

Attachment 1a

ANO-2 EFW System Analysis Work Package



ENTERGY

ARKANSAS NUCLEAR ONE
CALCULATION COVER SHEET

Calc. No.: 89-E-0048-07
Calc. Title: ANO-2 Emergency
Feedwater System
Analysis Work Package

Unit: 2 Category: Q

System(s): EFW

Topic(s): PRAS

Calc. Type: NS

Component No(s): --

Plt Area: Bldg. -- Elev. --

Room -- Wall --

Coordinates: --

Abstract (Included Purpose/Results):

The purpose of this calculation is to document the ANO-2 Emergency Feedwater System Analysis Work Package (SAWP) and the development of the system fault tree model. The results of this system fault tree model and other ANO-2 system fault tree models are compiled into a plant-level model which when combined with the event tree top logic relates component failures, maintenance events, and human failures to ANO-2 core-damage and containment release accident sequences.

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ATT. F1-3, ATT. G0-30

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Generic Letter 88-20		

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By: Mark Horn / MF / 3/1/89 Rvw'd: D.W. Fouts / N/A / 12-22-97

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(Print Name) (Initials)(Date) (Print Name) (Initials)(Date)

Check if Additional Revisions: _____

SYSTEMS ANALYSIS WORK PACKAGE

Emergency Feedwater System

Calculation No. 89-E-0048-07
Revision 1.0

Modular Fault Tree

Calculation No 89-E-0048-07
Revision 1
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Checked by:
Reviewed by:

M. M. Freeman 

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ANO-2 EMERGENCY FEEDWATER SYSTEM

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Dependence of the colenoid bypass valve (SVC) is associated to the logic tree for the event of the P&ID module. The event is associated to the logic tree for the event of the P&ID module.

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SYSTEMS ANALYSIS WORK PACKAGE
EMERGENCY FEEDWATER SYSTEM

1. PURPOSE

This work package and the associated fault trees exist to support the definition of accident sequences. The following top logic event is supported:

Q001: EFW FAILS TO PROVIDE FLOW TO 1 OF 2 SGs FROM 1 OF 2 PUMPS

2. ASSUMPTIONS AND GIVEN INFORMATION

2.1 System Functions

The Emergency Feedwater System (EFW) is the primary backup to the main feedwater system in removing decay heat from the reactor coolant system through the steam generators. If the main feedwater flow is interrupted, thereby causing the steam generator level to decrease below a predetermined level, the EFW system is automatically put into operation.

The EFW system is automatically actuated by the Emergency Feedwater Actuation Signal (EFAS). The functions of EFAS are:

- automatic initiation of the emergency feedwater system pumps and valves;
- control of the emergency feedwater flow rate (secondary side level control)
- automatic isolation of a steam generator on low steam generator pressure.

2.2 Design Basis

The EFW is designed to provide a supply of water to the intact steam generator(s) following a postulated main steam line rupture or loss of main feedwater to remove reactor decay heat and cooldown the RCS to conditions at which the Shutdown Cooling System may be placed in operation. Redundancy of components is provided to guarantee operation in the event of a single failure of a mechanical or electrical component within the system. The EFW meets the redundant parallel flow path (piping and valves) requirements of Recommendation GL-2 in NUREG-0635, pages x-51. Redundancy of power supplies is also provided to meet the diversity requirement of NRC Branch Technical Position APCSB 10-1. All electrically operated components associated with the turbine driven pump train receive Channel 2 DC power (except for isolation valves 2CV-1037-1 and 2CV-1039-1). Channel 1 AC power is provided to all active components in the motor driven pump train (except for isolation valves 2CV-1036-2 and 2CV-1038-2).

2.3 System Description

The EFW consists of one turbine driven pump, one motor driven pump, and two independent emergency feedwater trains, each capable of supplying either or both of the two steam generators. The two pumps are identical with the exception of the drivers. The pumps can take suction from the Condensate Storage Tanks (2T41A and B), the outlet of the start-up and blow down demineralizer, or the Service Water loops. Both pumps are normally aligned to the CST during

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power operation.

2CV-0707 and 2EFW-0706 are suction valves that select EFW pump suction from either the Condensate Storage Tanks or the SU/BD Demineralizers. These two headers combine to a single header containing isolation valve 2EFW-802 which will isolate EFW pump suction if needed. During plant startup, these valves are normally left open and suction is supplied from the highest pressured source to 2P7A and B. At about 10% full power, 2EFW-0706 is closed to prevent possible pump cavitation resulting from hot feedwater being forced into pumps suction during LOOP situations. 2CV-0707 is operated from 2C33 in the control room. 2EFW-0706 is a locked closed manual valve. A bypass valve is provided around the CST suction check valve 2EFW-16 to allow rejection of DI effluent water to the CST for recovery of SU boiler heating gland steam input from Unit 1.

2CV-0789-1 and 2CV-0795-2 are motor operated valves that select condensate suction to both Emergency Feedwater Pumps. These valves close automatically when suction pressure decreases to below a setpoint (with an EFAS signal present), and 2CV-0716-1 and 2CV-0711-2 open to supply service water to the EFP's. An EFAS signal initiates this transfer of suction. The handswitches for these valves are located in the control room on 2C16 and 2C17.

The pump discharge piping and valving are arranged to allow either pump to supply both steam generators. Each supply line to each steam generator is provided with redundant control valves to ensure isolation and feeding of the steam generators and feeding of the remaining intact steam generator(s) as required following a main steam or feedwater line break.

A recirculation or flushing path is provided to either the SU/BD Demineralizer, the Unit 1 Circ Water Flume, or the Chemical Waste pond. 2CV-0798-1 and 2CV-0714-1 are air-operated valves that are automatically closed by EFAS when the EFW is initiated.

A pump minimum flow recirculation line is provided from each pump discharge, bypassing the air-operated flush line isolation valves. Each minimum flow line is provided with an orifice and globe valve for regulating the flow while providing a normally open flow path to ensure that each pump has a minimum flow.

Steam to the EFW pump turbine is supplied from each main steam header upstream of the main steam isolation valves, providing an assured source of steam to the turbine, from both or either steam generators even when the main steam isolation valves are closed. To minimize thermal shock to the turbine and associated piping, the main steam header isolation valves, 2CV-1000-1 and 2CV-1050-2, are normally open. When an EFAS signal is received, the turbine bearing cooling water isolation solenoid valve 2SV-0317-2 and the main steam supply bypass valve 2SV-0205 will open. After a time delay, the main steam supply valve 2CV-0340-2 opens and the bypass valve 2CV-0205 closes as the turbine reaches rated speed. Appendix F contains simplified P&ID's and other system schematics.

2.4 System Operation

During normal plant operations, the Emergency Feedwater system is not in operation. The EFW is automatically started by an EFAS. When an EFAS is issued, both pumps, 2P7A and 2P7B, start and all valves in the discharge lines open. However, if a steam generator isolation is required, as in the case of a postulated main steam line break, the EFAS opens only the valves leading to the intact steam generator. Pressure indication for each steam generator is used to determine which generator (s) are intact. The system is normally aligned to provide pump suction from the condensate tanks. If the condensate supply fails, pressure switches in the condensate

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and for injection valve operation. The gates used from the DC power fault tree are D501A and D501B for buses D27 and D26, respectively.

ESFAS

ESFAS generates the EFAS signals required for EFW initiation and control. The following gates are used from the ESFAS fault tree: A083, A084, A094, A097, A098, A100, A102, A103, A104, A105, A106, A106A, A107, A107A, A108, A108A, A109, A109A, A110A, A111A, A112A, A113A, and A120 [Ref. 17]

2.6 Test and Maintenance Requirements

The EFW pumps are tested on a monthly basis by utilizing a recirculation flow path by taking suction from the CST or the SU/BD Demineralizer effluent and pumping through the SU/BD inlet header (Technical Specification 4.7.1.2 and OP 2106.006).

EFW system power operated valves are stroke tested quarterly [Ref. 1]. All other valves in the flow path are proven operable during monthly pump testing (Tech Spec 4.7.1.2, and OP 2106.006). Steam supply check valves 2MS-39A and B are proven operable during the 2P7A monthly pump test.

The turbine driven pump 2P7A train is verified by performing a flow test after each cold shutdown. The flow test verifies the flow path from the CST to the steam generators per Tech Spec 4.7.1.2.b.4.

Automatic actuation of the system by EFAS is tested at least once per 18 months during shutdown (Tech Spec 4.7.1.2.b).

The condensate storage tank level is verified at least once per 12 hours when the tank is the supply source for the EFW pumps. A minimum contained water volume of 160,000 gallons is required (Tech Specs 3.7.1.3 and 4.7.1.3.1).

3.0 ANALYSIS RESULTS: FAULT TREE MODEL

The fault tree model is provided in several appendices as given below:

<u>Attachment</u>	<u>Contents</u>
B	Fault Tree Basic Event Descriptions
C	Fault Tree Module Descriptions
D	Fault Tree Mutually Exclusive Events
F	Simplified P&ID's
G	Modular Fault Tree

6. Minimum recirculation flow is assumed to be required through the bypass valves 2EFW-10A and B. 2CV-0798-1 or 2CV-0714-1 are required to close for successful operation of the EFW system. These valves are flush lines to the Startup and Blowdown Demineralizer, and are conservatively assumed to each divert sufficient flow to fail the EFW system due to not enough flow going to the Steam Generators. Failure of either one of the flush valves (2CV-0798-1 or 2CV-0714-1) is assumed to fail the motor-driven pump, since flow from this pump can be diverted by either valve.. These valves are initially closed, but a 'fails to close' failure is conservatively included, since these valves receive an EFAS signal to close.

Valves 2EFW-10A and B are the minimum recirculation valves for pumps 2P7A and B, and are required to be open when the pumps are operating. Flow diversion through failed open valve 2EFW-11A and normally open 2EFW-10B is assumed to NOT divert sufficient flow to fail train A if pump 2P7B is not operating. Likewise, flow diversion through failed open valve 2EFW-11B and normally open 2EFW-10A is assumed to NOT divert sufficient flow to fail train B if pump 2P7A is not operating.

Failure of either one of the flush valves coupled with a failure of its associated manual isolation valve (2EFW-11A or 2EFW-11B) is considered as a failure of the turbine-driven pump.

7. Flow diversion through manual valve 2EFW-0706 is not considered because this valve is locked closed above 10% FP.
8. Blowdown through the 2-inch bypass lines around the MSIV's is assumed to depressurize the steam generators to the point where EFW will automatically isolate.
9. Room cooling is assumed NOT to be required for successful operation of either EFW pump.
10. Backflow through a non-operating pump line is not considered as a system failure. The configuration requires multiple failures for backflow to occur. Also, backflow has not been observed at ANO-2, although the required surveillance is performed.
11. Overfill of a steam generator could occur if the appropriate EFAS relays do not reset or if the motor-operated injection valves do not close when the steam generator level increases to an adequate level. On a single injection line, both injection valves must fail to reclose to result in an overfill condition. The handswitches associated with these valves were not modelled as a contributor to failure, since these switches are 'spring-return-to-normal' and a transfers open failure is negligible given the conservatism in the model.
12. A spurious MSIV signal causes both steam generators to isolate. Isolation logic is included in the tree to account for the EFW system feeding the non broken steam generator.
13. A steam line/ feed line break is only modelled for SG A. Both steam generators are assumed to be identical, and have an identical likelihood of a break. If the steam line break were modeled for SG B as well, it would be double counting, since the data is for either steam generator. "A" is choosen to represent either steam generator. It is assumed the liklihood of both steam generators having a break at the same time is negligible.

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3.4 System Level Initiators

No system level initiating events are included in this fault tree.

3.5 Common Cause Failure Events

The following common cause failure module is used to represent common cause failure of valves 2CV-1025-1 and 2CV-1075-1, which are both AC-powered, motor-operated globe valves in parallel:

QMM2CCF1AC COMMON CAUSE FAILURE OF EFW AC INJECTION VALVES

The following common cause failure module is used to represent common cause failure of valves 2CV-1026-2 and 2CV-1076-2, which are both DC-powered, motor-operated gate valves in parallel:

QMM2CCF1DC COMMON CAUSE FAILURE OF EFW DC INJECTION VALVES

The following common cause failure module is used to represent common cause failure of valves 2CV-0711-2 and 2CV-0716-1, which are motor-operated valves in parallel provided flow from the Service Water system to EFW pump suction:

QMM2CCF003 CCF MODULE FOR SERVICE WATER SUCTION VALVES

4.0 REFERENCES

1. Steam System Operating Procedure, OP 2106.06, Emergency Feedwater System Operations, Rev. 41
2. This reference has been deleted
3. This reference has been deleted
4. This reference has been deleted
5. This reference has been deleted
6. This reference has been deleted
7. Technical Specifications 3.7.1.2, 3.7.1.3, 4.7.1.2, 4.7.1.3, Amendment 136
8. Electrical Wiring Diagram E-2280, Emergency Feedwater Pump Room Unit Cooler Valve 2CV-1529-2, Sheet 4, Rev. 7, 10/29/91
9. Electrical Wiring Diagram E-2443, EFP Turbine Driver Steam Isolation Valves, Sheet 3, Rev. 7, 7/22/91
10. P&ID M-2202, Sheet 4, Lube Oil, Lube Oil Cooling, Electro/hydraulic controls & Main Steam Rev. 11, 10/11/92
11. P&ID M-2204, Sheet 4, Emergency Feedwater System, Rev. 51, 5/7/93

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12. P&ID M-2206, Sheet 1, Steam Generator Secondary System, Rev. 107
13. P&ID M-2210, Sheet 3, Service Water System, Rev. 64
14. P&ID M-2212, Sheet 4, Makeup Water Demin. System, Rev. 19, 12/92
15. P&ID M-2403 Functional Description and Logic Diagram EFW System, Rev. 11.
16. P&ID M-204 , Sheet 5, Emergency Feedwater System, Rev. 12
17. Entergy Calculation 89-E-0041-01, Rev. 1 ESFAS System Analysis Work Package.
18. Electrical Wiring Diagram E-2018, Sheet 1, Rev. 13.
19. Electrical Wiring Diagram E-2014, 480 Volt Motor Control Center 2B51, Sheet 1, Rev. 32
20. Electrical Wiring Diagram E-2014, 480 Volt Motor Control Center 2B53, Sheet 3, Rev. 30.
21. Electrical Wiring Diagram E-2015, 480 Volt Motor Control Center 2B63, Sheet 3, Rev. 30.
22. Entergy Calculation 86-E-0020-01, Rev. 5, Battery 2D11 Duty Cycle and sizing Calculation

