

ASP Analysis - REJECT

Accident Sequence Precursor Program – Office of Nuclear Regulatory Research

Perry Nuclear Power Plant, Unit 1	Loss of Feedwater Results in Automatic Reactor Protection System Actuation		
Event Date: 10/20/2014	LER: 440-2014-004	IR: 50-440/2015-001	
Plant Type: General Electric BWR/6 with Wet MARK III Containment			
Plant Operating Mode (Reactor Power Level): Mode 1 (99 Percent Reactor Power)			
Analyst: Keith Tetter	Reviewer: David Aird	Contributors: N/A	BC Approved Date: 4/5/2016

Event Description. On October 20, 2014 at 2:17 am, an automatic reactor scram occurred due to a Reactor Protection System (RPS) actuation in response to a low reactor water level (Level 3) signal caused by a loss of feedwater flow (A and B turbine-driven reactor feedwater pumps (RFPs)) to the Reactor Pressure Vessel (RPV). The loss of feedwater resulted when the feedwater demand signals were driven to zero based on a loss of power to Digital Feedwater Control System (DFWCS) input signals for determining the availability of feedwater pumps. The motor-driven RFP started as designed on the turbine-driven RFP trip signal. All control rods fully inserted into the core.

RPV water level continued to decrease to the Level 2 setpoint (130 inches above the top of active fuel (TAF)) where the Reactor Core Isolation Cooling (RCIC) and High Pressure Core Spray (HPCS) systems started and injected into the RPV. Containment isolation occurred with isolation of all required valves. Both Reactor Recirculation pumps tripped as designed. The Division 3 emergency diesel generator, which supplies emergency electrical power to the HPCS system started but, as designed, did not load onto the bus. At approximately 2:21 am, the HPCS and RCIC systems and the motor-driven RFP stopped injecting when the Level 8 setpoint (219 inches above the TAF) was reached. The lowest RPV water level reached during the event was 87.1 inches above the TAF. Mode 4 (Cold Shutdown) was entered at 11:23 pm when the average reactor coolant temperature decreased to 200 degrees Fahrenheit.

Cause. The RPS scram was caused by an electrical transient in the balance-of-plant (BOP) 120 volt AC Uninterruptable Power Supply (UPS) system. At the time of the event plant operators were in the process of shifting the BOP static transfer switch to its alternate source for maintenance on the BOP Inverter. The transient was caused by a degraded static transfer switch component. Alternate supply voltage was available, but a static transfer failure resulted in a loss of power to the UPS system loads.

The control logic for the DFWCS is one of the electrical loads serviced by the UPS. Among the loads was an input signal to the RFP availability logic. Disruption of the DFWCS power due to the electrical transient affected the feedwater system causing the control circuit to believe it was not available and drove the output to zero. As a result, feedwater flow was lost to the RPV and the RPS actuated, as designed, when RPV Level 3 was reached.

IR Summary/SDP Result. The inspectors reviewed this issue when it occurred and no findings were identified. The LER is closed.

Modeling Assumptions. The Perry Standardized Plant Analysis Risk (SPAR) model, Revision 8.19, created in May 2014, was used for this analysis. Results of the risk analysis are included at the end of this report as Appendix A. The following modeling assumptions were made for the analysis of this initiating event:

- The probability of IE-LOMF_W (*Loss of Main Feedwater Initiating Event*) was set to 1.0 and all other initiating event probabilities were set to zero.
- All safety systems responded as designed.

SPAR Model Modifications. No SPAR model modifications were needed to conduct this analysis.

Rejection Basis. The conditional core damage probability (CCDP) for this analysis with the loss of feedwater initiating event is 6.8×10^{-8} . This is less than the ASP Program threshold of 1×10^{-6} . Therefore, this event is not a precursor and is screened out of the ASP Program.

Dominant Sequence. The dominant accident sequence is LOMFW Sequence 30 (CCDP = 1.9×10^{-8}) which contributes approximately 29% of the total internal events CCDP. The cut sets/sequences that contribute to the top 95% and/or at least 1% of the total internal events CCDP are provided in Appendix A.

