Final Precursor Analysis

Accident Sequence Precursor Program --- Office of Nuclear Regulatory Research

Fermi 2	Emergency Diesel Generator 14 Inoperable for Greater Than the Technical Specification Allowed 7 Days	
Event Date: 03/28/0	**LER:** 341/01-00	**ΔCDP =** $3x10^{-6}$

Condition Summary

On March 21, 2001, a 24-hour endurance surveillance test run on emergency diesel generator (EDG) 14 was started. At about 12 hours into the run, the EDG 14 outboard bearing temperature was 228°F and rising. The EDG was manually tripped, but about 1 minute later there was a fire on the generator outboard bearing housing. The bearing had catastrophically failed due to a lack of lubrication in the bearing housing. The licensee determined that the EDG 14 oil sight glass and level mark were positioned too low. The diesel was subsequently repaired, tested, and returned to service on March 31, 2001 (References 1, 2, 3, and 4).

Cause. The root cause of this event was lower-than-adequate oil level in the bearing housing. Two causes led to this event. First, in 1984, during plant construction, a stiffener bar was installed on the EDG 14 end-bell to reduce axial vibrations. This caused improper sight glass piping lengths and the incorrect lowering of the sight glass to show 7/8 inch higher than actual level. Second, in 1997, an NRC maintenance inspection team opened an unresolved item on the EDG bearing level indicators. A technical service request (TSR) was issued to resolve the item. From the TSR, a minor maintenance work request was issued to install “green bands” on all EDGs. On or about March 3, 1999, a contract system engineer, responsible for installing the bands, failed to follow the TSR and marked the green band too low on EDG 14. The other three diesels were unaffected.

Condition duration. The condition has existed since at least March 3, 1999. The last successful 24-hour endurance test was completed on October 22, 1999. The time from the last successful test until the EDG failed its next 24-hour endurance test is about 17 months (October 22, 1999, to March 21, 2001). The EDG successfully completed a number of short runs during the 17-month period and had run about 12 hours prior to its failure on March 21, 2001. Because there is uncertainty about when the failure cause actually rendered the EDG unable to perform its design function, the time for Part 1 of the condition assessment is taken as one-half of the 17-month interval, or 8.5 months (6185 hours). EDG 14 was also inoperable from the time of its failed test on March 21, 2001, until it was subsequently repaired and returned to service on March 31, 2001. The time for Part 2 of the condition assessment is 10 days (240 hours).

Recovery opportunities. No recovery opportunity is believed to exist for EDG 14 for this event. The failure of the outboard bearing required about 10 days to repair, test, and return to service. This exceeds the EDG mission times assumed in this analysis.

Analysis Results

- **Importance**[1]

  The risk significance of the EDG being unavailable for automatic initiation is determined by subtracting the nominal core damage probability from the conditional core damage probability:

	Part 1	**Part 2**
Conditional core damage probability (CCDP) =	9.8×10^{-6}	1.0×10^{-6}
Nominal core damage probability (CDP) =	7.4×10^{-6}	4.2×10^{-7}
Importance (ΔCDP = CCDP - CDP) =	2.4×10^{-6}	5.8×10^{-7}
Total Importance =	**3.0×10^{-6}**	

  This is an increase of 3.0×10^{-6} over the nominal CDP for the 8.5-month period when the EDG was not available.

  The Accident Sequence Precursor Program acceptance threshold is an importance (ΔCDP) of 1.0×10^{-6}.

  For this condition we conducted a sensitivity analysis for Part 1 related to power being supplied to various containment isolation valves early in the loss of offsite power (LOOP). For the containment spray system, the shutdown cooling system, and the suppression pool cooling system, each fault tree had a transfer to DIV-4-AC, modeling the power supply required to open a containment isolation valve in each system. Because we are assuming in this analysis that EDG 14 would run for at least 12 hours, these valves would have power available if they have already received the demand to open. To check the sensitivity of this analysis to this power availability, we performed a sensitivity analysis with three fault tree modifications. For fault trees CSS-B, SDC-B, and SPC-B, we deleted the transfer to DIV-4-AC. The results of this sensitivity analysis gave a ΔCDP of 1.6×10^{-6}. We conclude that our original Part 1 results are conservative, but not overly so, based on this nonconservative (lower bound) sensitivity analysis.