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ATTACHMENT A

THIS ATTACHMENT HAS BEEN DELETED

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ATTACHEMENT B
FAULT TREE BASIC EVENT DESCRIPTIONS

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NAME	C	FACTOR	U	DESC	SOURCE
33 DCD22304XR	3	24	H	DC BREAKER 72-2304 TRANSFERS OPEN	R1:86-E-0020-01
39 EMM2B51XXX			N	480V MCC 2B51 FAULT MODULE	R1: E-2014
40 EMM2B53XXX			N	480V MCC 2B53 FAULT MODULE	R1: E-2014
43 LOSSLOADT2				LOSS OF PCS DUE TO CLOSURE OF ALL MSIV'S OR LOSS OF CONDENSER VACUUM	R1:
44 MSIVA				REACTOR TRIP DUE TO FULL OR PARTIAL CLOSURE OF MSIV (1 LOOP)	R1:
45 MSIVB				REACTOR TRIP DUE TO FULL OR PARTIAL CLOSURE OF MSIV (1 LOOP)	R1:
46 NFEFWATO				NO FLOW FROM TRAIN A TO SG A FLAG	R1:
47 NFEFWATOB				NO FLOW TO SGB FROM EFW PUMP TRAIN A FLAG	R1:
48 NFEFWBTO				NO FLOW FROM TRAIN B TO SG A FLAG	R1:
49 NFEFWBTOB				NO FLOW TO SGB FROM TRAIN B FLAG	R1:
50 P900				TWO OR MORE TBV'S OPEN AND FAIL TO RECLOSE	
51 PAS210101C	3	1	N	AIR-OPERATED VALVE 2CV-1010-1 FAILS TO CLOSE	R1:
52 PCV2MS39AK	3	24	H	CHECK VALVE 2MS-39A TRANSFERS CLOSED	R1:
53 PCV2MS39AN	3			CHECK VALVE 2MS-39A FAILS TO OPEN	R1:
54 PCV2MS39BK	3	24	H	CHECK VALVE 2MS-39B TRANSFERS CLOSED	R1:
55 PCV2MS39BN	3	1		CHECK VALVE 2MS-39B FAILS TO OPEN	R1:
56 PMV201000K	2	1	M	MOTOR-OPERATED VALVE 2CV-1000-1 TRANSFERS CLOSED	R1:
57 PMV201050K	2	1	M	MOTOR-OPERATED VALVE 2CV-1050-2 TRANSFERS CLOSED	R1:
58 PMV210401R	3	24	H	MOTOR-OPERATED VALVE 2CV-1040-1 TRANSFERS OPEN	R1:
59 PMV2CV340K	3	24	H	MOTOR-OPERATED VALVE 2CV-0340-2 TRANSFERS CLOSED	R1:
60 PMV2CV340N	3	1		MOTOR-OPERATED VALVE 2CV-0340-2 FAILS TO OPEN	R1:
61 PRY201002T	3	1		S/G SAFETY VALVE 2PSV-1002 FAILS TO CLOSE (STM)	R1:
62 PRY201003T	3	1		S/G SAFETY VALVE 2PSV-1003 FAILS TO CLOSE (STM)	R1:
63 PRY201004T	3	1		S/G SAFETY VALVE 2PSV-1004 FAILS TO CLOSE (STM)	R1:
64 PRY201005T	3	1		S/G SAFETY VALVE 2PSV-1005 FAILS TO CLOSE (STM)	R1:
65 PRY201006T	3	1		S/G SAFETY VALVE 2PSV-1006 FAILS TO CLOSE (STM)	R1:
66 PRY201052T	3	1		S/G SAFETY VALVE 2PSV-1052 FAILS TO CLOSE (STM)	R1:
67 PRY201053T	3	1		S/G SAFETY VALVE 2PSV-1053 FAILS TO CLOSE (STM)	R1:
68 PRY201054T	3	1		S/G SAFETY VALVE 2PSV-1054 FAILS TO CLOSE (STM)	R1:
69 PRY201055T	3	1		S/G SAFETY VALVE 2PSV-1055 FAILS TO CLOSE (STM)	R1:
70 PRY201056T	3	1		S/G SAFETY VALVE 2PSV-1056 FAILS TO CLOSE (STM)	R1:
71 PSV2SV205N	3	1		SOLENOID VALVE 2SV-0205 FAILS TO OPEN	R1:
72 QAV200714C	3	1		AIR-OPERATED VALVE 2CV-0714-1 FAILS TO CLOSE	R1:
73 QAV200714R	3	24	H	AIR-OPERATED VALVE 2CV-0714-1 TRANSFERS OPEN	R1:
74 QAV200798C	3	1		AIR-OPERATED VALVE 2CV-0798-1 FAILS TO CLOSE	R1:
75 QAV200798R	3	24	H	AIR-OPERATED VALVE 2CV-0798-1 TRANSFERS OPEN	R1:
76 QCB20A311R	2	.10E+01	M	AC BREAKER 2A311 TRANSFERS OPEN	R1:
77 QCB263H1AR	3	1104	H	AC BREAKER 2B63H1 TRANSFERS OPEN PRIOR TO MISSION	R1:E-2015,SH 3
78 QCB263H1FR	3	24	H	AC BREAKER 2B63H1 TRANSFERS OPEN DURING MISSION	R1: E-2015 SH 3
79 QCB263H3AR	3	1104	H	AC BREAKER 2B63H3 TRANSFERS OPEN PRIOR TO MISSION	R1: E-2015
80 QCB263H3FR	3	24	H	AC BREAKER 2B63H3 TRANSFERS OPEN DURING MISSION	R1: E-2015
81 QCB2B51N2R	2	1	M	AC BREAKER 2B51N2 TRANSFERS OPEN	R1: E-2014,R32
82 QCB2B53D1R	2	1	M	AC BREAKER 2B53D1 TRANSFERS OPEN	R1: E-2014
83 QCB2B53D2R	2	1	M	AC BREAKER 2B53D2 TRANSFERS OPEN	R1: E-2014
84 QCB2B53J2R	2	1	M	AC BREAKER 2B53J2 TRANSFERS OPEN	R1:E-2014,SH 3
85 QCD227B1AR	3	1104	H	DC BREAKER 2D27-B1 TRANSFERS OPEN PRIOR TO MISSION	R1: E-2018
86 QCD227B1FR	3	24	H	DC BREAKER 2D27-B1 TRANSFERS OPEN DURING MISSION	r1: E-2018
87 QCD227B2AR	3	1104	H	DC BREAKER 2D27-B2 TRANSFERS OPEN PRIOR TO MISSION	R1: E-2018
88 QCD227B2FR	3	24	H	DC BREAKER 2D27-B2 TRANSFERS OPEN DURING MISSION	R1: E-2018
89 QCD2D26A4R	3	36	H	DC BREAKER 2D26-A4 TRANSFERS OPEN	R1: E-2018

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90 QCD2D26B1R 3	36 H DC BREAKER 2D26-B1 TRANSFERS OPEN	R1: E-2018
91 QCD2D26B2R 3	36 H DC BREAKER 2D26-B2 TRANSFERS OPEN	R1: E-2018
92 QCD2D26B3R 3	36 H DC BREAKER 2D26-B3 TRANSFERS OPEN	R1: E-2018
93 QCD2D26C1R 3	36 H DC BREAKER 2D26-C1 TRANSFERS OPEN	R1: E-2018 SH 1
94 QCV200801K 3	24 H CHECK VALVE 2EFW-801 TRANSFERS CLOSED	R1:
95 QCV200801N 3	1 CHECK VALVE 2EFW-801 FAILS TO OPEN	R1:
96 QCV2EFW01K 3	24 H CHECK VALVE 2EFW-1 TRANSFERS CLOSED	R1:
97 QCV2EFW01N 3	1 CHECK VALVE 2EFW-1 FAILS TO OPEN	R1:
98 QCV2EFW16K 3	24 H CHECK VALVE 2EFW-16 TRANSFERS CLOSED	R1:
99 QCV2EFW16N 3	1 CHECK VALVE 2EFW-16 FAILS TO OPEN	R1:
100 QCV2EFW2AK 3	24 H CHECK VALVE 2EFW-2A TRANSFERS CLOSED	R1:
101 QCV2EFW2AN 3	1 CHECK VALVE 2EFW-2A FAILS TO OPEN	R1:
102 QCV2EFW2BK 3	24 H CHECK VALVE 2EFW-2B TRANSFERS CLOSED	R1:
103 QCV2EFW2BN 3	1 CHECK VALVE 2EFW-2B FAILS TO OPEN	R1:
104 QCV2EFW4AK 3	24 H CHECK VALVE 2EFW-4A TRANSFERS CLOSED	R1:
105 QCV2EFW4AN 3	1 CHECK VALVE 2EFW-4A FAILS TO OPEN	R1:
106 QCV2EFW4BK 3	24 H CHECK VALVE 2EFW-4B TRANSFERS CLOSED	R1:
107 QCV2EFW4BN 3	1 CHECK VALVE 2EFW-4B FAILS TO OPEN	R1:
108 QCV2EFW7AK 3	24 H CHECK VALVE 2EFW-7A TRANSFERS CLOSED	R1:
109 QCV2EFW7AN 3	1 CHECK VALVE 2EFW-7A FAILS TO OPEN	R1:
110 QCV2EFW7BK 3	24 H CHECK VALVE 2EFW-7B TRANSFERS CLOSED	R1:
111 QCV2EFW7BN 3	1 CHECK VALVE 2EFW-7B FAILS TO OPEN	R1:
112 QCV2EFW8AK 3	24 H CHECK VALVE 2EFW-8A TRANSFERS CLOSED	R1:
113 QCV2EFW8AN 3	1 CHECK VALVE 2EFW-8A FAILS TO OPEN	R1:
114 QCV2EFW8BK 3	24 H CHECK VALVE 2EFW-8B TRANSFERS CLOSED	R1:
115 QCV2EFW8BN 3	1 CHECK VALVE 2EFW-8B FAILS TO OPEN	R1:
116 QCV2EFW9AK 3	24 H CHECK VALVE 2EFW-9A TRANSFERS CLOSED	R1:
117 QCV2EFW9AN 3	1 CHECK VALVE 2EFW-9A FAILS TO OPEN	R1:
118 QCV2EFW9BK 3	24 H CHECK VALVE 2EFW-9B TRANSFERS CLOSED	R1:
119 QCV2EFW9BN 3	1 CHECK VALVE 2EFW-9B FAILS TO OPEN	R1:
120 QHF2EFWTAF	OPERATOR FAILS TO PROPERLY RESTORE EFW PUMP TRAIN A	R1:
121 QHF2EFWTBF	OPERATOR FAILS TO PROPERLY RESTORE EFW TRAIN B	R1:
122 QHF2REFILL	OPERATORS FAIL TO ALIGN EFW SUCTION TO ALTERNATE CONDENSATE STORAGE TANK	R1:
123 QMM2CCF003	CCF MODULE FOR SERVICE WATER SUCTION VALVES	R1:
124 QMM2CCF1AC	COMMON CAUSE FAILURE OF EFW AC INJECTION VALVES	R1:
125 QMM2CCF1DC	COMMON CAUSE FAILURE MODULE OF EFW DC INJECTION VALVES	R1:
126 QMM2COOLTB	LOSS OF BEARING COOLING TO P7A TURBINE(2K3)	R1:
127 QMM2CSTNKA	NO FLOW FROM CST (TYPE-1 FAULTS)	R1:
128 QMM2CSTNKF	NO FLOW FROM CST (TYPE-2 FAULTS)	R1:
129 QMM2CV1025	FAILURE TO CLOSE SGA (2E24A) INJECTION VALVE 2CV-1025-1	R1:
130 QMM2CV1026	FAILURE TO CLOSE SGA (2E24A) INJECTION VALVE 2CV-1026-2	R1:
131 QMM2CV1036	FAILURE TO CLOSE SGB (2E24B) INJECTION VALVE 2CV-1036-2	R1:
132 QMM2CV1037	FAILURE TO CLOSE SGA (2E24A) INJECTION VALVE 2CV-1037-1	R1:
133 QMM2CV1038	FAILURE TO CLOSE SGA (2E24A) INJECTION VALVE 2CV-1038-2	R1:
134 QMM2CV1039	FAILURE TO CLOSE SGB (2E24B) INJECTION VALVE 2CV-1039-1	R1:
135 QMM2CV1075	FAILURE TO CLOSE SGB (2E24B) INJECTION VALVE 2CV-1075-1	R1:
136 QMM2CV1076	FAILURE TO CLOSE SGB (2E24B) INJECTION VALVE 2CV-1076-2	R1: E-2018 SH 1
137 QMM2EFW9AF	CHECK VALVE 2EFW-9A FAILS TO PROVIDE FLOW	R1: E-2018 SH 1
138 QMM2EFW9BF	CHECK VALVE 2EFW-9B FAILS TO PROVIDE FLOW	R1: E-2018 SH 1
139 QMM2MSLIAF	SG A (2E24A) MAIN STEAM LINE ISOLATION VALVE FAILS TO CLOSE	R1: M-2206 R106
140 QMM2PMSUCA	NO FLOW THROUGH COMMON PUMP SUCTION LINE (TYPE-1 FAULTS)	R1:
141 QMM2PMSUCF	NO FLOW THROUGH COMMON PUMP SUCTION LINE (TYPE-2 FAULTS)	R1:

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142	QMM2SGAP7A		NO FLOW TO SGA (2E24A) FROM 2P7A	R1:
143	QMM2SGAP7B		NO FLOW TO SGA (2E24A) FROM 2P7B	R1:
144	QMM2SGBP7A		NO FLOW TO SGB (2E24B) FROM 2P7A	R1:
145	QMM2SGBP7B		NO FLOW TO SGB (2E24B) FROM 2P7B	R1:
146	QMM2STMADM		STEAM ADMISSION VALVE 2CV-0340-2 OR BYPASS VALVE 2SV-0205 FAIL	R1:
147	QMM2STSSGA		STEAM GENERATOR A (2E24A) SUPPLY LINE BLOCKED	R1:
148	QMM2STSSGB		STEAM GENERATOR B (2E24B) SUPPLY LINE BLOCKED	R1:
149	QMM2SWASUP		LOSS OF SUPPLY FROM SW TO TRAIN A	R1:
150	QMM2SWBSUP		LOSS OF SUPPLY FROM SW TO TRAIN B DUE TO BREAKERS AND VALVES	R1:
151	QMM2TRANAA		EFW PUMP TRAIN A FAILS TO DELIVER FLOW (TYPE 1 FAULTS)	R1:
152	QMM2TRANAF		EFW PUMP TRAIN A FAILS TO DELIVER FLOW (TYPE 2 FAULTS)	R1:
153	QMM2TRANBA		EFW PUMP TRAIN B FAILS TO DELIVER FLOW (TYPE 1 FAULTS)	R1:
154	QMM2TRANBF		EFW PUMP TRAIN B FAILS TO DELIVER FLOW (TYPE 2 FAULTS)	R1:
155	QMP202P7BA	3	1 MOTOR-DRIVEN PUMP 2P7B FAILS TO START	R1:
156	QMP202P7BF	3	24 H MOTOR-DRIVEN PUMP 2P7B FAILS TO RUN	R1:
157	QMV200711K	3	24 H MOTOR-OPERATED VALVE 2CV-0711-2 TRANSFERS CLOSED	R1:
158	QMV200711N	3	1 MOTOR-OPERATED VALVE 2CV-0711-2 FAILS TO OPEN	R1:
159	QMV200716K	3	24 H MOTOR-OPERATED VALVE 2CV-0716-1 TRANSFERS CLOSED	R1:
160	QMV200716N	3	1 MOTOR-OPERATED VALVE 2CV-0716-1 FAILS TO OPEN	R1:
161	QMV200789C	3	1 MOTOR-OPERATED VALVE 2CV-0789-1 FAILS TO CLOSE	R1:
162	QMV200789K	3	1 M MOTOR-OPERATED VALVE 2CV-0789-1 TRANSFERS CLOSED	R1:
163	QMV200795C	3	1 MOTOR-OPERATED VALVE 2CV-0795-2 FAILS TO CLOSE	R1:
164	QMV201025C	3	1 MOTOR-OPERATED VALVE 2CV-1025-1 FAILS TO CLOSE	R1:
165	QMV201025K	3	24 H MOTOR-OPERATED VALVE 2CV-1025-1 TRANSFERS CLOSED	R1:
166	QMV201025N	3	1 MOTOR-OPERATED VALVE 2CV-1025-1 FAILS TO OPEN	R1:
167	QMV201025R	3	24 MOTOR-OPERATED VALVE 2CV-1025-1 TRANSFERS OPEN	R1:
168	QMV201026C	3	1 MOTOR-OPERATED VALVE 2CV-1026-2 FAILS TO CLOSE	R1:
169	QMV201026K	3	24 H MOTOR-OPERATED VALVE 2CV-1026-2 TRANSFERS CLOSED	R1:
170	QMV201026N	3	1 MOTOR-OPERATED VALVE 2CV-1026-2 FAILS TO OPEN	R1:
171	QMV201026R	3	24 MOTOR-OPERATED VALVE 2CV-1026-2 TRANSFERS OPEN	R1:
172	QMV201036C	3	1 MOTOR-OPERATED VALVE 2CV-1036-2 FAILS TO CLOSE	R1:
173	QMV201036K	2	3 M MOTOR-OPERATED VALVE 2CV-1036-2 TRANSFERS CLOSED	R1:
174	QMV201036R	3	24 H MOTOR-OPERATED VALVE 2CV-1036-2 TRANSFERS OPEN	R1:
175	QMV201037C	3	1 MOTOR-OPERATED VALVE 2CV-1037-1 FAILS TO CLOSE	R1:
176	QMV201037K	2	3 M MOTOR-OPERATED VALVE 2CV-1037-1 TRANSFERS CLOSED	R1:
177	QMV201037R	3	24 H MOTOR-OPERATED VALVE 2CV-1037-1 TRANSFERS OPEN	R1:
178	QMV201038C	3	1 MOTOR-OPERATED VALVE 2CV-1038-2 FAILS TO CLOSE	R1:
179	QMV201038K	2	3 M MOTOR-OPERATED VALVE 2CV-1038-2 TRANSFERS CLOSED	R1:
180	QMV201038R	3	24 H MOTOR-OPERATED VALVE 2CV-1038-2 TRANSFERS OPEN	R1:
181	QMV201039C	3	1 MOTOR-OPERATED VALVE 2CV-1039-1 FAILS TO CLOSE	R1:
182	QMV201039K	2	3 M MOTOR-OPERATED VALVE 2CV-1039-1 TRANSFERS CLOSED	R1:
183	QMV201039R	3	24 H MOTOR-OPERATED VALVE 2CV-1039-1 TRANSFERS OPEN	R1:
184	QMV201075C	3	1 MOTOR-OPERATED VALVE 2CV-1075-1 FAILS TO CLOSE	R1:
185	QMV201075K	3	24 H MOTOR-OPERATED VALVE 2CV-1075-1 TRANSFERS CLOSED	R1:
186	QMV201075N	3	1 MOTOR-OPERATED VALVE 2CV-1075-1 FAILS TO OPEN	R1:
187	QMV201075R	3	24 MOTOR-OPERATED VALVE 2CV-1075-1 TRANSFERS OPEN	R1:
188	QMV201076C	3	1 MOTOR-OPERATED VALVE 2CV-1076-2 FAILS TO CLOSE	R1:
189	QMV201076K	3	24 H MOTOR-OPERATED VALVE 2CV-1076-2 TRANSFERS CLOSED	R1:
190	QMV201076N	3	1 MOTOR-OPERATED VALVE 2CV-1076-2 FAILS TO OPEN	R1:
191	QMV201076R	3	24 MOTOR-OPERATED VALVE 2CV-1076-2 TRANSFERS OPEN	R1:
192	QMV2CCFBF\$	3	.10E+01 BETA FACTOR FOR EFW MOV S	R1:
193	QMV2CV707K	2	1 M MOTOR-OPERATED VALVE 2EFW-0707 TRANSFERS CLOSED	R1:

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194 QMV2CV795K 2	1 M	MOTOR-OPERATED VALVE 2CV-0795-2 TRANSFERS CLOSED	R1:
195 QPS200789D 3	1	PRESSURE SWITCH 2PIS-0789-1 FAILS TO RESPOND	R1:
196 QPS200795D 3	1	PRESSURE SWITCH 2PIS-0795-2 FAILS TO RESPOND	R1:
197 QSV200714C 3	1	SOLENOID VALVE 2SV-0714-1 FAILS TO CLOSE	R1:
198 QSV200714R 3	24 H	SOLENOID VALVE 2SV-0714-1 TRANSFERS OPEN	R1:
199 QSV200798C 3	1	SOLENOID VALVE 2SV-0798-1 FAILS TO CLOSE	R1:
200 QSV200798R 3	24 H	SOLENOID VALVE 2SV-0798-1 TRANSFERS OPEN	R1:
201 QSV2SV317K 3	24 H	SOLENOID VALVE 2SV-0317-2 TRANSFERS CLOSED	R1:
202 QSV2SV317N 3	1	SOLENOID VALVE 2SV-0317-2 FAILS TO OPEN	R1:
203 QTK2CT41AJ 3	24 H	CST TANK 2T41A RUPTURE OR LEAKAGE	R1:
204 QTM2EFWTAF		EFW PUMP TRAIN A UNAVAILABLE DUE TO MAINTENANCE	R1:
205 QTM2EFWTAT		EFW PUMP TRAIN A IN TEST W/ ASSOC'D FLUSH VALVES OPEN	R1:
206 QTM2EFWTBF		EFW PUMP TRAIN B UNAVAILABLE DUE TO MAINTENANCE	R1:
207 QTM2EFWTBT		EFW PUMP TRAIN B IN TEST W/ ASSOC'D FLUSH VALVES OPEN	R1:
208 QTP202P7AA 3	1	TURBINE-DRIVEN PUMP 2P7A FAILS TO START	R1:
209 QTP202P7AF 3	24 H	TURBINE-DRIVEN PUMP 2P7A FAILS TO RUN	R1:
210 QXV20011AR 3	396	MANUAL VALVE 2EFW-11A TRANSFERS OPEN	R1:
211 QXV20011BR 3	396	MANUAL VALVE 2EFW-11B TRANSFERS OPEN	R1:
212 QXV200802K 2	1 M	MANUAL VALVE 2EFW-802 TRANSFERS CLOSED	R1:
213 QXV2CT005K 2	1 M	MANUAL VALVE 2CT-5 TRANSFERS CLOSED	R1:
214 QXV2CV706R 2	396 H	MANUAL VALVE 2EFW-0706 TRANSFERS OPEN	R1:
215 QXV2EF10AK 2	1 M	MANUAL VALVE 2EFW-10A TRANSFERS CLOSED	R1:
216 QXV2EF10BK 2	1 M	MANUAL VALVE 2EFW-10B TRANSFERS CLOSED	R1:
217 QXV2EF789K 3	396 H	MANUAL VALVE 2EFW-0789A TRANSFERS CLOSED	R1:
218 QXV2EF795K 3	396 H	MANUAL VALVE 2EFW-0795A TRANSFERS CLOSED	R1:
219 QXV2EFW06K 2	1 M	MANUAL VALVE 2EFW-6 TRANSFERS CLOSED	R1:
220 QXV2EFW20K 2	1 M	MANUAL VALVE 2EFW-20 TRANSFERS CLOSED	R1:
221 QXV2EFW21K 2	1 M	MANUAL VALVE 2EFW-21 TRANSFERS CLOSED	R1:
222 QXV2EFW3AK 2	1 M	MANUAL VALVE 2EFW-3A TRANSFERS CLOSED	R1:
223 QXV2EFW3BK 2	1 M	MANUAL VALVE 2EFW-3B TRANSFERS CLOSED	R1:
224 S101	1E-3	SERVICE WATER LOOP 1 NOT AVAILABLE	
225 S201	1E-3	SERVICE WATER LOOP 2 NOT AVAILABLE	
226 SKV2SW39AK 2	18 M	MANUAL VALVE 2SW-39A TRANSFERS CLOSED	R1:
227 SKV2SW39BK 2	18 M	MANUAL VALVE 2SW-39B TRANSFERS CLOSED	R1:
228 T1		Turbine Trip <IE>	R1:
229 T2		Loss of PCS <IE>	R1:
230 T3		Loss of Offsite Power <IE>	R1:
231 T5		Steamline/Feedline break initiating event <IE>	R1:
232 T6		REACTOR TRIP INITIATING EVENT <IE>	R1:
233 XSEFWATO A	1	EXCESSIVE EFW FLOR FROM PUMP A TO SG A FLAG	R1:
234 XSEFWATO B	1	EXCESSIVE FLOW TO SG B FROM 2P7A FLAG	R1:
235 XSEFWBTO A	1	EXCESSIVE EFW FLOR FROM PUMP B TO SG A FLAG	R1:
236 XSEFWBTO B	1	EXCESSIVE FLOW TO SG B FROM 2P7B FLAG	R1:

ATTACHMENT C
FAULT TREE MODULE DESCRIPTIONS

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CUTSET REPORT

MODULE/EVENT NAME DESCRIPTION

- 1) QMM2CCF003 CCF MODULE FOR SERVICE WATER SUCTION VALVES
 - 1) QMV200711N MOTOR-OPERATED VALVE 2CV-0711-2 FAILS TO OPEN
QMV2CCFBF\$ BETA FACTOR FOR EFW MOV S
- 2) QMM2CCF1AC COMMON CAUSE FAILURE OF EFW AC INJECTION VALVES
 - 1) QMV201025N MOTOR-OPERATED VALVE 2CV-1025-1 FAILS TO OPEN
QMV2CCFBF\$ BETA FACTOR FOR EFW MOV S
- 3) QMM2CCF1DC COMMON CAUSE FAILURE MODULE OF EFW DC INJECTION VALVES
 - 1) QMV201026N MOTOR-OPERATED VALVE 2CV-1026-2 FAILS TO OPEN
QMV2CCFBF\$ BETA FACTOR FOR EFW MOV S
- 4) QMM2COOLTB LOSS OF BEARING COOLING TO P7A TURBINE(2K3)
 - 1) QSV2SV317N SOLENOID VALVE 2SV-0317-2 FAILS TO OPEN
 - 2) QSV2SV317K SOLENOID VALVE 2SV-0317-2 TRANSFERS CLOSED
 - 3) QXV2EFW20K MANUAL VALVE 2EFW-20 TRANSFERS CLOSED
 - 4) QXV2EFW21K MANUAL VALVE 2EFW-21 TRANSFERS CLOSED
- 5) QMM2CSTNKA NO FLOW FROM CST (TYPE-1 FAULTS)
 - 1) QCV2EFW16N CHECK VALVE 2EFW-16 FAILS TO OPEN
 - 2) QMV2CV707K MOTOR-OPERATED VALVE 2EFW-0707 TRANSFERS CLOSED
 - 3) QXV2CT005K MANUAL VALVE 2CT-5 TRANSFERS CLOSED
- 6) QMM2CSTNKF NO FLOW FROM CST (TYPE-2 FAULTS)
 - 1) QCV2EFW16K CHECK VALVE 2EFW-16 TRANSFERS CLOSED
 - 2) QTK2CT41AJ CST TANK 2T41A RUPTURE OR LEAKAGE
- 7) QMM2CV1025 FAILURE TO CLOSE SGA (2E24A) INJECTION VALVE 2CV-1025-1
 - 1) QMV201025C MOTOR-OPERATED VALVE 2CV-1025-1 FAILS TO CLOSE
 - 2) QMV201025R MOTOR-OPERATED VALVE 2CV-1025-1 TRANSFERS OPEN
- 8) QMM2CV1026 FAILURE TO CLOSE SGA (2E24A) INJECTION VALVE 2CV-1026-2
 - 1) QMV201026C MOTOR-OPERATED VALVE 2CV-1026-2 FAILS TO CLOSE
 - 2) QMV201026R MOTOR-OPERATED VALVE 2CV-1026-2 TRANSFERS OPEN
- 9) QMM2CV1036 FAILURE TO CLOSE SGB (2E24B) INJECTION VALVE 2CV-1036-2
 - 1) QMV201036C MOTOR-OPERATED VALVE 2CV-1036-2 FAILS TO CLOSE
 - 2) QMV201036R MOTOR-OPERATED VALVE 2CV-1036-2 TRANSFERS OPEN
- 10) QMM2CV1037 FAILURE TO CLOSE SGA (2E24A) INJECTION VALVE 2CV-1037-1
 - 1) QMV201037C MOTOR-OPERATED VALVE 2CV-1037-1 FAILS TO CLOSE
 - 2) QMV201037R MOTOR-OPERATED VALVE 2CV-1037-1 TRANSFERS OPEN
- 11) QMM2CV1038 FAILURE TO CLOSE SGA (2E24A) INJECTION VALVE 2CV-1038-2
 - 1) QMV201038C MOTOR-OPERATED VALVE 2CV-1038-2 FAILS TO CLOSE
 - 2) QMV201038R MOTOR-OPERATED VALVE 2CV-1038-2 TRANSFERS OPEN

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- 12) QMM2CV1039 FAILURE TO CLOSE SGB (2E24B) INJECTION VALVE 2CV-1039-1
 - 1) QMV201039C MOTOR-OPERATED VALVE 2CV-1039-1 FAILS TO CLOSE
 - 2) QMV201039R MOTOR-OPERATED VALVE 2CV-1039-1 TRANSFERS OPEN

- 13) QMM2CV1075 FAILURE TO CLOSE SGB (2E24B) INJECTION VALVE 2CV-1075-1
 - 1) QMV201075C MOTOR-OPERATED VALVE 2CV-1075-1 FAILS TO CLOSE
 - 2) QMV201075R MOTOR-OPERATED VALVE 2CV-1075-1 TRANSFERS OPEN

- 14) QMM2CV1076 FAILURE TO CLOSE SGB (2E24B) INJECTION VALVE 2CV-1076-2
 - 1) QMV201076C MOTOR-OPERATED VALVE 2CV-1076-2 FAILS TO CLOSE
 - 2) QMV201076R MOTOR-OPERATED VALVE 2CV-1076-2 TRANSFERS OPEN

- 15) QMM2EFW9AF CHECK VALVE 2EFW-9A FAILS TO PROVIDE FLOW
 - 1) QCV2EFW9AN CHECK VALVE 2EFW-9A FAILS TO OPEN
 - 2) QCV2EFW9AK CHECK VALVE 2EFW-9A TRANSFERS CLOSED

- 16) QMM2EFW9BF CHECK VALVE 2EFW-9B FAILS TO PROVIDE FLOW
 - 1) QCV2EFW9BN CHECK VALVE 2EFW-9B FAILS TO OPEN
 - 2) QCV2EFW9BK CHECK VALVE 2EFW-9B TRANSFERS CLOSED

- 17) QMM2MSLIAF SG A (2E24A) MAIN STEAM LINE ISOLATION VALVE FAILS TO CLOSE
 - 1) PAS210101C AIR-OPERATED VALVE 2CV-1010-1 FAILS TO CLOSE
 - 2) PMV210401R MOTOR-OPERATED VALVE 2CV-1040-1 TRANSFERS OPEN

- 18) QMM2PMSUCA NO FLOW THROUGH COMMON PUMP SUCTION LINE (TYPE-1 FAULTS)
 - 1) QXV200802K MANUAL VALVE 2EFW-802 TRANSFERS CLOSED
 - 2) QCV2EFW01N CHECK VALVE 2EFW-1 FAILS TO OPEN
 - 3) QCV200801N CHECK VALVE 2EFW-801 FAILS TO OPEN

- 19) QMM2PMSUCF NO FLOW THROUGH COMMON PUMP SUCTION LINE (TYPE-2 FAULTS)
 - 1) QCV2EFW01K CHECK VALVE 2EFW-1 TRANSFERS CLOSED
 - 2) QCV200801K CHECK VALVE 2EFW-801 TRANSFERS CLOSED
 - 3) QXV2CV706R MANUAL VALVE 2EFW-0706 TRANSFERS OPEN

- 20) QMM2SGAP7A NO FLOW TO SGA (2E24A) FROM 2P7A
 - 1) QCV2EFW7AN CHECK VALVE 2EFW-7A FAILS TO OPEN
 - 2) QCV2EFW7AK CHECK VALVE 2EFW-7A TRANSFERS CLOSED
 - 3) QMV201037K MOTOR-OPERATED VALVE 2CV-1037-1 TRANSFERS CLOSED
 - 4) QMV201026N MOTOR-OPERATED VALVE 2CV-1026-2 FAILS TO OPEN
 - 5) QMV201026K MOTOR-OPERATED VALVE 2CV-1026-2 TRANSFERS CLOSED

- 21) QMM2SGAP7B NO FLOW TO SGA (2E24A) FROM 2P7B
 - 1) QCV2EFW7BN CHECK VALVE 2EFW-7B FAILS TO OPEN
 - 2) QCV2EFW7BK CHECK VALVE 2EFW-7B TRANSFERS CLOSED
 - 3) QMV201038K MOTOR-OPERATED VALVE 2CV-1038-2 TRANSFERS CLOSED
 - 4) QMV201025N MOTOR-OPERATED VALVE 2CV-1025-1 FAILS TO OPEN
 - 5) QMV201025K MOTOR-OPERATED VALVE 2CV-1025-1 TRANSFERS CLOSED

- 22) QMM2SGBP7A NO FLOW TO SGB (2E24B) FROM 2P7A
 - 1) QCV2EFW8AN CHECK VALVE 2EFW-8A FAILS TO OPEN
 - 2) QCV2EFW8AK CHECK VALVE 2EFW-8A TRANSFERS CLOSED

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- 3) QMV201039K MOTOR-OPERATED VALVE 2CV-1039-1 TRANSFERS CLOSED
 - 4) QMV201076N MOTOR-OPERATED VALVE 2CV-1076-2 FAILS TO OPEN
 - 5) QMV201076K MOTOR-OPERATED VALVE 2CV-1076-2 TRANSFERS CLOSED
- 23) QMM2SGBP7B NO FLOW TO SGB (2E24B) FROM 2P7B
- 1) QCV2EFW8BN CHECK VALVE 2EFW-8B FAILS TO OPEN
 - 2) QCV2EFW8BK CHECK VALVE 2EFW-8B TRANSFERS CLOSED
 - 3) QMV201036K MOTOR-OPERATED VALVE 2CV-1036-2 TRANSFERS CLOSED
 - 4) QMV201075N MOTOR-OPERATED VALVE 2CV-1075-1 FAILS TO OPEN
 - 5) QMV201075K MOTOR-OPERATED VALVE 2CV-1075-1 TRANSFERS CLOSED
- 24) QMM2STMADM STEAM ADMISSION VALVE 2CV-0340-2 OR BYPASS VALVE 2SV-0205 FAIL
- 1) PMV2CV340N MOTOR-OPERATED VALVE 2CV-0340-2 FAILS TO OPEN
 - 2) PMV2CV340K MOTOR-OPERATED VALVE 2CV-0340-2 TRANSFERS CLOSED
 - 3) PSV2SV205N SOLENOID VALVE 2SV-0205 FAILS TO OPEN
 - 4) QCD2D26B1R DC BREAKER 2D26-B1 TRANSFERS OPEN
- 25) QMM2STSSGA STEAM GENERATOR A (2E24A) SUPPLY LINE BLOCKED
- 1) PCV2MS39AN CHECK VALVE 2MS-39A FAILS TO OPEN
 - 2) PCV2MS39AK CHECK VALVE 2MS-39A TRANSFERS CLOSED
 - 3) PMV201000K MOTOR-OPERATED VALVE 2CV-1000-1 TRANSFERS CLOSED
- 26) QMM2STSSGB STEAM GENERATOR B (2E24B) SUPPLY LINE BLOCKED
- 1) PCV2MS39BK CHECK VALVE 2MS-39B TRANSFERS CLOSED
 - 2) PCV2MS39BN CHECK VALVE 2MS-39B FAILS TO OPEN
 - 3) PMV201050K MOTOR-OPERATED VALVE 2CV-1050-2 TRANSFERS CLOSED
- 27) QMM2SWASUP LOSS OF SUPPLY FROM SW TO TRAIN A
- 1) QPS200795D PRESSURE SWITCH 2PIS-0795-2 FAILS TO RESPOND
 - 2) QXV2EF795K MANUAL VALVE 2EFW-0795A TRANSFERS CLOSED
 - 3) QMV200711N MOTOR-OPERATED VALVE 2CV-0711-2 FAILS TO OPEN
 - 4) QMV200711K MOTOR-OPERATED VALVE 2CV-0711-2 TRANSFERS CLOSED
 - 5) QCV2EFW2AN CHECK VALVE 2EFW-2A FAILS TO OPEN
 - 6) QCV2EFW2AK CHECK VALVE 2EFW-2A TRANSFERS CLOSED
 - 7) QMV200795C MOTOR-OPERATED VALVE 2CV-0795-2 FAILS TO CLOSE
 - 8) QCD2D26B2R DC BREAKER 2D26-B2 TRANSFERS OPEN
 - 9) QCD2D26B3R DC BREAKER 2D26-B3 TRANSFERS OPEN
 - 10) SXV2SW39BK MANUAL VALVE 2SW-39B TRANSFERS CLOSED
- 28) QMM2SWBSUP LOSS OF SUPPLY FROM SW TO TRAIN B DUE TO BREAKERS AND VALVES
- 1) QPS200789D PRESSURE SWITCH 2PIS-0789-1 FAILS TO RESPOND
 - 2) QXV2EF789K MANUAL VALVE 2EFW-0789A TRANSFERS CLOSED
 - 3) QMV200716N MOTOR-OPERATED VALVE 2CV-0716-1 FAILS TO OPEN
 - 4) QMV200716K MOTOR-OPERATED VALVE 2CV-0716-1 TRANSFERS CLOSED
 - 5) QCV2EFW2BN CHECK VALVE 2EFW-2B FAILS TO OPEN
 - 6) QCV2EFW2BK CHECK VALVE 2EFW-2B TRANSFERS CLOSED
 - 7) QMV200789C MOTOR-OPERATED VALVE 2CV-0789-1 FAILS TO CLOSE
 - 8) QCB2B53D1R AC BREAKER 2B53D1 TRANSFERS OPEN
 - 9) QCB2B53D2R AC BREAKER 2B53D2 TRANSFERS OPEN
 - 10) SXV2SW39AK MANUAL VALVE 2SW-39A TRANSFERS CLOSED
- 29) QMM2TRANAA EFW PUMP TRAIN A FAILS TO DELIVER FLOW (TYPE 1 FAULTS)

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- 1) QCV2EFW4AN CHECK VALVE 2EFW-4A FAILS TO OPEN
 - 2) QTP202P7AA TURBINE-DRIVEN PUMP 2P7A FAILS TO START
- 30) QMM2TRANAF EFW PUMP TRAIN A FAILS TO DELIVER FLOW (TYPE 2 FAULTS)
- 1) QCV2EFW4AK CHECK VALVE 2EFW-4A TRANSFERS CLOSED
 - 2) QTP202P7AF TURBINE-DRIVEN PUMP 2P7A FAILS TO RUN
 - 3) QXV2EFW3AK MANUAL VALVE 2EFW-3A TRANSFERS CLOSED
 - 4) QXV2EF10AK MANUAL VALVE 2EFW-10A TRANSFERS CLOSED
- 31) QMM2TRANBA EFW PUMP TRAIN B FAILS TO DELIVER FLOW (TYPE 1 FAULTS)
- 1) QCV2EFW4BN CHECK VALVE 2EFW-4B FAILS TO OPEN
 - 2) QMP202P7BA MOTOR-DRIVEN PUMP 2P7B FAILS TO START
 - 3) QCB20A311R AC BREAKER 2A311 TRANSFERS OPEN
- 32) QMM2TRANBF EFW PUMP TRAIN B FAILS TO DELIVER FLOW (TYPE 2 FAULTS)
- 1) QCV2EFW4BK CHECK VALVE 2EFW-4B TRANSFERS CLOSED
 - 2) QMP202P7BF MOTOR-DRIVEN PUMP 2P7B FAILS TO RUN
 - 3) QXV2EFW3BK MANUAL VALVE 2EFW-3B TRANSFERS CLOSED
 - 4) QXV2EFW06K MANUAL VALVE 2EFW-6 TRANSFERS CLOSED
 - 5) QXV2EF10BK MANUAL VALVE 2EFW-10B TRANSFERS CLOSED

Calculation No 89-E-0048-07
Revision 1
Date: 12/17/93

Prepared by: M. M. Freeman _____
Checked by: _____
Reviewed by: _____

Page C-5 of 5

ATTACHMENT D
FAULT TREE MUTUALLY EXCLUSIVE EVENTS

The following events are mutually exclusive:

- 1) QTM2EFWTAF * QTM2EFWTBF

Calculation No 89-E-0048-07
Revision 1
Date: 7/16/94

Prepared by:
Checked by:
Reviewed by:

M. M. Freeman 

Page D-1 of 1

ATTACHMENT E
MINIMAL CUT SETS LISTS

This attachment has been deleted.