The events and important component failures in LOMFW Sequence 30 are:

- A loss of main feedwater occurs
- Reactor scram succeeds
- Safety Relief Valves close (if opened)
- Main condenser is unavailable
- Feedwater is available
- Suppression Pool Cooling failed
- Containment Spray failed
- Power Conversion System is unavailable (feedwater or condenser)
- Containment Venting failed
- Late Injection failed

Appendix A: SAPHIRE 8 Worksheet

Summary of Conditional Event Changes

Event	Description	Cond Value	Nominal Value
IE-LOMFW	LOSS OF FEEDWATER	1.00E+0 ^a	6.89E-2

a. All other initiating event probabilities were set to zero.

Dominant Sequence Results

Only items contributing at least 1.0% to the total CCDP are displayed.

EVENT TREE	SEQUENCE	CCDP	% CONTRIBUTION	DESCRIPTION
LOMFW	30	1.94E-8	28.6%	/RPS, /SRV, CND, /MFW, SPC, CSS, PCSR, CVS, LI03
LOMFW	23	1.32E-8	19.5%	/RPS, /SRV, /CND, MFW, RCI, HCS, DEP
LOMFW	77-26	1.19E-8	17.5%	RPS, /PPR, RPT
LOMFW	22	9.04E-9	13.3%	/RPS, /SRV, /CND, MFW, RCI, HCS, /DEP, LPI, VA
LOMFW	77-04	7.67E-9	11.3%	RPS, /PPR, /RPT, /PCS01, SLC
LOMFW	77-02	2.44E-9	3.6%	RPS, /PPR, /RPT, /PCS01, /SLC, /INH, LVL
LOMFW	77-03	2.44E-9	3.6%	RPS, /PPR, /RPT, /PCS01, /SLC, INH
Total		6.77E-8	100.0%	

Referenced Fault Trees

Fault Tree	Description
CND	MAIN CONDENSER
CSS	CONTAINMENT SPRAY
CVS	CONTAINMENT VENTING
DEP	MANUAL REACTOR DEPRESS
HCS	HPCS
INH	INHIBIT ADS/ HPCS
LI03	PERRY LATE INJECTION FAULT TREE
LPI	LOW PRESSURE INJECTION
LVL	PREVENT OVERFILL
MFW	FEEDWATER
PCSR	POWER CONVERSION SYSTEM RECOVERY
RCI	RCIC
RPS	REACTOR SHUTDOWN
RPT	RECIRC PUMP TRIP
SLC	STANDBY LIQUID CONTROL
SPC	SUPPRESSION POOL COOLING
VA	ALTERNATE LOW PRESS INJECTION

Cut Set Report - LOMFW 30

Only items contributing at least 1% to the total are displayed.

#	CCDP	TOTAL%	CUT SET
	1.94E-8	100	Displaying 11 Cut Sets. (11 Original)
1	1.50E-8	77.27	IE-LOMFW, CV05, CVS-XHE-XM-VENT1, MSS-TBV-CC-BYPAS, PCS-XHE-XL-LTLOFW, RHR-XHE-XM-ERROR
2	4.28E-9	22.08	IE-LOMFW, CV03, CVS-XHE-XM-VENT1, MSS-TBV-CC-BYPAS, PCS-XHE-XL-LTLOFW, RHR-XHE-XM-ERROR

Cut Set Report - LOMFW 23

Only items contributing at least 1% to the total are displayed.