- **Dominant sequences**

  The dominant core damage sequence for this event (for both parts) is a LOOP sequence (Sequence 17). The events and important component failures in Sequence 17 (shown in Figure 1) include:

[1] Since this condition did not involve an actual initiating event, the parameter of interest is the measure of the incremental increase between the conditional probability for the period in which the condition existed and the nominal probability for the same period but with the condition nonexistent and plant equipment available. This incremental increase or "importance" is determined by subtracting the CDP from the CCDP. This measure is used to assess the risk significance of hardware unavailabilities especially for those cases where the nominal CDP is high with respect to the incremental increase of the conditional probability caused by the hardware unavailability.

- a LOOP initiating event,
- a successful reactor trip,
- successful operation of the emergency power system,
- the safety relief valves (SRVs) successfully reclose after opening,
- failure of the standby feedwater system,
- successful operation of the reactor core isolation cooling (RCIC) system,
- failure of the suppression pool cooling mode of the residual heat removal (RHR) system,
- successful manual depressurization,
- failure of the shutdown cooling mode of the RHR system,
- failure of the containment spray cooling mode of the RHR system, and
- failure of the containment venting system.

- **Results tables**

  - The conditional probability of the dominant sequences are shown in Tables 1a and 1b.
  - The event tree sequence logic for the dominant sequences is provided in Table 2a.
  - The conditional cut sets for the dominant sequences are provided in Tables 3a and 3b.

Modeling Assumptions

- **Assessment summary**

  This event was modeled as an at-power condition assessment with EDG 14 unavailable for 8.5 months. Because EDG 14 had successfully completed a number of short runs and had run about 12 hours prior to its failure on March 21, 2001, it is reasonable to assume that the EDG would successfully operate for short mission times. Therefore, this analysis was performed in two parts. The first part considered the portion of the 8.5 months (6185 hours) when the EDG was inoperable only for severe weather-related LOOPs lasting longer than 12 hours. The second part considered the 10 days (240 hours) at the end of the period when the EDG was inoperable for all types of LOOPs. Revision 3.01 of the Fermi Unit 2 standardized plant analysis risk (SPAR) model (Reference 5) was used for this assessment. The discussion below provides the bases for significant changes.

  Concurrent with this condition, another condition also existed. This event was reported in LER 341/00-009 (Reference 6). Between March 4 and April 2, 2000, EDG 11 was technically inoperable due to low viscosity oil in its alternator bearings. The licensee event report (LER) states that EDG 11 would likely have operated for a period of 3 days and 10 hours while EDG 13 was out of service for preventive maintenance. Because the failure probability for the diesels includes maintenance/out-of-service time and because the time to failure for EDG 11 exceeds the maximum modeled mission time for EDGs of 24 hours, this additional condition was not included in the condition assessment.

- **Basic event probability changes**

  Tables 4a and 4b provide the basic events that were modified to reflect the event condition being analyzed. The bases for these changes are as follows:

- ***Frequency of loss of offsite power initiating event (IE-LOOP).*** In Part 1, the LOOP initiating event frequency was reduced to model only those severe weather LOOP initiating events that lasted longer than 12 hours. This was done by subtracting the contribution from plant-centered and grid-related LOOPs out. Then we applied a factor of 0.1 to account for the fact that only 10% of severe-weather related LOOPs last longer than 12 hours.

- ***Frequency of divisional LOOP initiating event (IE-LOOP-I and IE-LOOP-II).*** In Part 1, the divisional LOOP initiating event frequencies were reduced to remain proportional to the full LOOP initiating event frequency.

- ***Operator fails to align the alternate DG to a dead bus (EPS-XHE-XM-ALTDG).*** In Part 1, the probability that the operator would fail to align the alternate DG to a dead bus was modified to account for the longer time available to complete this action. In the nominal model a performance shaping factor (PSF) of 10 is applied for Available Time. In Part 1, there is a nominal amount of time available to complete this action, so the Nominal PSF of 1.0 would apply.

- ***Operator fails to recover ac power (ACP-XHE-NOREC-30, -90, -4H, and -BD).*** In Part 1, the probability that the operator would recover ac power was set to a failure probability of TRUE to reflect that the event being modeled is a severe weather LOOP lasting longer than 12 hours. This analysis conservatively assumes that failed diesel generators cannot be repaired in time to be of use in preventing core damage.