Plant level cutsets were generated rather than sytem-level cutsets. The plant-level cutsets are documented outside of this calculation.

Calculation No 89-E-0048-07
Revision 1
Date: 7/16/94

Prepared by:
Checked by:
Reviewed by:

M. M. Freeman 

Page E-1 of 1

ATTACHMENT F
SIMPLIFIED P&ID

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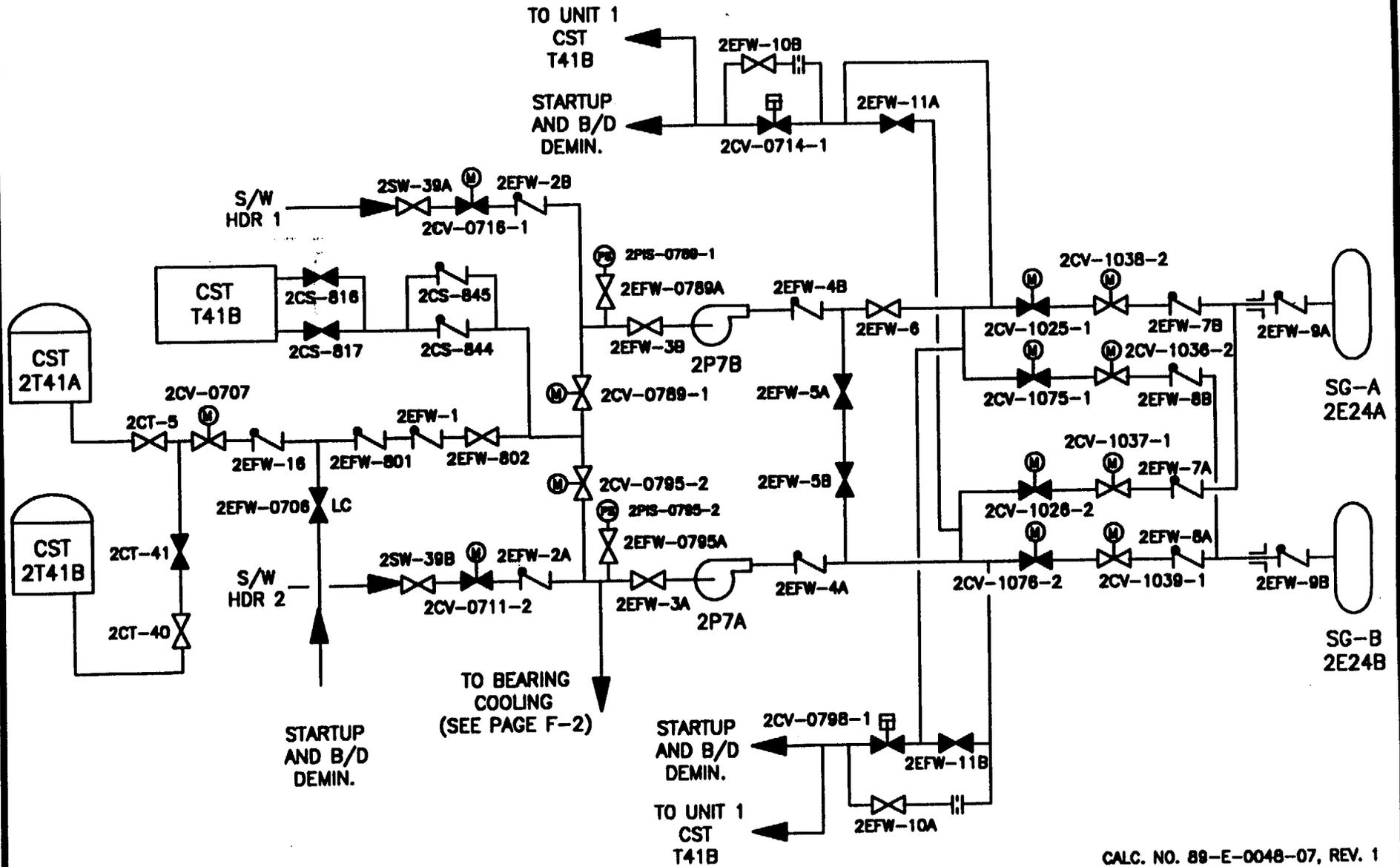
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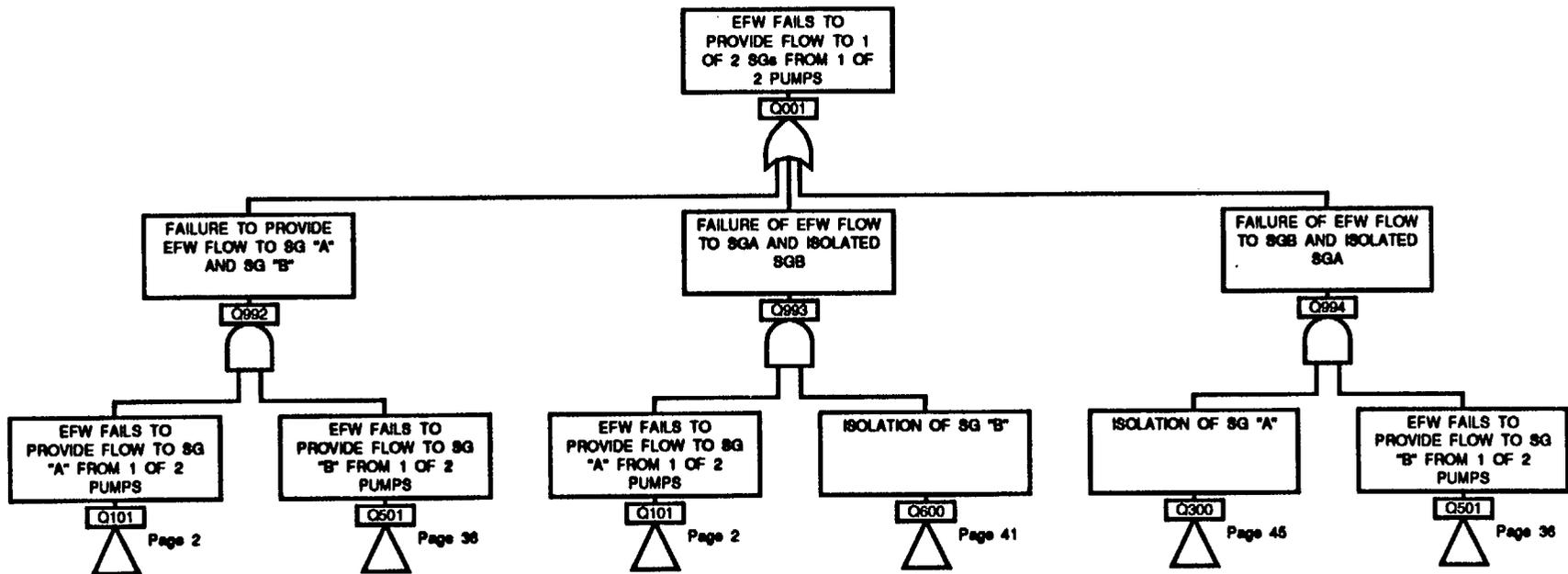
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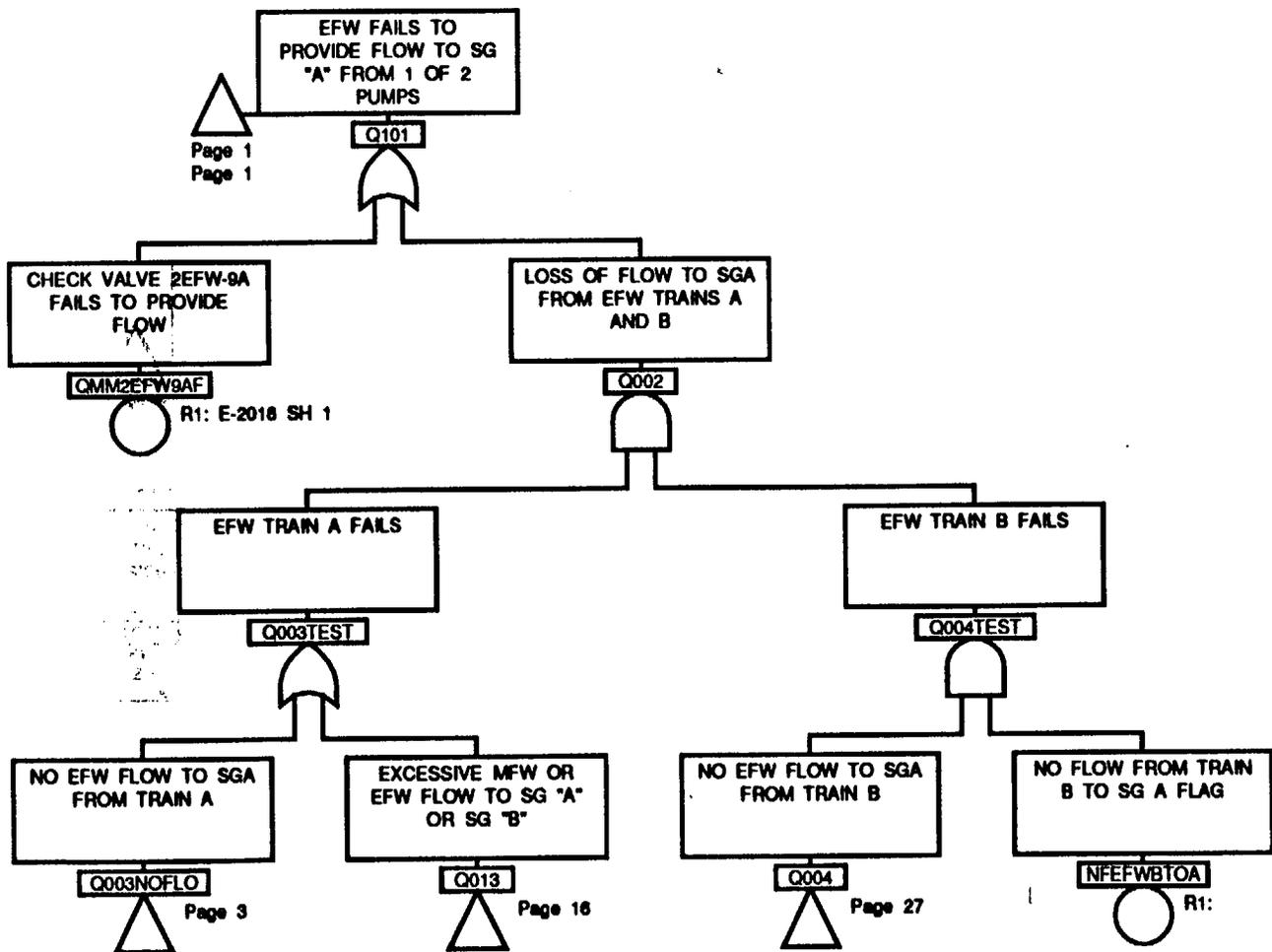
Calculation No 89-E-0048-07	Prepared by:	M. M. Freeman 	Page F-1 of 3
Revision 1	Checked by:		
Date: 7/16/94	Reviewed by:		

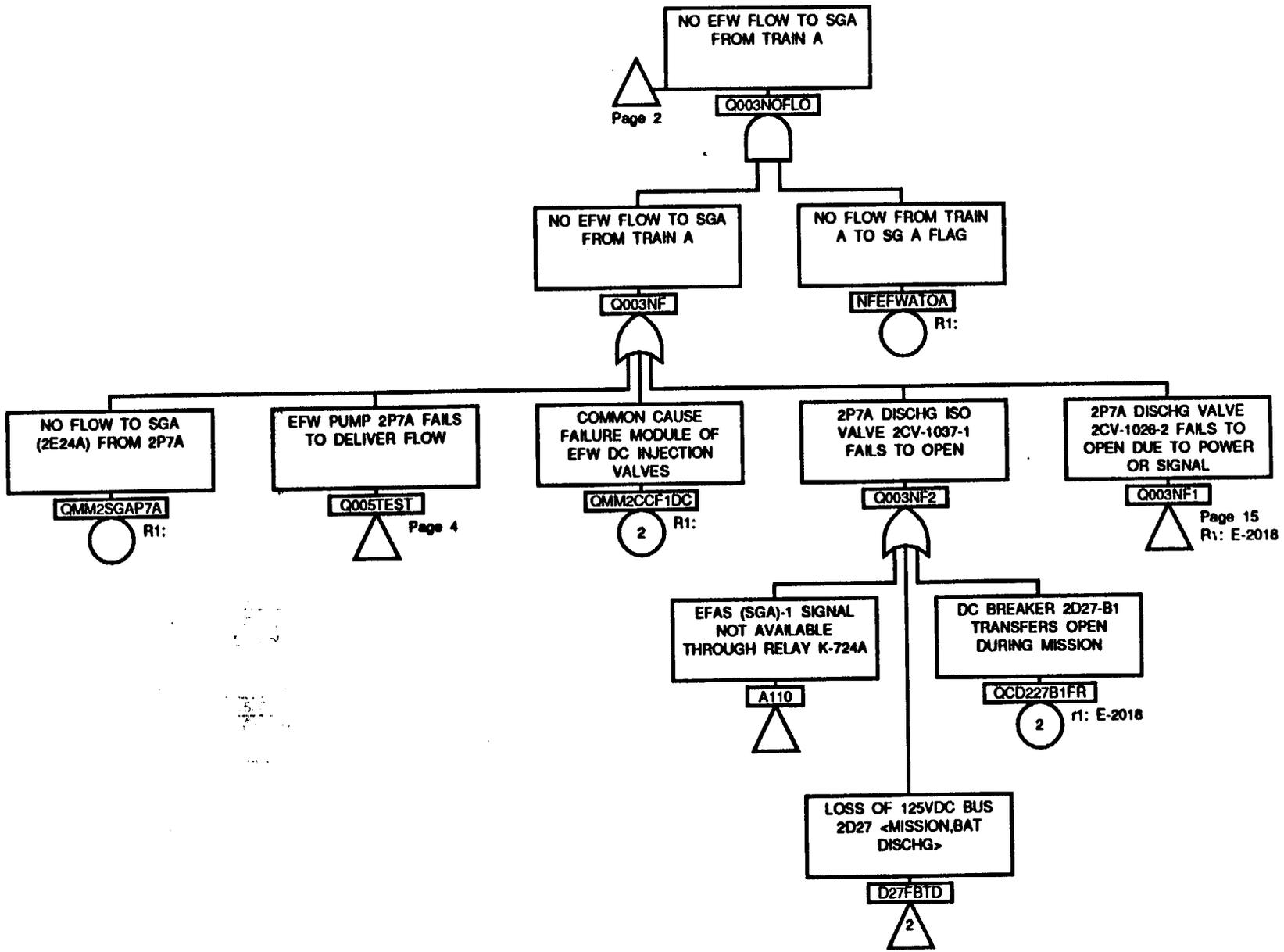
FIGURE F-1 ANO-2 EMERGENCY FEEDWATER SYSTEM