#	CCDP	TOTAL%	CUT SET
	1.32E-8	100	Displaying 209 Cut Sets. (209 Original)
1	1.87E-9	14.18	IE-LOMFW,ADS-XHE-XM-MDEPR,ESW-MDP-TM-PUMPC,MFW-MDP-TM-MDFWP,RCI-TDP-FR-PUMP
2	9.63E-10	7.30	IE-LOMFW,ADS-XHE-XM-MDEPR,HCS-MDP-TM-HPCS,MFW-MDP-TM-MDFWP,RCI-TDP-FR-PUMP
3	7.14E-10	5.41	IE-LOMFW,ADS-XHE-XM-MDEPR,DCP-BAT-TM-U1BOP1,ESW-MDP-TM-PUMPC,RCI-TDP-FR-PUMP
4	4.24E-10	3.21	IE-LOMFW,ADS-XHE-XM-MDEPR,HCS-MOV-FT-SUCTR,MFW-MDP-TM-MDFWP,RCI-TDP-FR-PUMP
5	3.68E-10	2.79	IE-LOMFW,ADS-XHE-XM-MDEPR,DCP-BAT-TM-U1BOP1,HCS-MDP-TM-HPCS,RCI-TDP-FR-PUMP
6	3.58E-10	2.71	IE-LOMFW,ADS-XHE-XM-MDEPR,ESW-MDP-TM-PUMPC,MFW-MDP-FS-MDFWP,RCI-TDP-FR-PUMP
7	3.06E-10	2.32	IE-LOMFW,ADS-XHE-XM-MDEPR,ESW-MDP-TM-PUMPC,MFW-MDP-TM-MDFWP,RCI-TDP-FS-PUMP
8	2.63E-10	1.99	IE-LOMFW,ADS-XHE-XM-MDEPR,ESW-MDP-TM-PUMPC,PCS-XHE-XO-ERROR,RCI-TDP-FR-PUMP
9	2.50E-10	1.89	IE-LOMFW,ADS-XHE-XM-MDEPR,CDS-AOV-CC-MKUP1,ESW-MDP-TM-PUMPC,RCI-TDP-FR-PUMP
10	2.50E-10	1.89	IE-LOMFW,ADS-XHE-XM-MDEPR,CDS-AOV-CC-MKUP2,ESW-MDP-TM-PUMPC,RCI-TDP-FR-PUMP
11	2.18E-10	1.66	IE-LOMFW,ADS-XHE-XM-MDEPR,CDS-TNK-HW-CST
12	1.92E-10	1.46	IE-LOMFW,ADS-XHE-XM-MDEPR,ESW-MDP-FS-PUMPC,MFW-MDP-TM-MDFWP,RCI-TDP-FR-PUMP
13	1.84E-10	1.40	IE-LOMFW,ADS-XHE-XM-MDEPR,HCS-MDP-TM-HPCS,MFW-MDP-FS-MDFWP,RCI-TDP-FR-PUMP
14	1.62E-10	1.23	IE-LOMFW,ADS-XHE-XM-MDEPR,DCP-BAT-TM-U1BOP1,HCS-MOV-FT-SUCTR,RCI-TDP-FR-PUMP
15	1.58E-10	1.20	IE-LOMFW,ADS-XHE-XM-MDEPR,HCS-MDP-TM-HPCS,MFW-MDP-TM-MDFWP,RCI-TDP-FS-PUMP
16	1.41E-10	1.07	IE-LOMFW,ADS-XHE-XM-MDEPR,ESW-MDP-TM-PUMPA,HCS-MOV-FT-SUCTR,MFW-MDP-TM-MDFWP
17	1.41E-10	1.07	IE-LOMFW,ADS-XHE-XM-MDEPR,ESW-MDP-TM-PUMPC,MFW-MDP-TM-MDFWP,RCI-RESTART,RCI-TDP-FS-RSTRT,RCI-XHE-XL-RSTRT
18	1.41E-10	1.07	IE-LOMFW,ADS-XHE-XM-MDEPR,ESW-XHE-XR-TRNC,MFW-MDP-TM-MDFWP,RCI-TDP-FR-PUMP
19	1.36E-10	1.03	IE-LOMFW,ADS-XHE-XM-MDEPR,HCS-MOV-CC-INJEC,MFW-MDP-TM-MDFWP,RCI-TDP-FR-PUMP
20	1.36E-10	1.03	IE-LOMFW,ADS-XHE-XM-MDEPR,ESW-MOV-CC-F140,MFW-MDP-TM-MDFWP,RCI-TDP-FR-PUMP
21	1.35E-10	1.03	IE-LOMFW,ADS-XHE-XM-MDEPR,HCS-MDP-TM-HPCS,PCS-XHE-XO-ERROR,RCI-TDP-FR-PUMP
22	1.34E-10	1.01	IE-LOMFW,ADS-XHE-XM-MDEPR,HCS-MDP-FS-HPCS,MFW-MDP-TM-MDFWP,RCI-TDP-FR-PUMP

