

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: 11/7/2014	LER: 440-2014-005	IR: 50-440/2014-005 and 50-440/15-003	
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 November 7, 2014 at 8:47 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 was a result of an invalid feedwater signal from the redundant reactivity control system (RRCS). 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)) when the Reactor Core Isolation Cooling (RCIC) and High Pressure Core Spray (HPCS) systems started and injected into the RPV. Balance-of-plant isolation occurred with isolation of all required valves and 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. The motor-driven RFP started as designed on a RFP trip signal. At approximately 8:50 am, the HPCS and RCIC system injections terminated on a Level 8 setpoint (219 inches above the TAF) as designed. The lowest RPV water level reached during the event was 77.2 inches above the TAF and the RPS was reset at 9:15 am. Mode 4 (Cold Shutdown) was entered at 5:52 pm when the average reactor coolant temperature decreased to 200 degrees Fahrenheit.

Cause. The RPS scram was caused by an invalid feedwater runback signal from the division 1 RRCS. The root cause was determined to be a latent design flaw in the upgrade design package of the digital feedwater control system (DFWCS) modification in 2005. Due to implementing the new digital upgrade, the interface between RRCS and DFWCS involving the runback signal was altered. The original design used interposing relays as the interface between the RRCS and the feedwater control system. The digital upgrade changed the design interface and removed the interposing relays tying the output of RRCS directly into DFWCS.

IR Summary/SDP Result. In Inspection Report (IR) 50-440/2014-005, the inspectors identified a Green self-revealing finding for the licensee's failure to establish and maintain a correct surveillance inspection procedure for RRCS channel checks. Also in IR 50-440/2014-005, the inspectors identified a Green self-revealing finding for the licensee's failure to complete a Regulatory Applicability Determination (RAD) specified in a procedure. In this case, the licensee made changes to the RRCS, including blocking inputs to the DFWCS runback function and disabling the RRCS self-test for both divisions of RRCS. These changes would likely have been subject to additional review had the RAD been completed. In IR 50-440/2015-003, the inspectors reviewed a licensee-identified violation of 10 CFR 50, Appendix B, Criterion III that a latent design flaw existed in the DFWCS design package. The inspectors evaluated the issue and determined the safety significance of the event was very low. The LER was closed in IR 50-440/2015-003.

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-LOMFW (*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 MOVS 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-PMPR	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

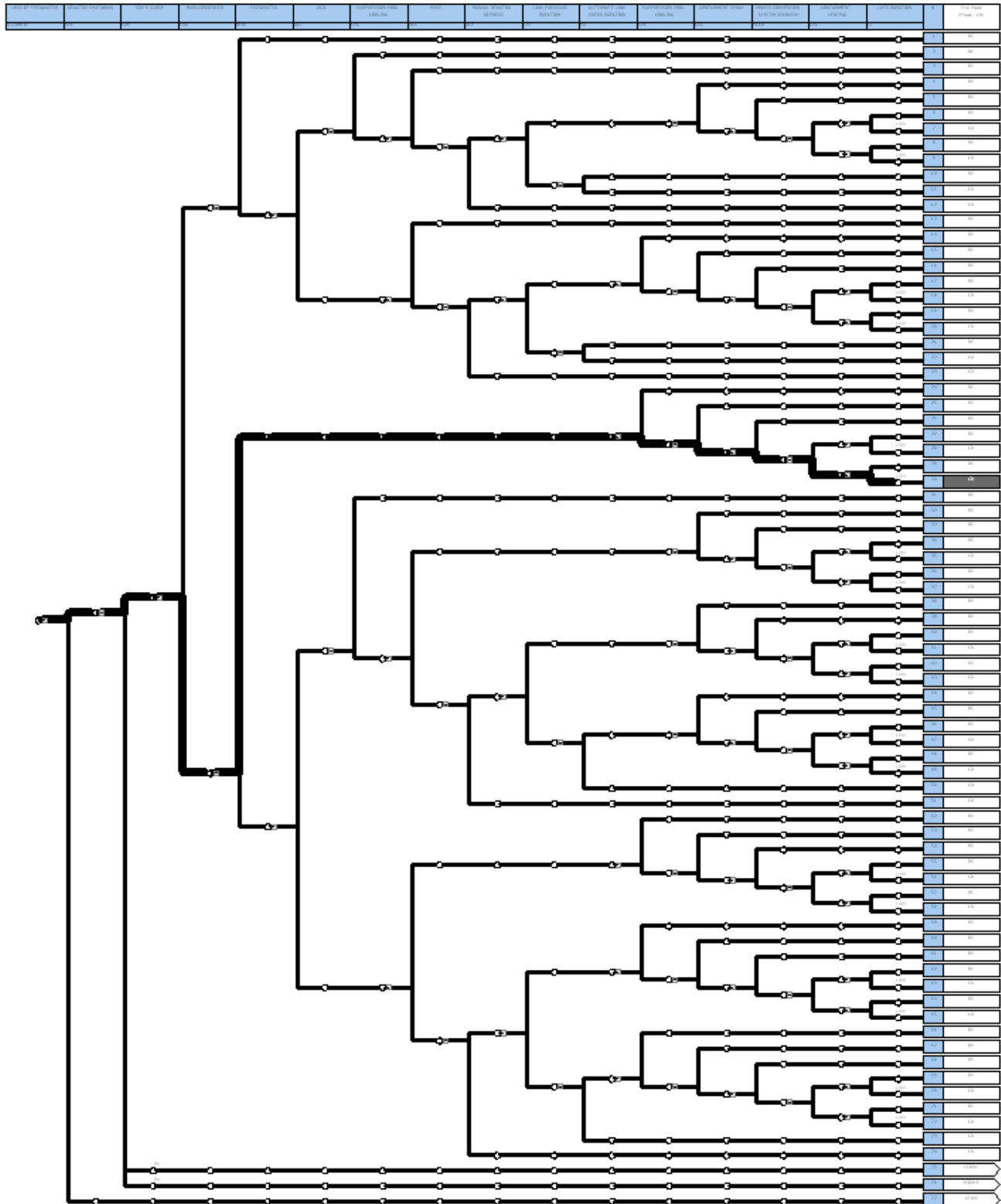


Figure B-1: Perry, Unit 1 LOMFW Event Tree