F-2







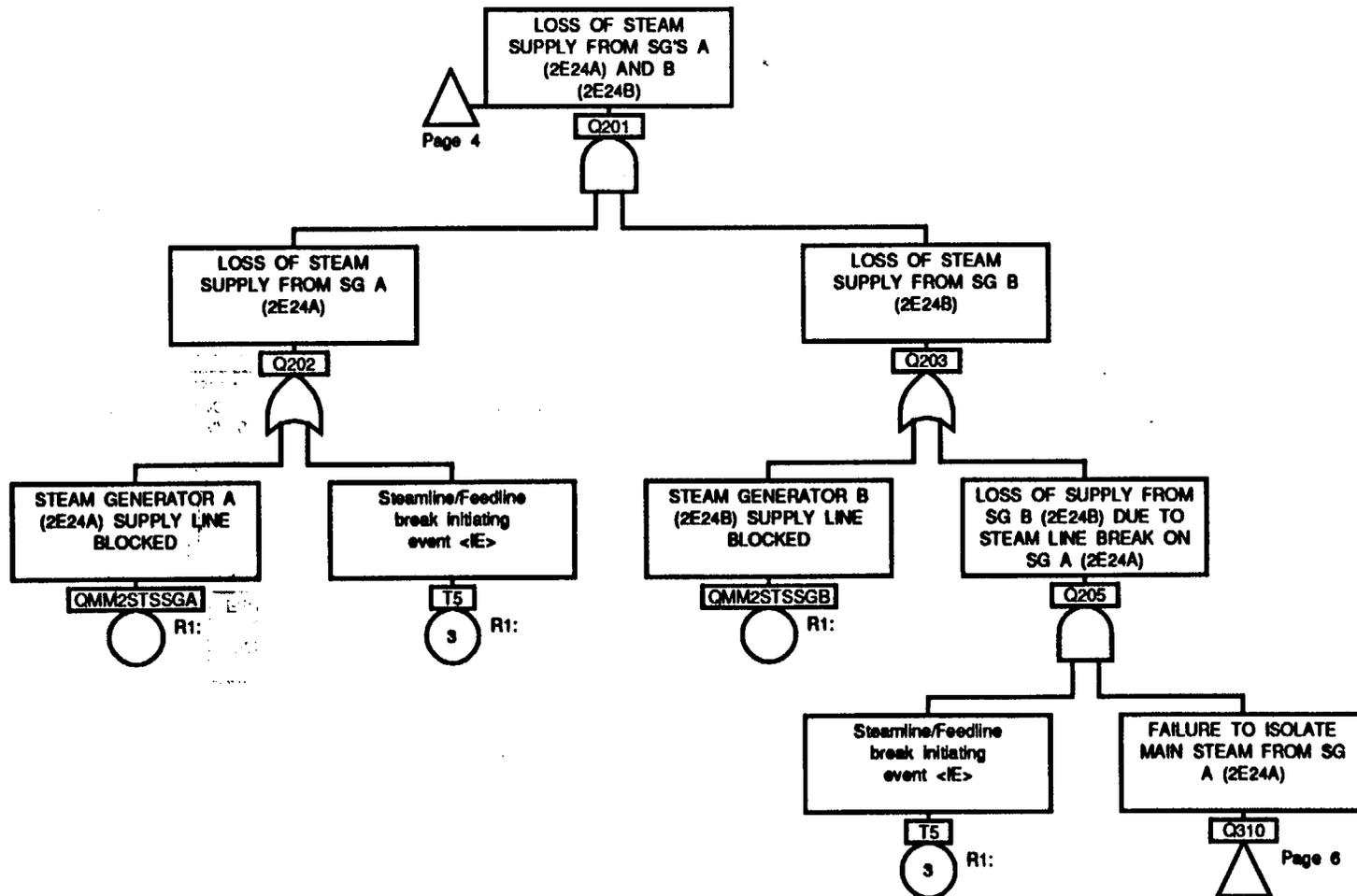


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R1: E-2018

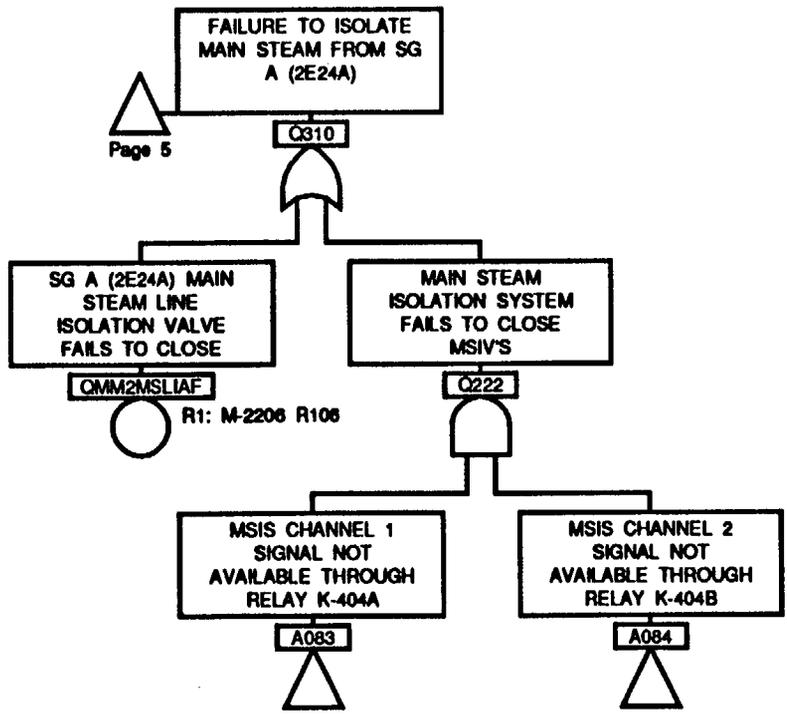
r1: E-2018

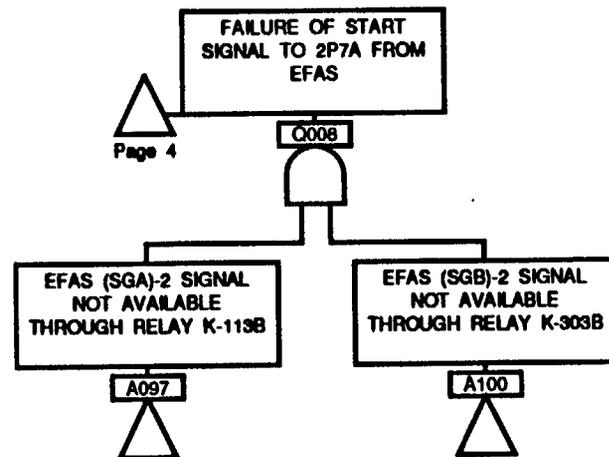
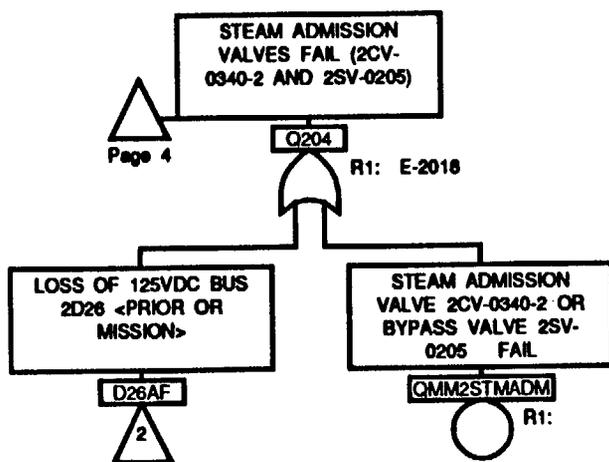


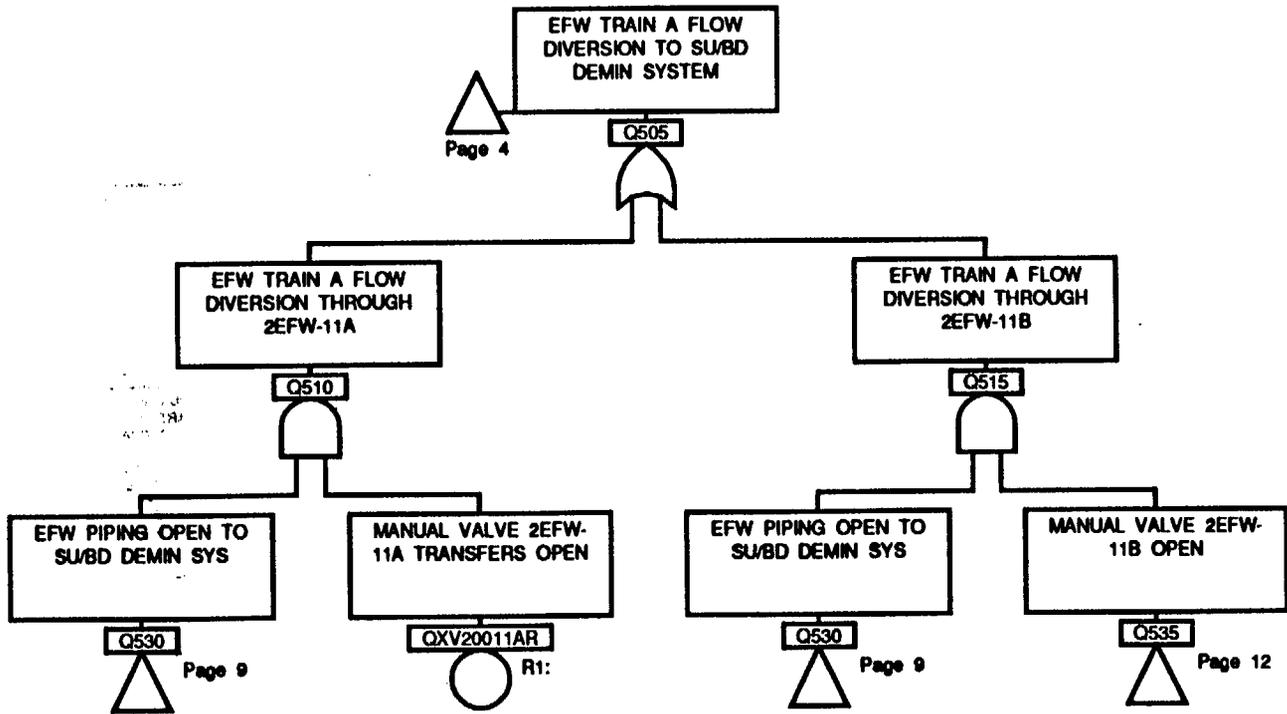
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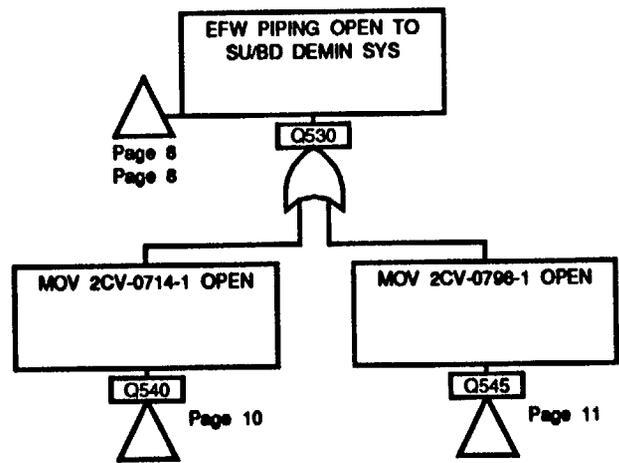
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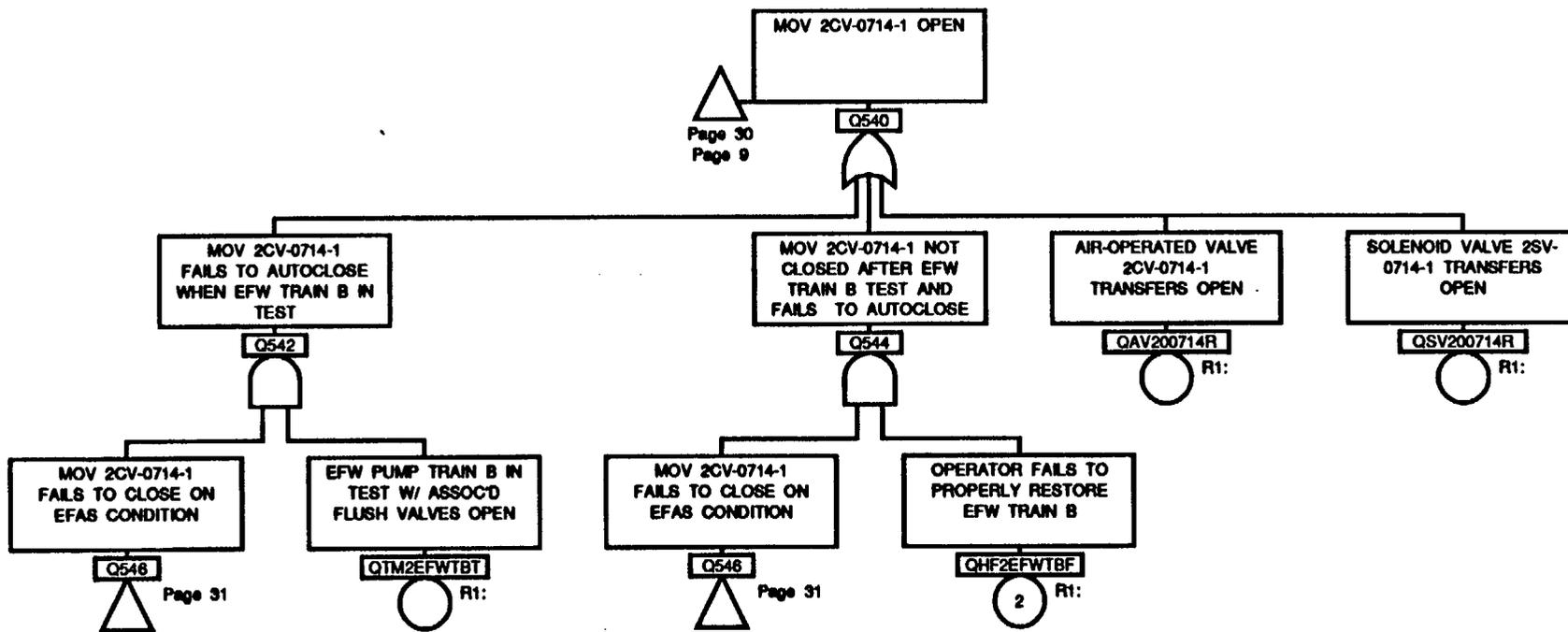
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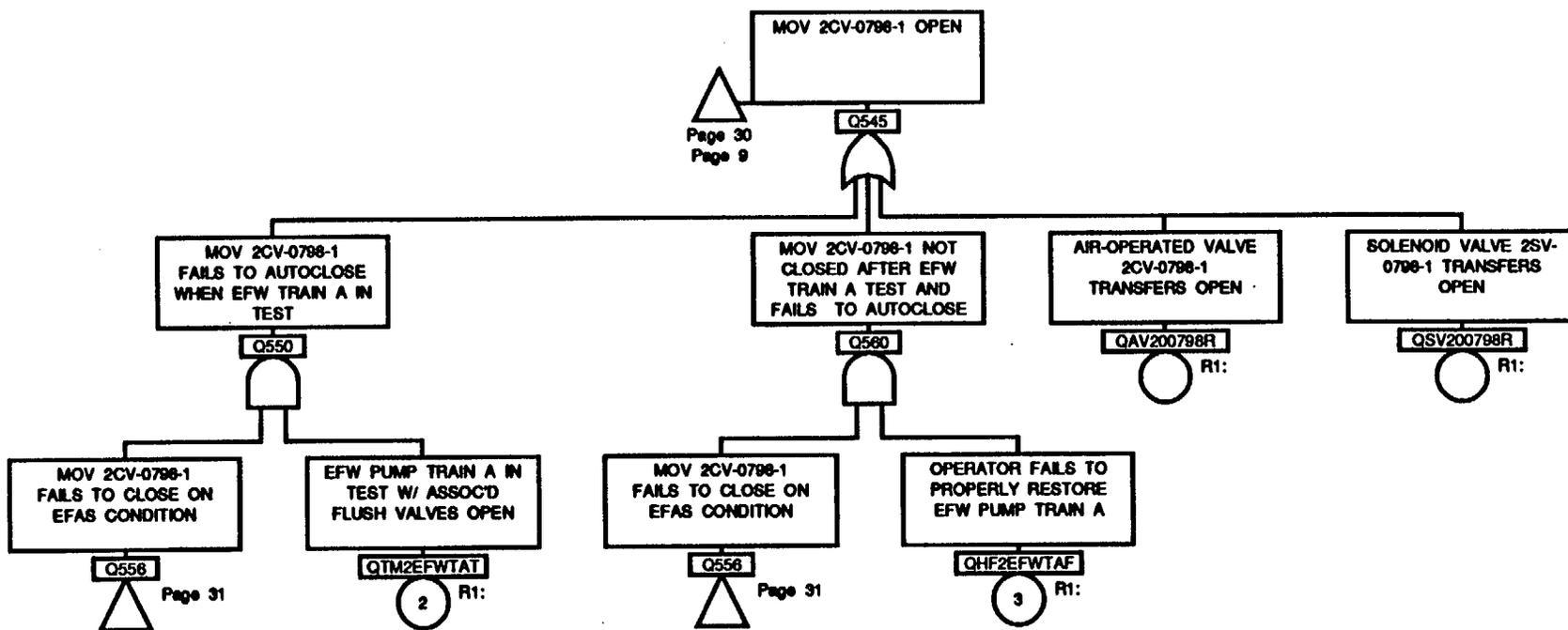