Cut Set Report - LOMFW 77-26

Only items contributing at least 1% to the total are displayed.

#	CCDP	TOTAL%	CUT SET
	1.19E-8	100	Displaying 10 Cut Sets. (10 Original)
1	4.07E-9	34.30	IE-LOMFW,RPS-SYS-FC-PSOVS,RRS-CRB-CC-PUMP2
2	4.07E-9	34.30	IE-LOMFW,RPS-SYS-FC-PSOVS,RRS-CRB-CC-PUMP1
3	9.09E-10	7.67	IE-LOMFW,RPS-SYS-FC-RELAY,RRS-CRB-CC-PUMP2
4	9.09E-10	7.67	IE-LOMFW,RPS-SYS-FC-RELAY,RRS-CRB-CC-PUMP1
5	5.98E-10	5.04	IE-LOMFW,RPS-SYS-FC-CRD,RRS-CRB-CC-PUMP2
6	5.98E-10	5.04	IE-LOMFW,RPS-SYS-FC-CRD,RRS-CRB-CC-PUMP1
7	2.63E-10	2.22	IE-LOMFW,RPS-SYS-FC-HCU,RRS-CRB-CC-PUMP2
8	2.63E-10	2.22	IE-LOMFW,RPS-SYS-FC-HCU,RRS-CRB-CC-PUMP1

Cut Set Report - LOMFW 22

Only items contributing at least 1% to the total are displayed.