- ***Operator fails to recover offsite power (OEP-XHE-NOREC-01H, -02H, -04H, and -10H).*** In Part 1, the probability that the operator would recover offsite power was set to a failure probability of TRUE to reflect that the event being modeled is a severe weather LOOP lasting longer than 12 hours.

- ***Probability of failure of diesel generator 14 (EPS-DGN-FR-DGD).*** In both parts, the probability that the EDG would fail to start and run was set to a failure probability of TRUE to reflect the failure of the EDG to provide emergency power.

- **Model update**

A project rule was added to model the complete dependence between basic events EPS-XHE-XM-ALTDG and EPS-XHE-XM-CTG. The new rule is as follows:

```
if EPS-XHE-XM-ALTDG * EPS-XHE-XM-CTG then
    DeleteEvent = EPS-XHE-XM-CTG;
    AddEvent = EPS-XHE-XM-CTG1;
endif
```

References

1. LER 341/01-001, *Emergency Diesel Generator 14 Inoperable for Greater Than the Technical Specification Allowed 7 Days*, March 28, 2001 (ADAMS Accession No. ML011500260).

2. NRC Inspection Report No. 50-341/01-06, April 27, 2001 (ADAMS Accession No. ML011170320).

3. NRC Inspection Report No. 50-341/01-09, July 25, 2001 (ADAMS Accession No. ML012070116).

4. NRC Supplemental Inspection Report No. 50-341/01-10, August 17, 2001 (ADAMS Accession No. ML012330138).

5. J. A. Schroeder, *Standardized Plant Analysis Risk Model for Fermi 2 (ASP BWR C),* Revision 3.01, Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID, September 2003.

6. LER 341/00-009, *Emergency Diesel Generator Inoperable Due to Low Viscosity Oil in the Alternator Bearings*, May 8, 2000 (ADAMS Accession No. ML003722838).

Table 1a. Conditional probabilities associated with the highest probability sequences. (Part 1)[1]

Event tree name	Sequence no.	Conditional core damage probability (CCDP)	Core damage probability (CDP)	Importance (CCDP - CDP)[3]
LOOP	17	8.6E-007	8.1E-008	—
XFMR65	06	6.1E-007	1.3E-007	—
LOOP	60-04	3.8E-007	1.5E-008	
Total (all sequences)[2]		**9.8E-006**	**7.4E-006**	**2.4E-006**

Note:
1. (File name: GEM 341-01-001 03-29-2004 141404 Part 1.wpd)
2. Total CCDP includes all sequences (including those not shown in this table).
3. Importance is calculated using the total CCDP and total CDP from all sequences. Sequence level importance measures are not additive.

Table 1b. Conditional probabilities associated with the highest probability sequences. (Part 2)[1]

Event tree name	Sequence no.	Conditional core damage probability (CCDP)	Core damage probability (CDP)	Importance (CCDP - CDP)[3]
LOOP	17	4.2E-007	4.0E-008	—
LOOP	31	8.1E-008	6.2E-009	—
LOOP	56	5.0E-008	2.7E-009	—
Total (all sequences)[2]		**1.0E-006**	**4.2E-007**	**5.8E-007**

Note:
1. (File name: GEM 341-01-001 03-29-2004 134628 Part 2.wpd)
2. Total CCDP includes all sequences (including those not shown in this table).
3. Importance is calculated using the total CCDP and total CDP from all sequences. Sequence level importance measures are not additive.

Table 2a. Event tree sequence logic for the dominant sequences.

Event tree name	Sequence no.	Logic ("/" denotes success; see Table 2b for top event names)
LOOP	17	/RPS, /EPS, /SRV, SFW, /RCI, SPC, /DEP, SDC, CSS, CVS
XFMR65	06	/RPS, PCS, /SRV, /SFW, SPC, /DEP, SDC, CSS, CVS
LOOP	60-04	/RPS, EPS, /SRV, /RCI, /DEP, VA3, AC-4HR

Table 2b. Definitions of fault trees listed in Table 2a.