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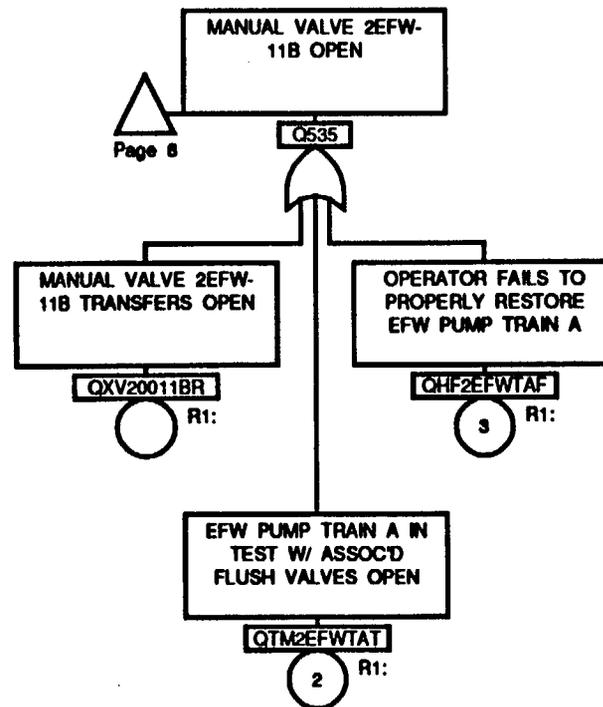
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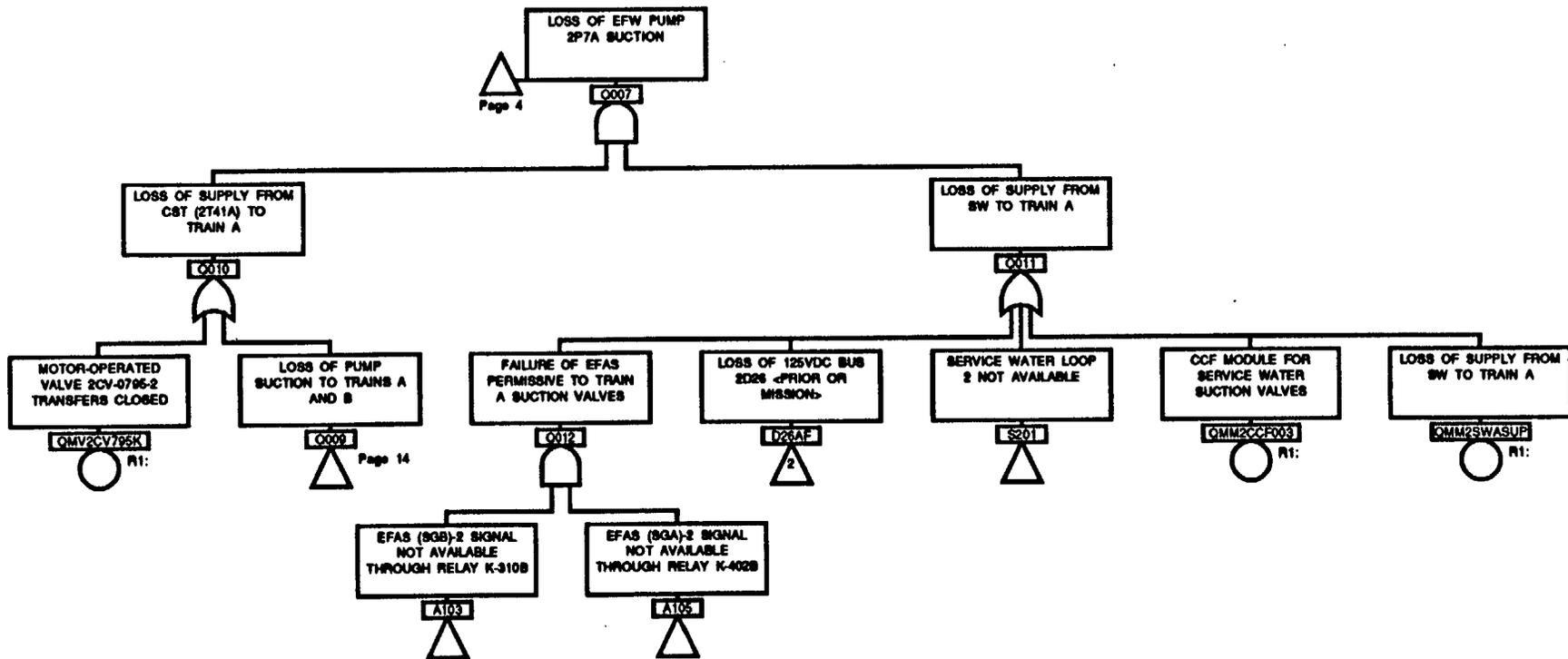
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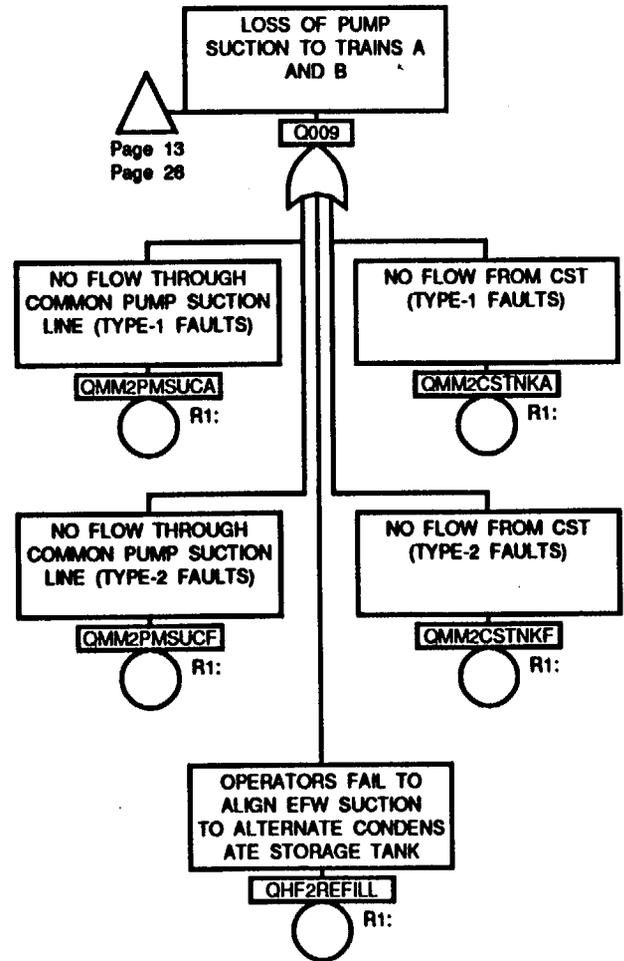
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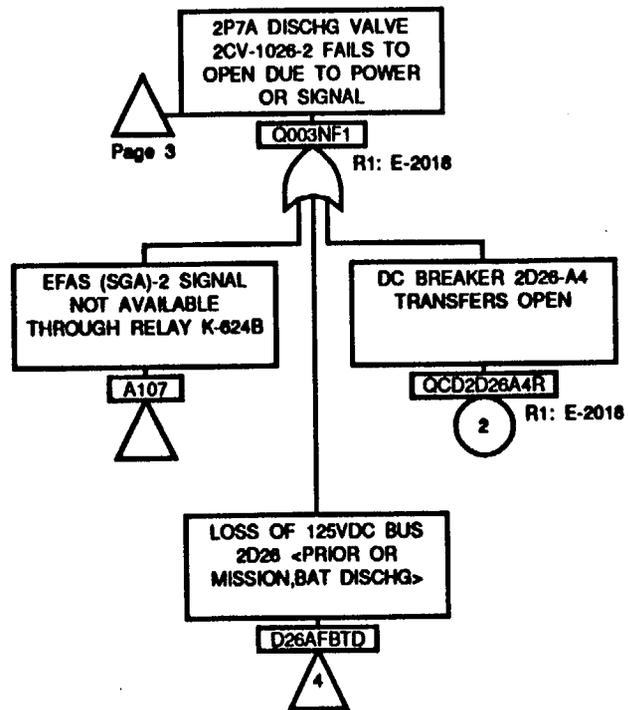


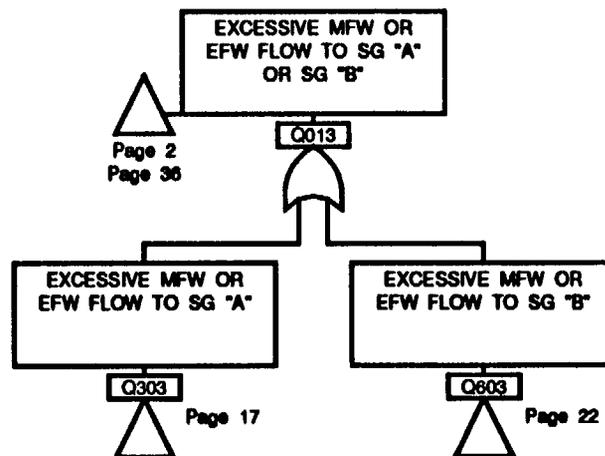
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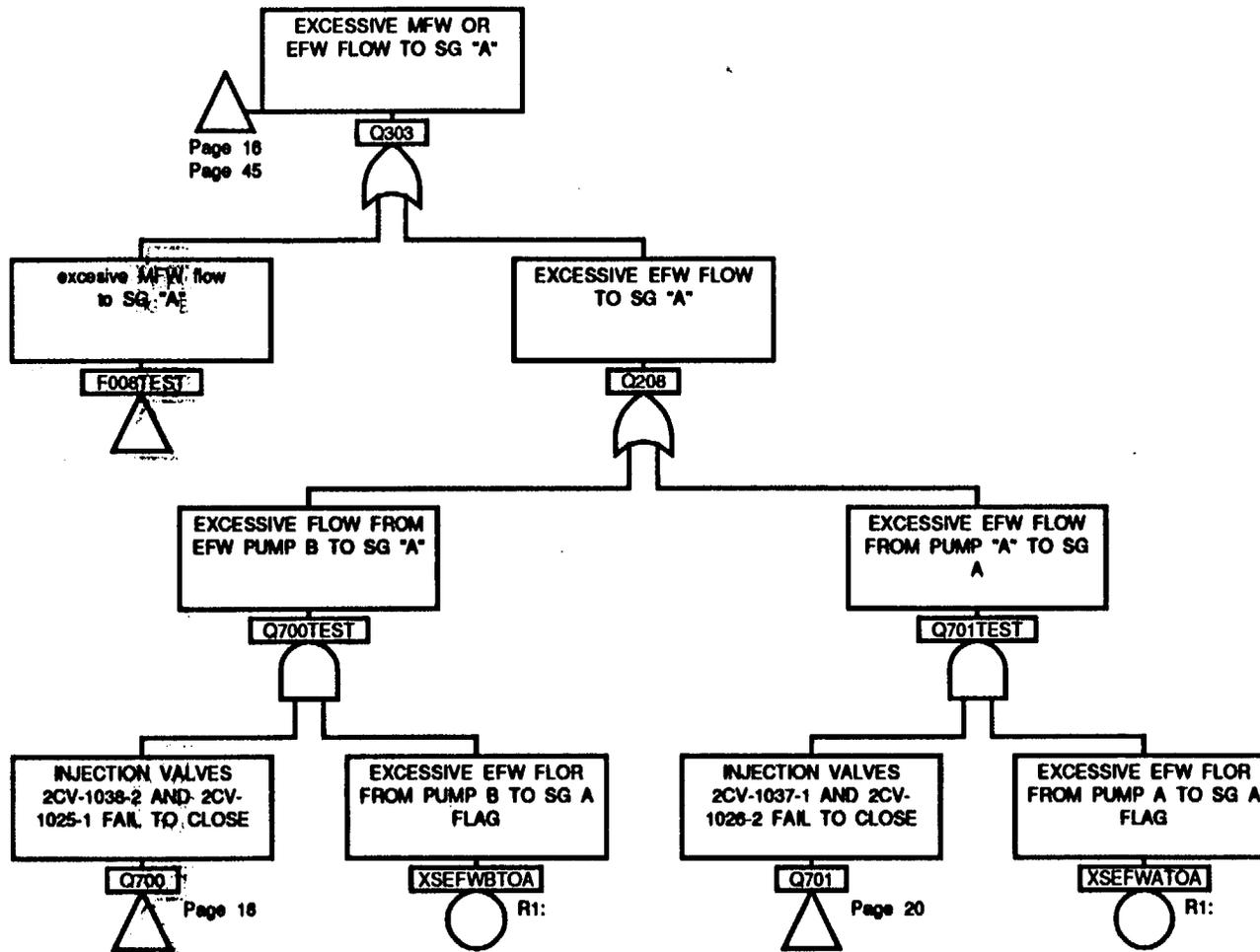


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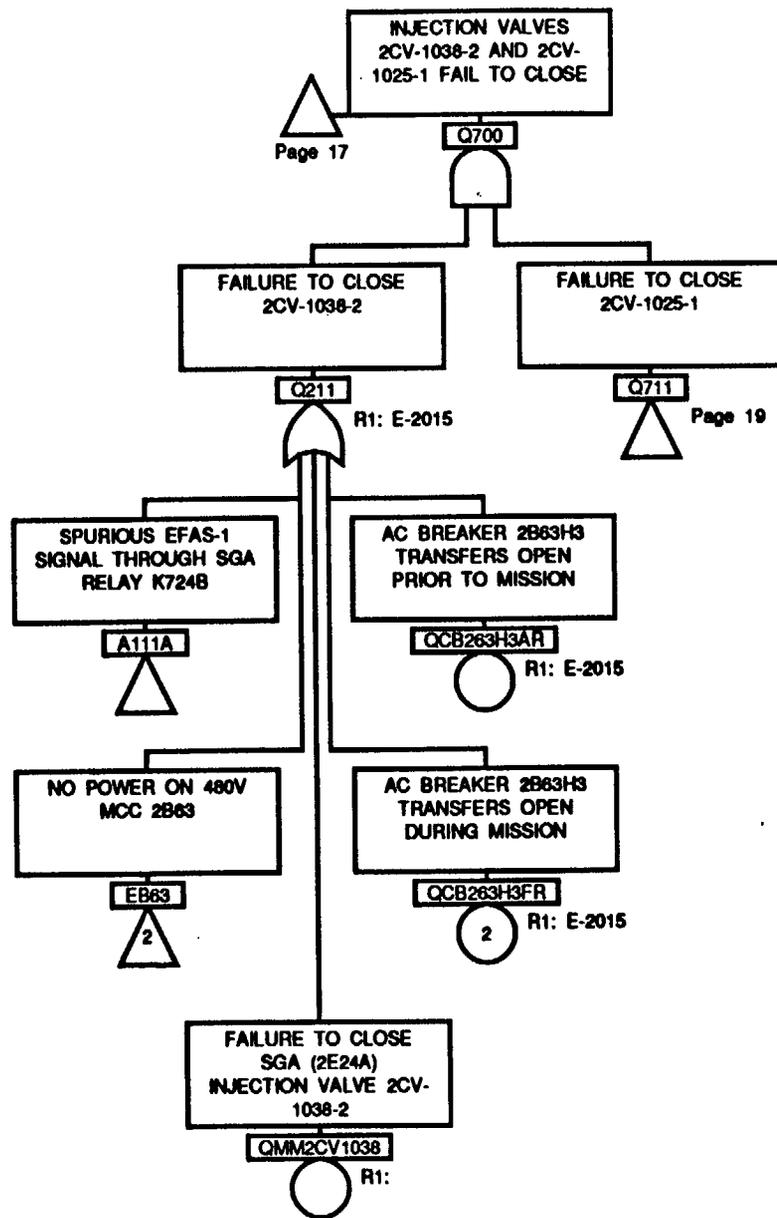