#	CCDP	TOTAL%	CUT SET
	9.04E-9	100	Displaying 74 Cut Sets. (74 Original)
1	1.63E-9	18.05	IE-LOMFW,DCP-BAT-TM-U1BOP1,FWS-XHE-XM-ERROR,RHR-STR-CF-NLOCA,SPCAI
2	1.42E-9	15.68	IE-LOMFW,DCP-BAT-TM-U1BOP1,FWS-EDP-FR-PUMP,FWS-XHE-XL-PMPR,RHR-STR-CF-NLOCA,SPCAI
3	9.08E-10	10.05	IE-LOMFW,DCP-BAT-TM-U1BOP1,ESW-MOV-CF-F130AB,FWS-XHE-XM-ERROR,LCS-XHE-XL-RCOOL,SPCAI
4	7.89E-10	8.73	IE-LOMFW,DCP-BAT-TM-U1BOP1,ESW-MOV-CF-F130AB,FWS-EDP-FR-PUMP,FWS-XHE-XL-PMPR,LCS-XHE-XL-RCOOL,SPCAI
5	6.09E-10	6.73	IE-LOMFW,DCP-BAT-TM-U1BOP1,ESW-MDP-CF-START,FWS-XHE-XM-ERROR,LCS-XHE-XL-RCOOL,SPCAI
6	5.29E-10	5.85	IE-LOMFW,DCP-BAT-TM-U1BOP1,ESW-MDP-CF-START,FWS-EDP-FR-PUMP,FWS-XHE-XL-PMPR,LCS-XHE-XL-RCOOL,SPCAI
7	2.56E-10	2.84	IE-LOMFW,CTS-XHE-XM-ERROR,FWS-XHE-XM-ERROR,MFW-MDP-TM-MDFWP,RHR-STR-CF-NLOCA,SPCAI
8	2.23E-10	2.46	IE-LOMFW,CTS-XHE-XM-ERROR,FWS-EDP-FR-PUMP,FWS-XHE-XL-PMPR,MFW-MDP-TM-MDFWP,RHR-STR-CF-NLOCA,SPCAI
9	1.96E-10	2.16	IE-LOMFW,DCP-BAT-TM-U1BOP1,FWS-EDP-TM-PUMP,FWS-XHE-XL-PMPR,RHR-STR-CF-NLOCA,SPCAI
10	1.43E-10	1.58	IE-LOMFW,CTS-XHE-XM-ERROR,ESW-MOV-CF-F130AB,FWS-XHE-XM-ERROR,LCS-XHE-XL-RCOOL,MFW-MDP-TM-MDFWP,SPCAI
11	1.39E-10	1.53	IE-LOMFW,DCP-BAT-TM-U1BOP1,FWS-EDP-FS-PUMP,FWS-XHE-XL-PMPR,RHR-STR-CF-NLOCA,SPCAI
12	1.24E-10	1.37	IE-LOMFW,CTS-XHE-XM-ERROR,ESW-MOV-CF-F130AB,FWS-EDP-FR-PUMP,FWS-XHE-XL-PMPR,LCS-XHE-XL-RCOOL,MFW-MDP-TM-MDFWP,SPCAI
13	1.09E-10	1.20	IE-LOMFW,DCP-BAT-TM-U1BOP1,ESW-MOV-CF-F130AB,FWS-EDP-TM-PUMP,FWS-XHE-XL-PMPR,LCS-XHE-XL-RCOOL,SPCAI
14	9.56E-11	1.06	IE-LOMFW,CTS-XHE-XM-ERROR,ESW-MDP-CF-START,FWS-XHE-XM-ERROR,LCS-XHE-XL-RCOOL,MFW-MDP-TM-MDFWP,SPCAI
15	9.44E-11	1.04	IE-LOMFW,DCP-BAT-TM-U1BOP1,ESW-MDP-CF-RUN,FWS-XHE-XM-ERROR,LCS-XHE-XL-RCOOL,SPCAI

Cut Set Report - LOMFW 77-04

Only items contributing at least 1% to the total are displayed.

#	CCDP	TOTAL%	CUT SET
	7.67E-9	100	Displaying 20 Cut Sets. (20 Original)
1	3.40E-9	44.35	IE-LOMFW,RPS-SYS-FC-PSOVS,SLC-XHE-XM-ERROR
2	1.70E-9	22.17	IE-LOMFW,RPS-SYS-FC-PSOVS,SLC-XHE-XR-SLCS
3	7.60E-10	9.91	IE-LOMFW,RPS-SYS-FC-RELAY,SLC-XHE-XM-ERROR
4	5.00E-10	6.52	IE-LOMFW,RPS-SYS-FC-CRD,SLC-XHE-XM-ERROR
5	3.80E-10	4.96	IE-LOMFW,RPS-SYS-FC-RELAY,SLC-XHE-XR-SLCS
6	2.50E-10	3.26	IE-LOMFW,RPS-SYS-FC-CRD,SLC-XHE-XR-SLCS
7	2.20E-10	2.87	IE-LOMFW,RPS-SYS-FC-HCU,SLC-XHE-XM-ERROR
8	1.10E-10	1.43	IE-LOMFW,RPS-SYS-FC-HCU,SLC-XHE-XR-SLCS
9	1.09E-10	1.42	IE-LOMFW,RPS-SYS-FC-PSOVS,SLC-EPV-CF-F004AB

Cut Set Report - LOMFW 77-02

Only items contributing at least 1% to the total are displayed.