AC-4HR	OPERATOR FAILS TO RECOVER AC POWER IN 4 HOURS
CSS	CONTAINMENT SPRAY COOLING IS UNAVAILABLE
CVS	CONTAINMENT (SUPPRESSION POOL) VENTING FAILS
DEP	MANUAL DEPRESSURIZATION FAILS
EPS	EMERGENCY POWER FAILS
PCS	POWER CONVERSION SYSTEM IS UNAVAILABLE
RCI	RCIC FAILS TO PROVIDE SUFFICIENT FLOW TO REACTOR
RPS	REACTOR SHUTDOWN FAILS
SDC	SHUTDOWN COOLING MODE OF RHR FAILS
SFW	STANDBY FEEDWATER IS UNAVAILABLE
SPC	SUPPRESSION POOL COOLING MODE OF RHR FAILS
SRV	NO SRV FAILS TO CLOSE
VA3	FIREWATER INJECTION IS UNAVAILABLE

Table 3a. Conditional cut sets for Sequence 17 (Part 1).

CCDP	Percent contribution	Minimal cut sets[1]	
Event Tree: LOOP, Sequence 17			
9.90E-008	11.2	/SRV EPS-DGN-TM-DG12	EPS-XHE-XM-ALTDG EPS-XHE-XM-CTG1
9.90E-008	11.2	/SRV EPS-DGN-TM-DG11	EPS-XHE-XM-ALTDG EPS-XHE-XM-CTG1
8.04E-008	9.0	/SRV EPS-DGN-FS-DG11	EPS-XHE-XM-ALTDG EPS-XHE-XM-CTG1
8.04E-008	9.0	/SRV EPS-DGN-FS-DG12	EPS-XHE-XM-ALTDG EPS-XHE-XM-CTG1
5.44E-008	6.3	/SRV ESW-MDP-TM-TRNB	EPS-XHE-XM-ALTDG EPS-XHE-XM-CTG1
5.44E-008	6.3	/SRV ESW-MDP-TM-TRNA	EPS-XHE-XM-ALTDG EPS-XHE-XM-CTG1
5.20E-008	6.0	/SRV EPS-DGN-FR-DG11	EPS-XHE-XM-ALTDG EPS-XHE-XM-CTG1
5.20E-008	6.0	/SRV EPS-DGN-FR-DG12	EPS-XHE-XM-ALTDG EPS-XHE-XM-CTG1
3.09E-008	3.6	/SRV EPS-FAN-FC-2DG12	EPS-XHE-XM-ALTDG EPS-XHE-XM-CTG1
3.09E-008	3.6	/SRV EPS-FAN-FC-1DG11	EPS-XHE-XM-ALTDG EPS-XHE-XM-CTG1
3.09E-008	3.6	/SRV EPS-FAN-FC-2DG11	EPS-XHE-XM-ALTDG EPS-XHE-XM-CTG1
3.09E-008	3.6	/SRV EPS-FAN-FC-1DG12	EPS-XHE-XM-ALTDG EPS-XHE-XM-CTG1
7.8E-007	**Total[2]**		

Notes:
1. See Table 4a for definitions and probabilities for the basic events.
2. Total CCDP includes all cut sets (including those not shown in this table).

Table 3b. Conditional cut sets for Sequence 17 (Part 2).

CCDP	Percent contribution	Minimal cut sets[1]	
Event Tree: LOOP, Sequence 17			
5.28E-008	12.5	/SRV OEP-XHE-NOREC-10H EPS-XHE-XM-CTG1	EPS-XHE-XM-ALTDG EPS-DGN-TM-DG12
5.28E-008	12.5	/SRV OEP-XHE-NOREC-10H EPS-XHE-XM-CTG1	EPS-XHE-XM-ALTDG EPS-DGN-TM-DG11
4.32E-008	10.1	/SRV OEP-XHE-NOREC-10H EPS-XHE-XM-CTG1	EPS-XHE-XM-ALTDG EPS-DGN-FS-DG12
4.32E-008	10.1	/SRV OEP-XHE-NOREC-10H EPS-XHE-XM-CTG1	EPS-XHE-XM-ALTDG EPS-DGN-FS-DG11
2.88E-008	7.1	/SRV OEP-XHE-NOREC-10H EPS-XHE-XM-CTG1	EPS-XHE-XM-ALTDG ESW-MDP-TM-TRNB
2.88E-008	7.1	/SRV OEP-XHE-NOREC-10H EPS-XHE-XM-CTG1	EPS-XHE-XM-ALTDG ESW-MDP-TM-TRNA
1.68E-008	4.0	/SRV OEP-XHE-NOREC-10H EPS-XHE-XM-CTG1	EPS-XHE-XM-ALTDG EPS-FAN-FC-2DG12
1.68E-008	4.0	/SRV OEP-XHE-NOREC-10H EPS-XHE-XM-CTG1	EPS-XHE-XM-CTG EPS-FAN-FC-1DG11
1.68E-008	4.0	/SRV OEP-XHE-NOREC-10H EPS-XHE-XM-CTG1	EPS-CTG-TM-CTG EPS-FAN-FC-1DG12
1.68E-008	4.0	/SRV OEP-XHE-NOREC-10H EPS-XHE-XM-CTG1	EPS-XHE-XM-CTG EPS-FAN-FC-2DG11
3.8E-007	**Total[2]**		