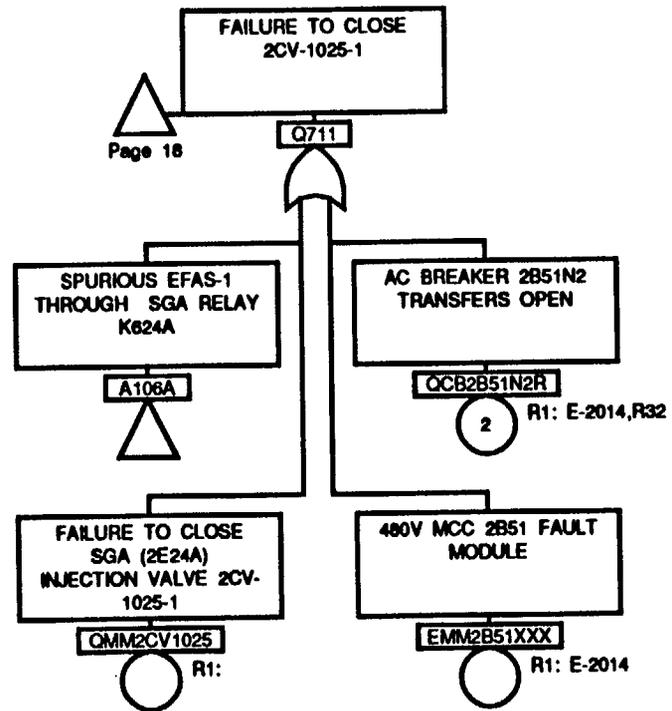


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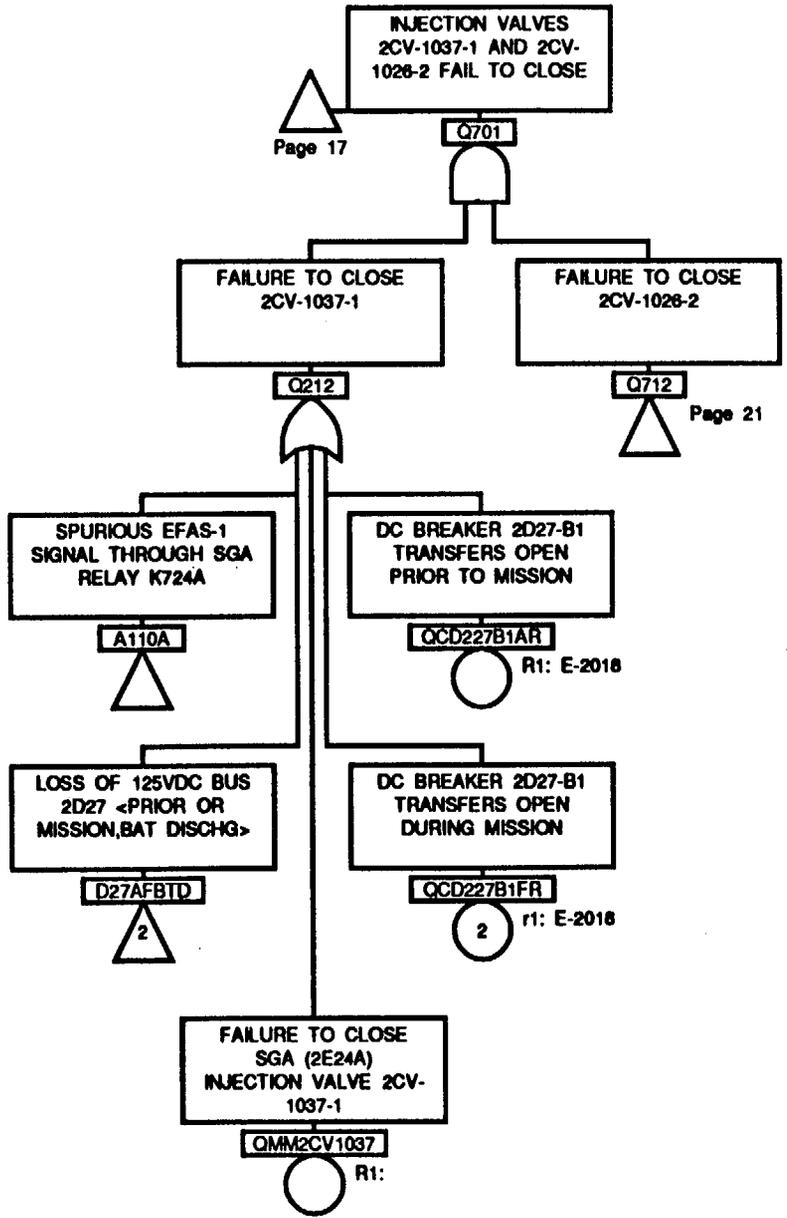
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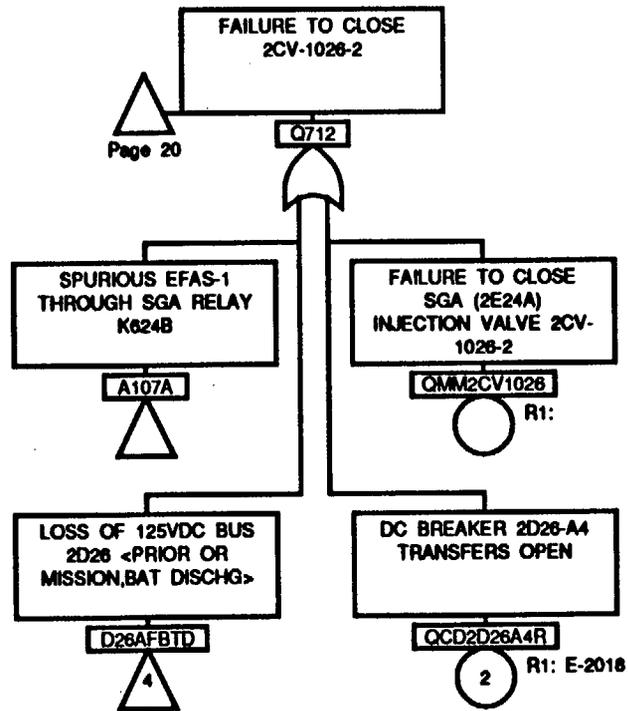


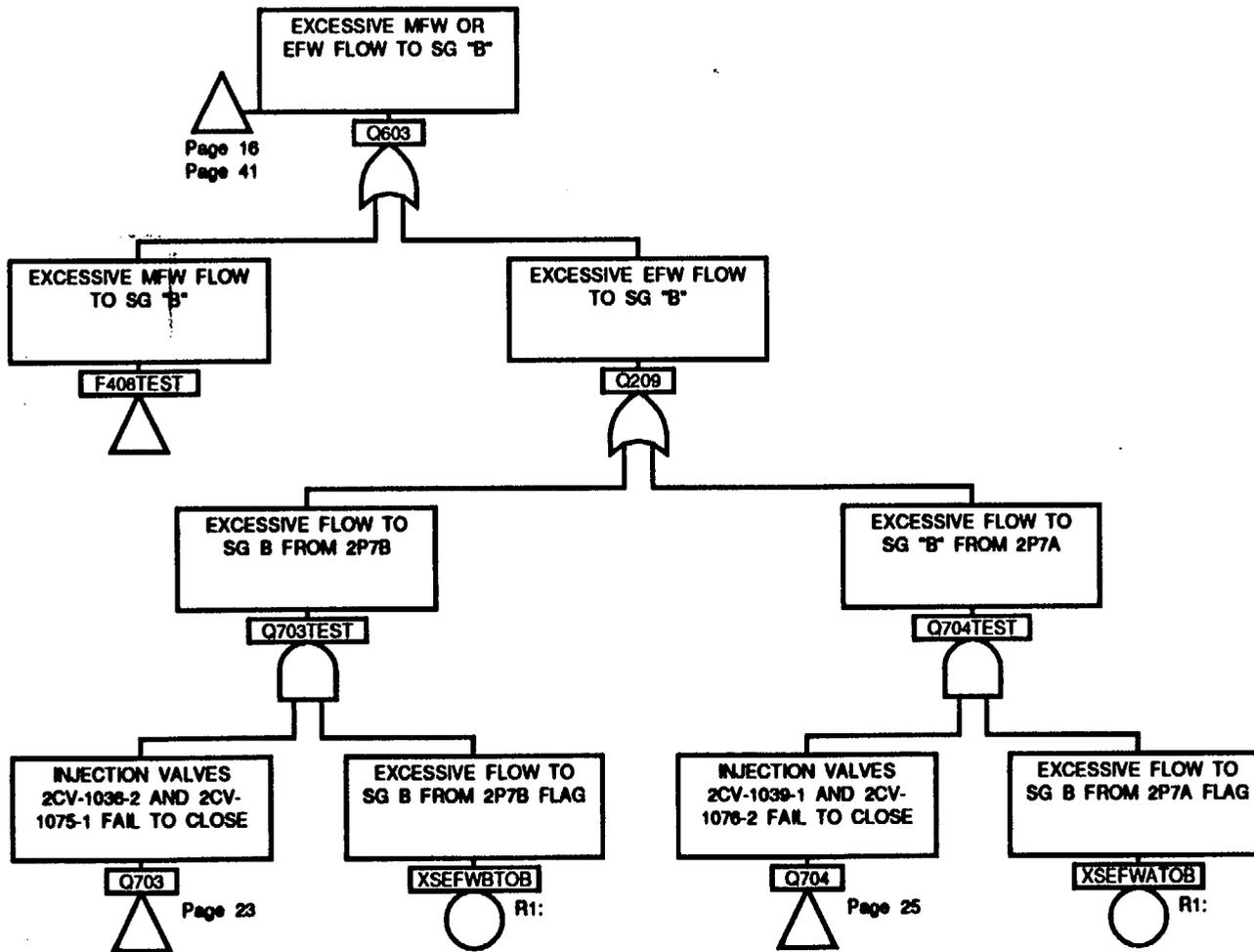
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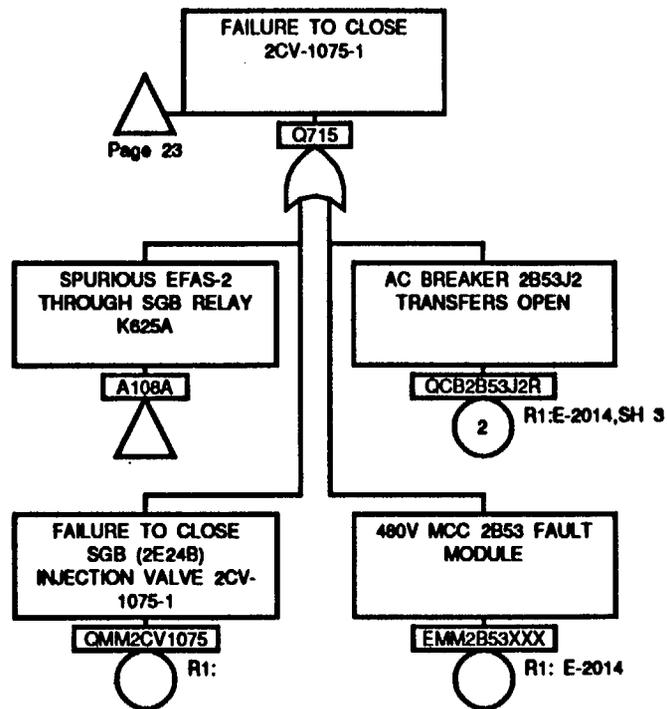


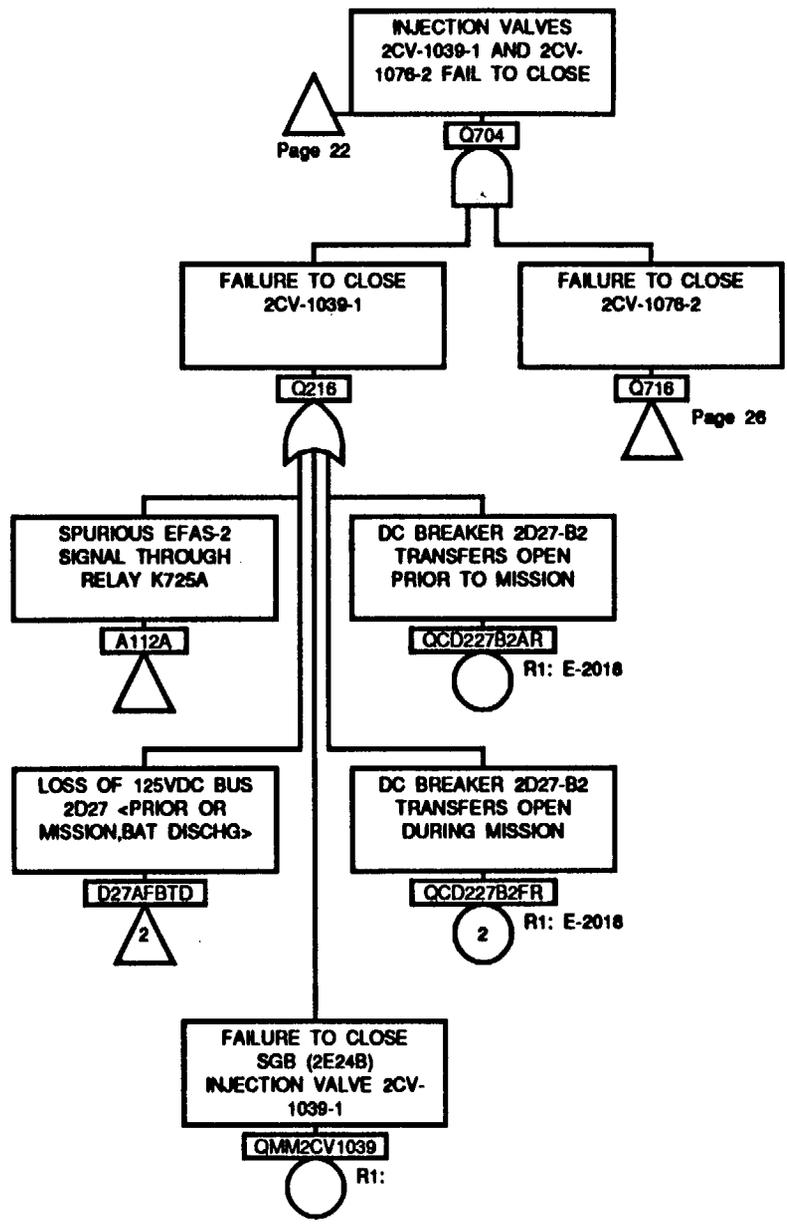
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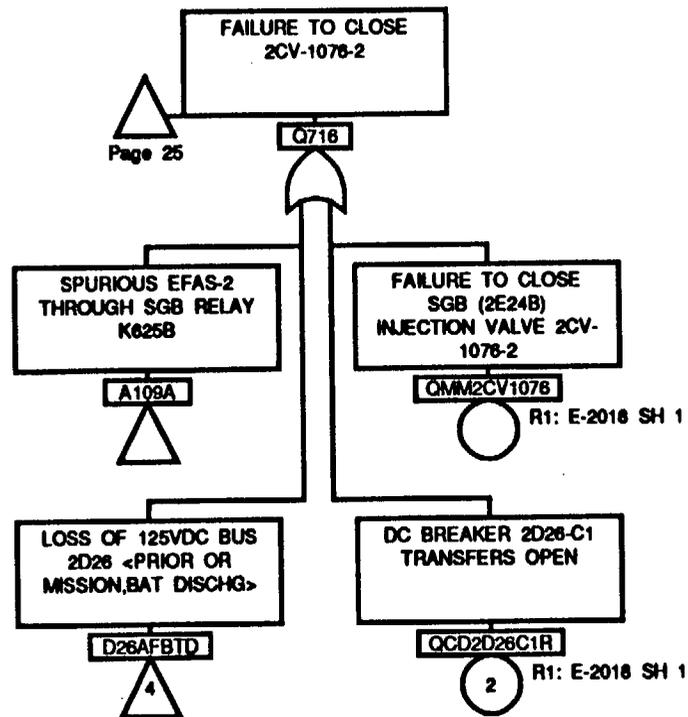