#	CCDP	TOTAL%	CUT SET
Total	2.44E-9	100	Displaying 4 Cut Sets. (4 Original)
1	1.70E-9	69.67	IE-LOMFW,OPR-XHE-XM-NOOVRFIL,RPS-SYS-FC-PSOVS
2	3.80E-10	15.57	IE-LOMFW,OPR-XHE-XM-NOOVRFIL,RPS-SYS-FC-RELAY
3	2.50E-10	10.25	IE-LOMFW,OPR-XHE-XM-NOOVRFIL,RPS-SYS-FC-CRD
4	1.10E-10	4.51	IE-LOMFW,OPR-XHE-XM-NOOVRFIL,RPS-SYS-FC-HCU

Cut Set Report - LOMFW 77-03

Only items contributing at least 1% to the total are displayed.

#	CCDP	TOTAL %	CUT SET
Total	2.44E-9	100	Displaying 4 Cut Sets. (4 Original)
1	1.70E-9	69.67	IE-LOMFW,OPR-XHE-XM-ADSINHIB,RPS-SYS-FC-PSOVS
2	3.80E-10	15.57	IE-LOMFW,OPR-XHE-XM-ADSINHIB,RPS-SYS-FC-RELAY
3	2.50E-10	10.25	IE-LOMFW,OPR-XHE-XM-ADSINHIB,RPS-SYS-FC-CRD
4	1.10E-10	4.51	IE-LOMFW,OPR-XHE-XM-ADSINHIB,RPS-SYS-FC-HCU

