONTAINMENT SPRAY - 2 OF 3 (AUTO)			
		- CONTAINMENT ISOLATION			
		- CONTAINMENT SPRAY - 1 OF 3 (MANUAL)			