Notes:
1. See Table 4b for definitions and probabilities for the basic events.
2. Total CCDP includes all cut sets (including those not shown in this table).

Table 4a. Definitions and probabilities for modified or dominant basic events (Part 1).

Event name	Description	Probability/ frequency	Modified
ACP-XHE-NOREC-30	OPERATOR FAILS TO RECOVER AC POWER IN 30 MINUTES	TRUE	YES[1]
ACP-XHE-NOREC-4H	OPERATOR FAILS TO RECOVER AC POWER IN 4 HOURS	TRUE	YES[1]
ACP-XHE-NOREC-90	OPERATOR FAILS TO RECOVER AC POWER IN 90 MINUTES	TRUE	YES[1]
ACP-XHE-NOREC-BD	OPERATOR FAILS TO RECOVER AC POWER BEFORE BATTERY DEPLETION	TRUE	YES[1]
EPS-CTG-FR-BLKST	BLACKSTART CTG FAILS TO RUN	5.0E-002	NO
EPS-CTG-FS-BLKST	BLACKSTART CTG FAILS TO START	4.0E-002	NO
EPS-CTG-TM-CTG	CTG OUT FOR TEST & MAINTENANCE	6.0E-002	NO
EPS-DGN-CF-RUN	DIESEL GENERATOR FAILS FROM COMMON CAUSE TO RUN	1.9E-003	NO
EPS-DGN-FR-DG11	DIESEL GENERATOR 11 FAILS TO RUN	1.7E-002	YES[2]
EPS-DGN-FR-DG12	DIESEL GENERATOR 12 FAILS TO RUN	1.7E-002	YES[2]
EPS-DGN-FR-DG13	DIESEL GENERATOR 13 FAILS TO RUN	1.7E-002	YES[2]
EPS-DGN-FR-DG14	DIESEL GENERATOR 14 FAILS TO RUN	TRUE	YES[3]
EPS-DGN-FS-DG11	DIESEL GENERATOR 11 FAILS TO START	2.5E-002	NO
EPS-DGN-FS-DG12	DIESEL GENERATOR 12 FAILS TO START	2.5E-002	NO
EPS-DGN-FS-DG13	DIESEL GENERATOR 13 FAILS TO START	2.5E-002	NO
EPS-DGN-TM-DG11	DG 11 IS UNAVAILABLE BECAUSE OF MAINTENANCE	3.1E-002	NO
EPS-DGN-TM-DG12	DG 12 IS UNAVAILABLE BECAUSE OF MAINTENANCE	3.1E-002	NO
EPS-DGN-TM-DG13	DG 13 IS UNAVAILABLE BECAUSE OF MAINTENANCE	3.1E-002	NO
EPS-FAN-FC-1DG11	DG11 ROOM COOLING FAN 1 FAILS TO START AND RUN	1.0E-002	NO
EPS-FAN-FC-1DG12	DG12 ROOM COOLING FAN 1 FAILS TO START AND RUN	1.0E-002	NO
EPS-FAN-FC-2DG11	DG11 ROOM COOLING FAN 2 FAILS TO START AND RUN	1.0E-002	NO
EPS-FAN-FC-2DG12	DG12 ROOM COOLING FAN 2 FAILS TO START AND RUN	1.0E-002	NO
EPS-XHE-XM-ALTDG	OPERATOR FAILS TO ALIGN ALT DG TO DEAD BUS	5.0E-003	YES[4]
EPS-XHE-XM-CTG	OPERATOR FAILS TO START CTG	6.0E-002	NO[5]
EPS-XHE-XM-CTG1	OPERATOR FAILS TO START CTG 1	1.0E+000	YES[5]
ESW-MDP-TM-TRNA	ESW PUMP A IS UNAVAILABLE BECAUSE OF MAINTENANCE	1.8E-002	NO
ESW-MDP-TM-TRNB	ESW PUMP B IS UNAVAILABLE BECAUSE OF MAINTENANCE	1.8E-002	NO
IE-LOOP	LOSS OF OFFSITE POWER INITIATOR	1.0E-007	YES[6]
IE-LOOP-I	LOSS OF OFFSITE POWER TO DIVISION I INITIATOR	1.7E-007	YES[7]
IE-LOOP-II	LOSS OF OFFSITE POWER TO DIVISION II INITIATOR	1.9E-008	YES[7]
OEP-XHE-NOREC-01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	TRUE	YES[1]
OEP-XHE-NOREC-02H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 2 HOURS	TRUE	YES[1]
OEP-XHE-NOREC-04H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 4 HOURS	TRUE	YES[1]