Referenced Events

Event	Description	Probability
ADS-XHE-XM-MDEPR	OPERATOR FAILS TO DEPRESSURIZE THE REACTOR	5.00E-4
CDS-AOV-CC-MKUP1	MAKEUP PATH 1 FAILS	9.51E-4
CDS-AOV-CC-MKUP2	MAKEUP PATH 2 FAILS	9.51E-4
CDS-TNK-HW-CST	CONDENSATE STORAGE TANK FAILS	4.37E-7
CTS-XHE-XM-ERROR	OPERATOR FAILS TO ALIGN CONDENSATE TRANSFER ALTERNATE INJECTION	6.00E-2
CV03	CONTAINMENT FAILURE CAUSES LOSS OF INJECTION	4.00E-2
CV05	CONTAINMENT FAILURE CAUSES LOSS OF INJECTION	1.40E-1
CVS-XHE-XM-VENT1	OPERATOR FAILS TO VENT CONTAINMENT (DEP EVT)	5.09E-2
DCP-BAT-TM-U1BOP1	UNIT 1 BOP BATTERY D-1-B IS IN TEST OR MAINTENANCE	2.72E-3
ESW-MDP-CF-RUN	ESW PUMPS FAIL FROM COMMON CAUSE TO RUN	5.78E-7
ESW-MDP-CF-START	ESW PUMPS FAIL FROM COMMON CAUSE TO START	3.73E-6
ESW-MDP-FS-PUMPC	ESW PUMP 1P45-C002 FAILS TO START	1.36E-3
ESW-MDP-TM-PUMPA	ESW PUMP 1P45-C001A IS IN TEST OR MAINTENANCE	1.32E-2
ESW-MDP-TM-PUMPC	ESW PUMP 1P45-C002 IS IN TEST OR MAINTENANCE	1.32E-2
ESW-MOV-CC-F140	ESW PUMP C DISCH MOV F140 FAILS TO OPEN	9.63E-4
ESW-MOV-CF-F130AB	ESW MOV F130A, B FAIL FROM COMMON CAUSE	5.56E-6
ESW-XHE-XR-TRNC	ESW TRAIN C NOT RESTORED AFTER MAINTENANCE	1.00E-3
FWS-EDP-FR-PUMP	FIREWATER PUMP FAILS TO RUN	5.21E-2
FWS-EDP-FS-PUMP	FIREWATER PUMP FAILS TO START	5.09E-3
FWS-EDP-TM-PUMP	DIESEL FIREWATER PUMP UNAVAILABLE BECAUSE OF MAINTENANCE	7.19E-3
FWS-XHE-XL-PMR	OFFSITE PUMPER TRUCK FAILS TO ARRIVE AND PROVIDE WATER	1.00E+0
FWS-XHE-XM-ERROR	OPERATOR FAILS TO ALIGN FIREWATER INJECTION	6.00E-2
HCS-MDP-FS-HPCS	HPCS PUMP FAILS TO START	9.47E-4
HCS-MDP-TM-HPCS	HPCI TRAIN IS UNAVAILABLE BECAUSE OF MAINTENANCE	6.82E-3
HCS-MOV-CC-INJEC	HPCS INJECTION VALVE FAILS TO OPEN	9.63E-4
HCS-MOV-FT-SUCTR	HPCS SUCTION TRANSFER FAILS	3.00E-3
IE-LOMFW	LOSS OF FEEDWATER	1.00E+0
LCS-XHE-XL-RCOOL	OPERATOR FAILS TO RECOVER ROOM COOLING	1.00E+0
MFW-MDP-FS-MDFWP	FEEDWATER PUMP 1N27-C004 FAILS TO START	1.36E-3
MFW-MDP-TM-MDFWP	FEEDWATER PUMP 1N27-C004 IS IN TEST OR MAINTENANCE	7.12E-3
MSS-TBV-CC-BYPAS	TURBINE BYPASS VALVES FAIL TO OPEN	4.20E-3
OPR-XHE-XM-ADSINHIB	OPERATOR FAILS TO INHIBIT ADS AND CONTROL LVL	1.00E-3
OPR-XHE-XM-NOOVRFIL	OPERATOR FAILS TO CONTROL LEVEL	1.00E-3
PCS-XHE-XL-LTLOFW	OPERATOR FAILS TO RECOVER THE MAIN CONDENSER	1.00E+0
PCS-XHE-XO-ERROR	OPERATOR FAILS TO MAINTAIN FEEDWATER INJECTION	1.00E-3
RCI-RESTART	RESTART OF RCIC IS REQUIRED	1.50E-1
RCI-TDP-FR-PUMP	RCIC PUMP FAILS TO RUN GIVEN THAT IT STARTED	3.97E-2
RCI-TDP-FS-PUMP	RCIC PUMP FAILS TO START	6.49E-3
RCI-TDP-FS-RSTRT	RCIC FAILS TO RESTART GIVEN START AND SHORT-TERM RUN	8.00E-2
RCI-XHE-XL-RSTRT	OPERATOR FAILS TO RECOVER RCIC FAILURE TO RESTART	2.50E-1
RHR-STR-CF-NLOCA	SUPPRESSION POOL STRAINERS FAIL FROM COMMON CAUSE (NON-LOCA)	1.00E-5
RHR-XHE-XM-ERROR	OPERATOR FAILS TO START/CONTROL RHR	5.00E-4
RPS-SYS-FC-CRD	CONTROL ROD DRIVE MECHANICAL FAILURE	2.50E-7
RPS-SYS-FC-HCU	HCU COMPONENTS FAIL	1.10E-7

RPS-SYS-FC-PSOVS	HCU SCRAM PILOT SOVS FAIL	1.70E-6
RPS-SYS-FC-RELAY	TRIP SYSTEM RELAYS FAIL	3.80E-7
RRS-CRB-CC-PUMP1	RECIRC PUMP 1 FIELD BREAKER FAILS TO OPEN	2.39E-3
RRS-CRB-CC-PUMP2	RECIRC PUMP 2 FIELD BREAKER FAILS TO OPEN	2.39E-3
SLC-EPV-CF-F004AB	SLC SQUIB VALVES FAIL FROM COMMON CAUSE	6.43E-5
SLC-XHE-XM-ERROR	OPERATOR FAILS START/CONTROL SLC	2.00E-3
SLC-XHE-XR-SLCS	OPERATOR FAILS TO RESTORE SLCS AFTER MAINTENANCE	1.00E-3
SPCAI	SUPPRESSION POOL CLEANUP ALTERNATE INJECTION IS UNAVAILABLE	1.00E+0