Table 4a. Definitions and probabilities for modified or dominant basic events (Part 1).

Event name	Description	Probability/ frequency	Modified
OEP-XHE-NOREC-10H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 10 HOURS	TRUE	YES[1]

Notes:
1. Updated value for Part 1 to reflect modeling only severe weather LOOPs lasting longer that 12 hours.
2. Updated value for Part 1 using a 24-hour mission time for the diesel generator.
3. Basic event changed to reflect event being analyzed.
4. Human error probability updated to reflect greater time to complete action for this condition. Base model updated to reduce Available Time PSF from 10 to 1.
5. Basic event added to model complete dependence with EPS-XHE-XM-ALTDG.
6. The LOOP initiating event frequency was reduced to model only those severe weather LOOP initiating events that lasted longer that 12 hours.
7. The divisional LOOP initiating event frequencies were reduced to remain proportional to the full LOOP initiating event frequency.

Table 4b. Definitions and probabilities for modified or dominant basic events (Part 2).

Event name	Description	Probability/ frequency	Modified
EPS-DGN-FR-DG11	DIESEL GENERATOR 11 FAILS TO RUN	8.1E-003	NO
EPS-DGN-FR-DG12	DIESEL GENERATOR 12 FAILS TO RUN	8.1E-003	NO
EPS-DGN-FR-DG14	DIESEL GENERATOR 14 FAILS TO RUN	TRUE	YES[1]
EPS-DGN-FS-DG11	DIESEL GENERATOR 11 FAILS TO START	2.5E-002	NO
EPS-DGN-FS-DG12	DIESEL GENERATOR 12 FAILS TO START	2.5E-002	NO
EPS-DGN-TM-DG11	DG 11 IS UNAVAILABLE BECAUSE OF MAINTENANCE	3.1E-002	NO
EPS-DGN-TM-DG12	DG 12 IS UNAVAILABLE BECAUSE OF MAINTENANCE	3.1E-002	NO
EPS-FAN-FC-1DG11	DG11 ROOM COOLING FAN 1 FAILS TO START AND RUN	1.0E-002	NO
EPS-FAN-FC-1DG12	DG12 ROOM COOLING FAN 1 FAILS TO START AND RUN	1.0E-002	NO
EPS-FAN-FC-2DG11	DG11 ROOM COOLING FAN 2 FAILS TO START AND RUN	1.0E-002	NO
EPS-FAN-FC-2DG12	DG12 ROOM COOLING FAN 2 FAILS TO START AND RUN	1.0E-002	NO
EPS-XHE-XM-ALTDG	OPERATOR FAILS TO ALIGN ALT DG TO DEAD BUS	5.0E-002	NO
EPS-XHE-XM-CTG	OPERATOR FAILS TO START CTG	6.0E-002	NO
EPS-XHE-XM-CTG1	OPERATOR FAILS TO START CTG 1	1.0E+000	YES[2]
ESW-MDP-TM-TRNA	ESW PUMP A IS UNAVAILABLE BECAUSE OF MAINTENANCE	1.8E-002	NO
ESW-MDP-TM-TRNB	ESW PUMP B IS UNAVAILABLE BECAUSE OF MAINTENANCE	1.8E-002	NO
OEP-XHE-NOREC-01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	3.0E-001	NO
OEP-XHE-NOREC-10H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 10 HOURS	2.7E-002	NO

Notes:
1. Basic event changed to reflect event being analyzed.
2. Basic event added to model complete dependence with EPS-XHE-XM-ALTDG.

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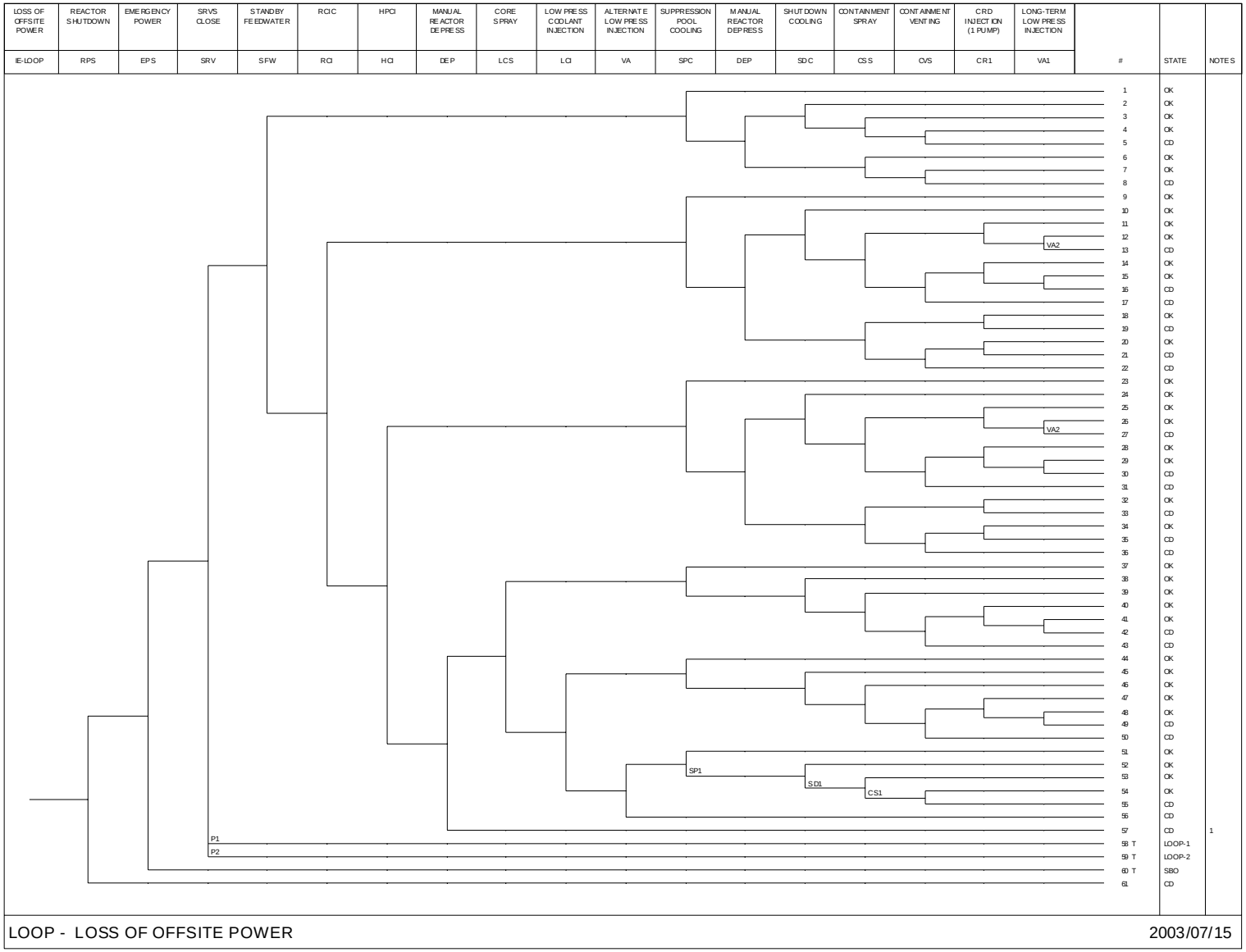

Figure 1 Loss of offsite power event tree.