Appendix B: Key Event Tree

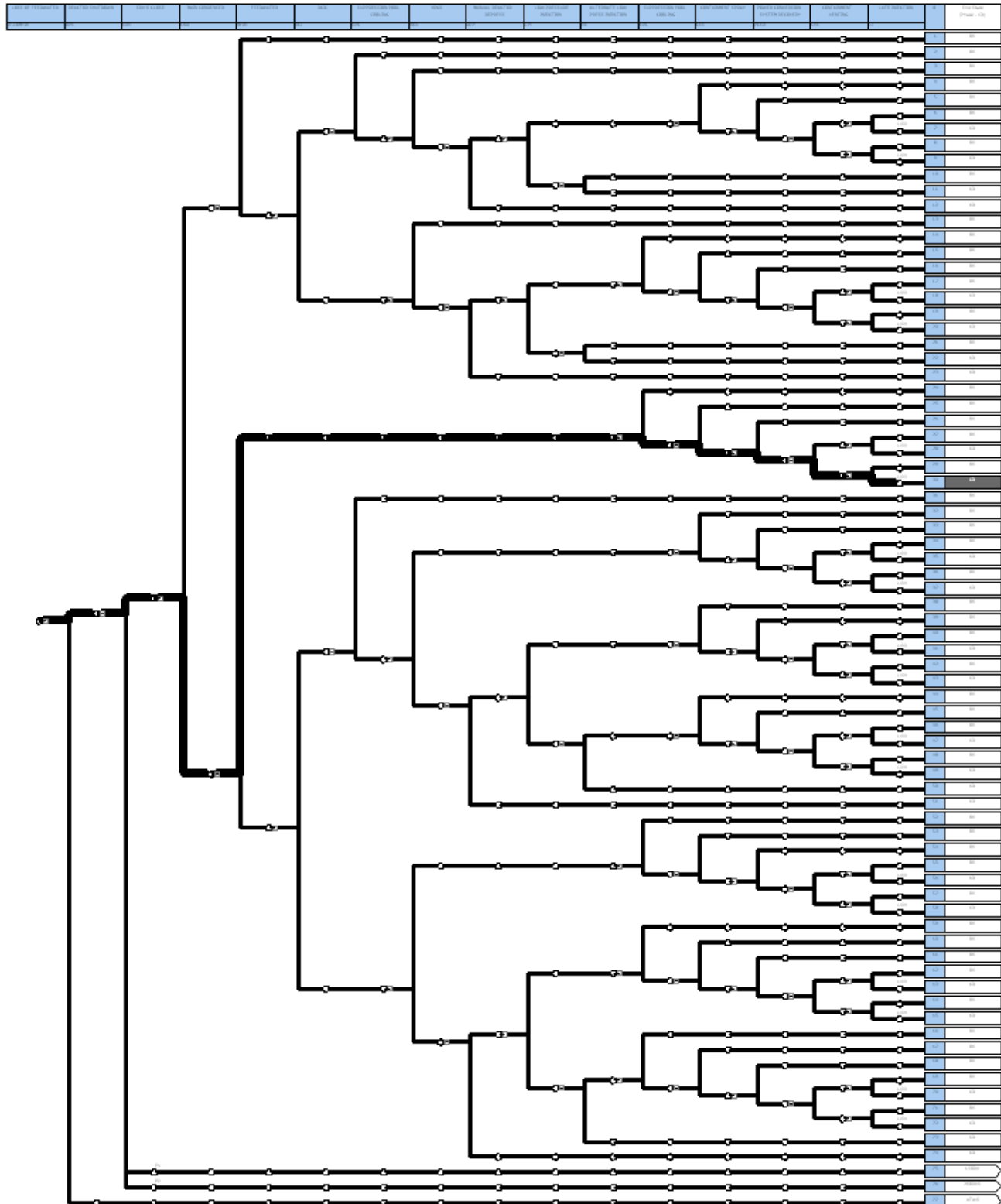


Figure B-1: Perry, Unit 1 LOMFW Event Tree