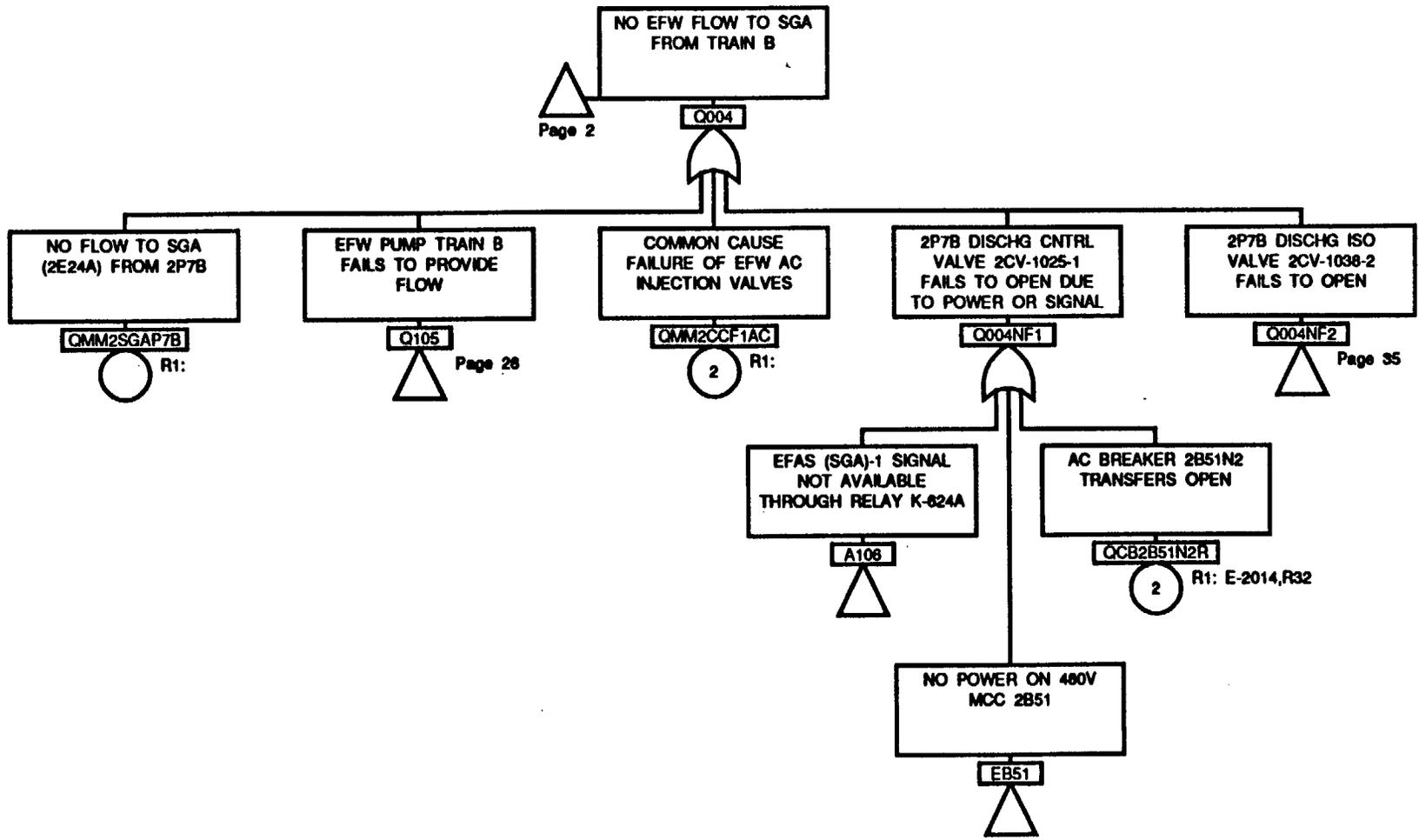


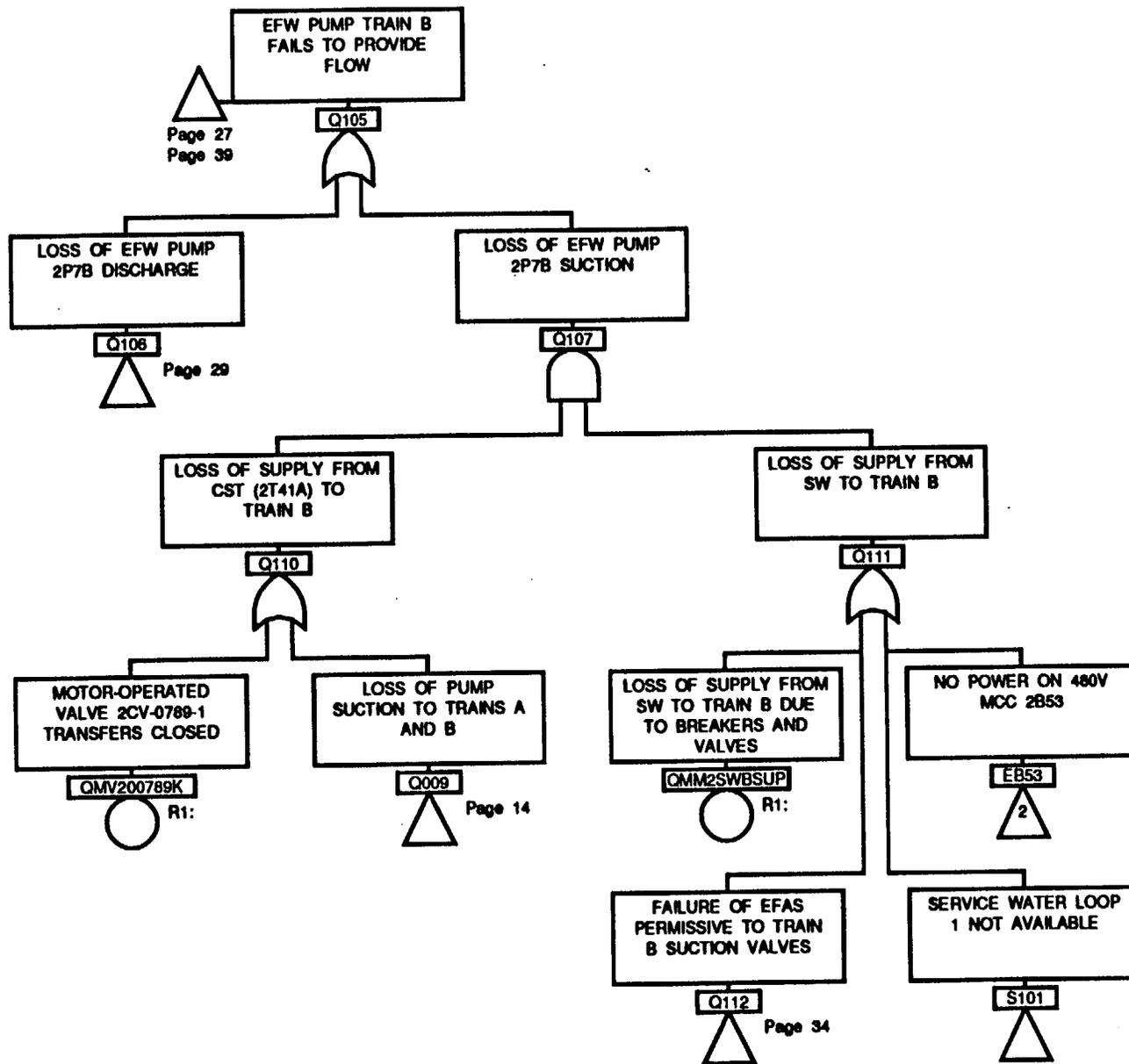


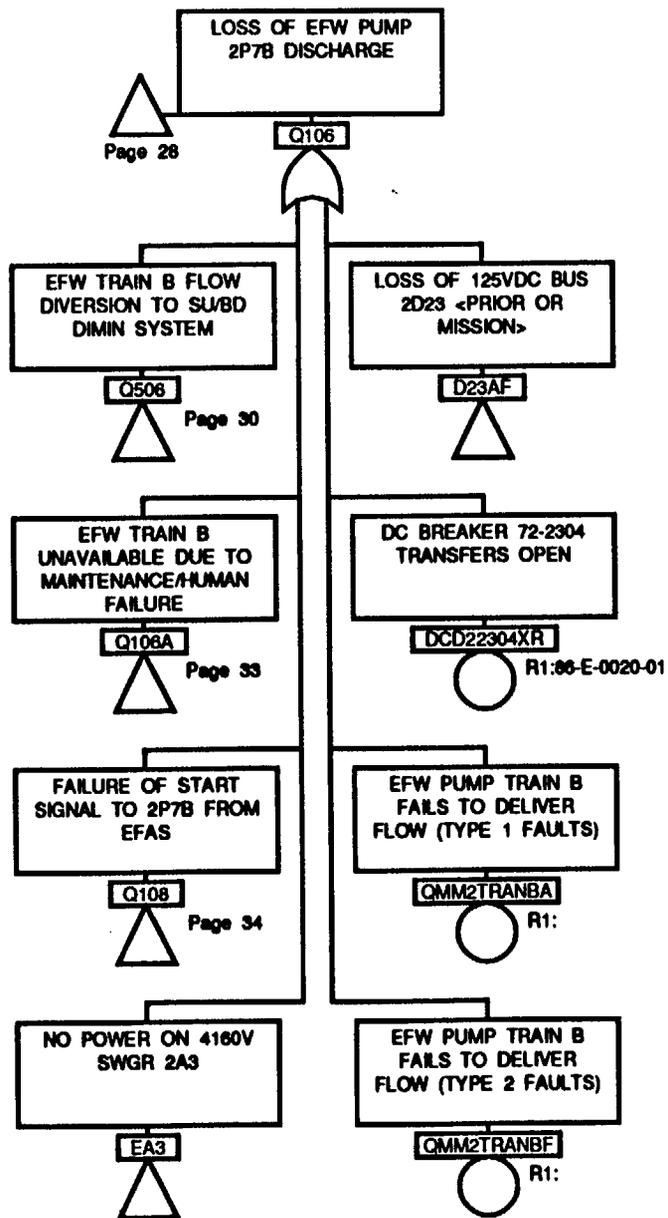
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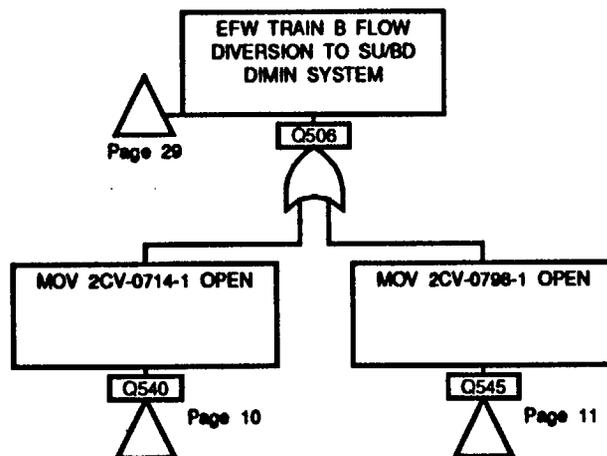
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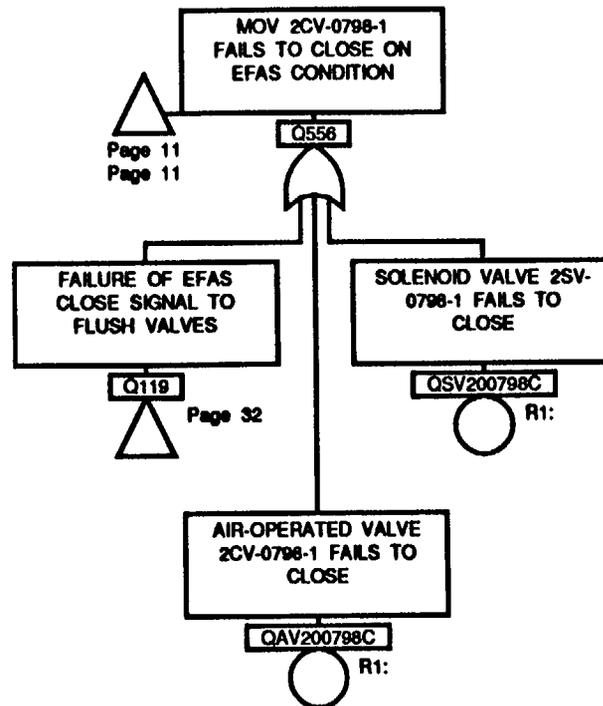
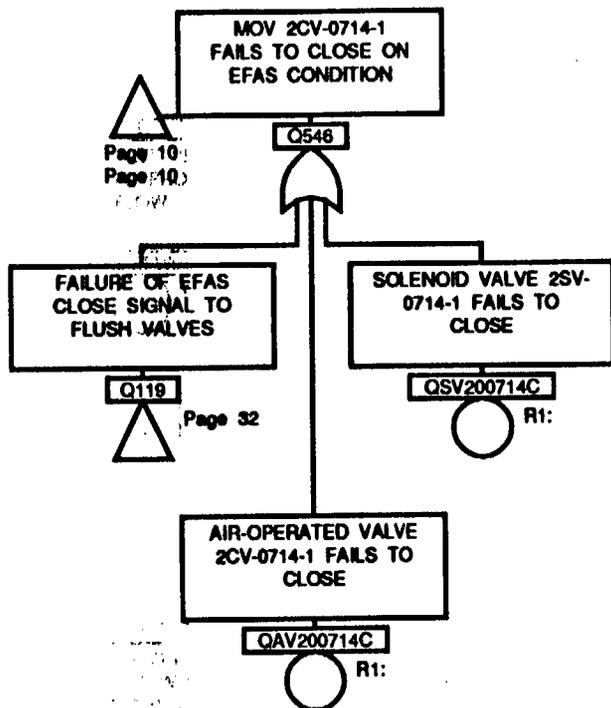


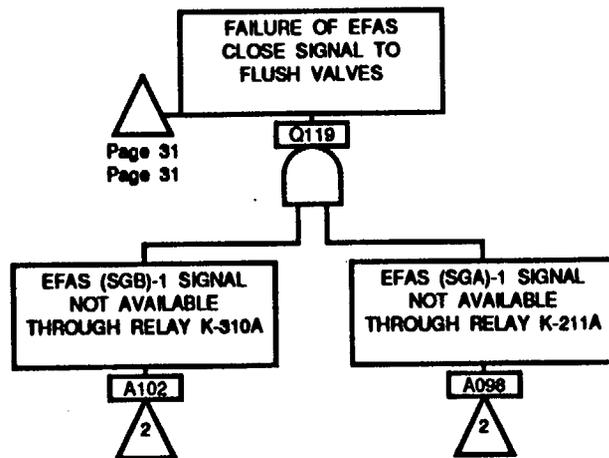


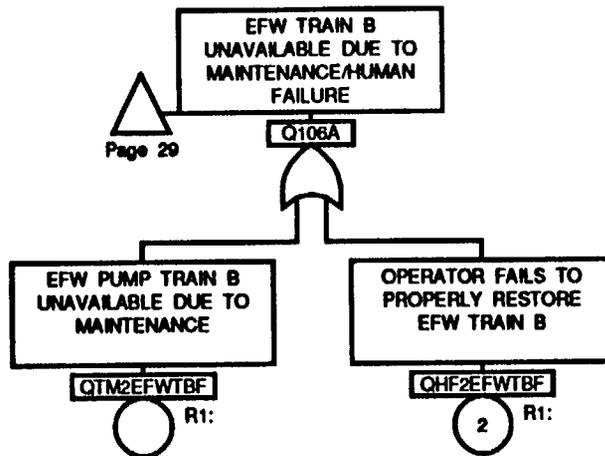




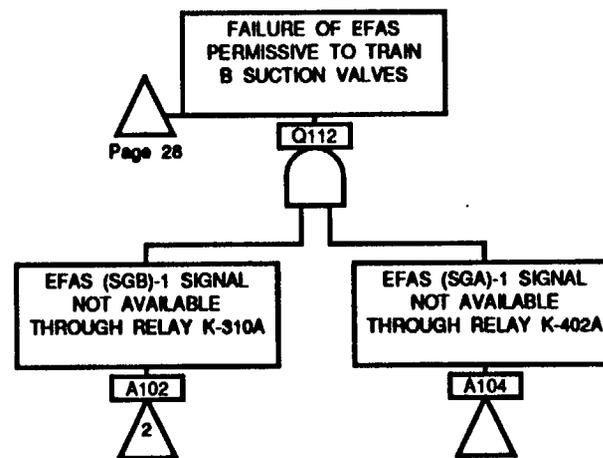
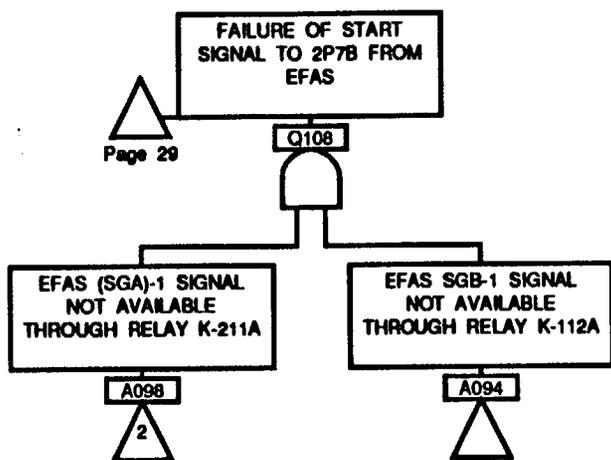


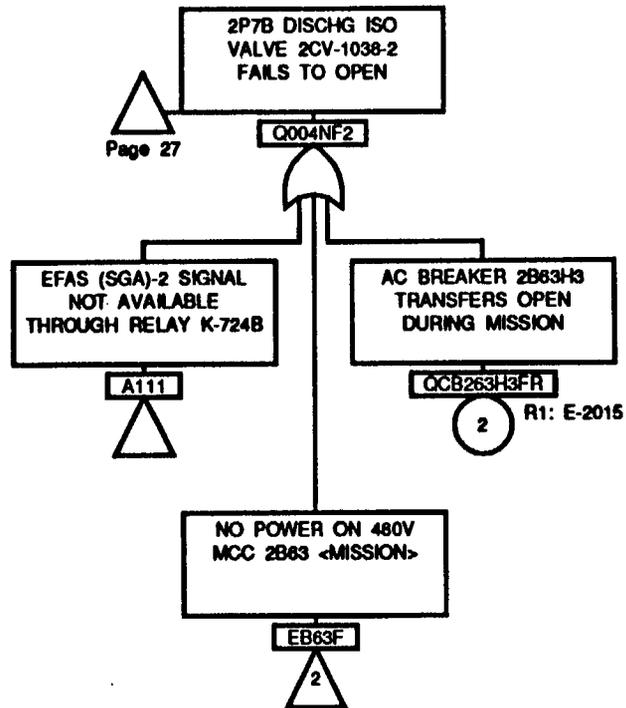






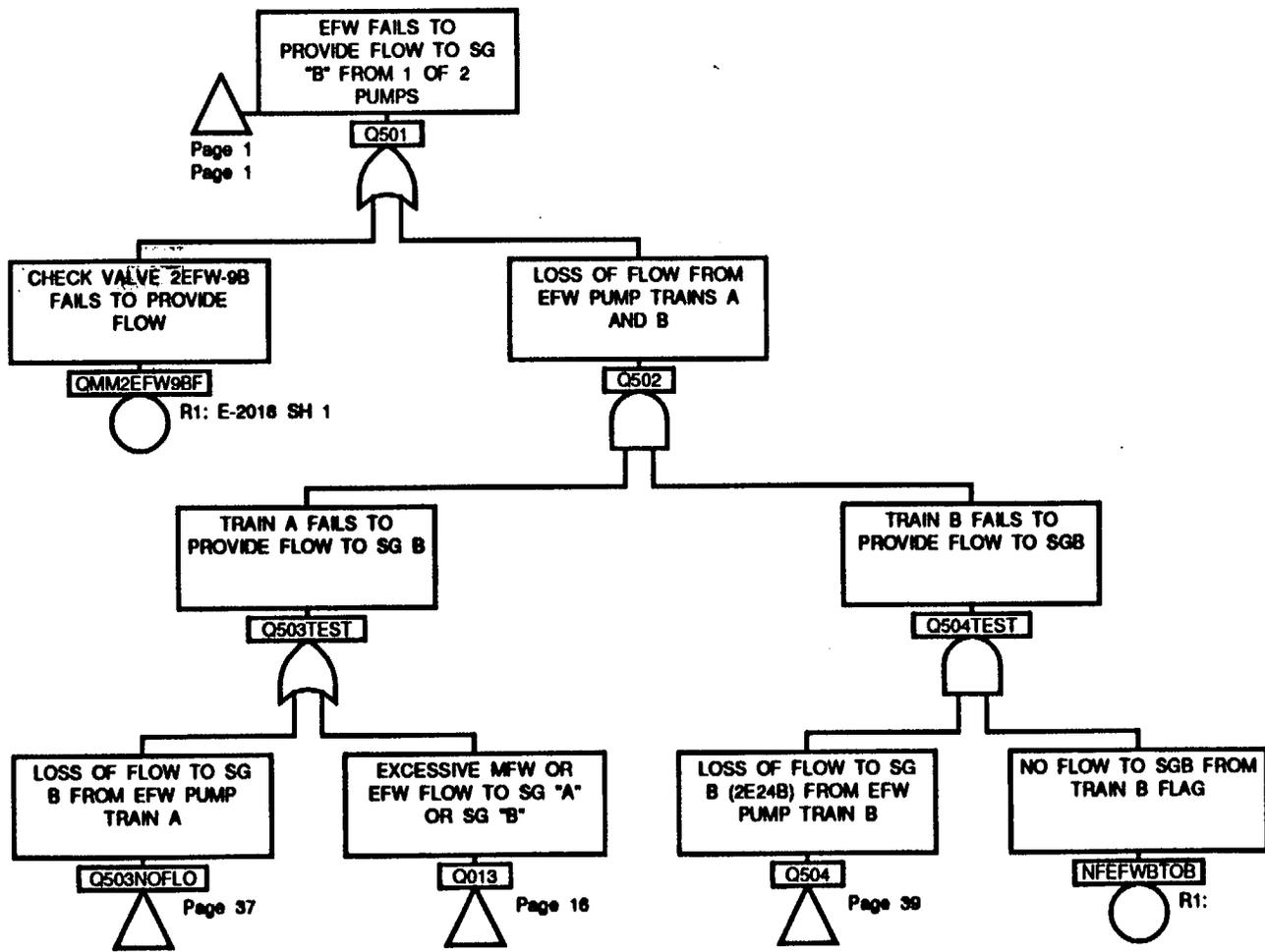
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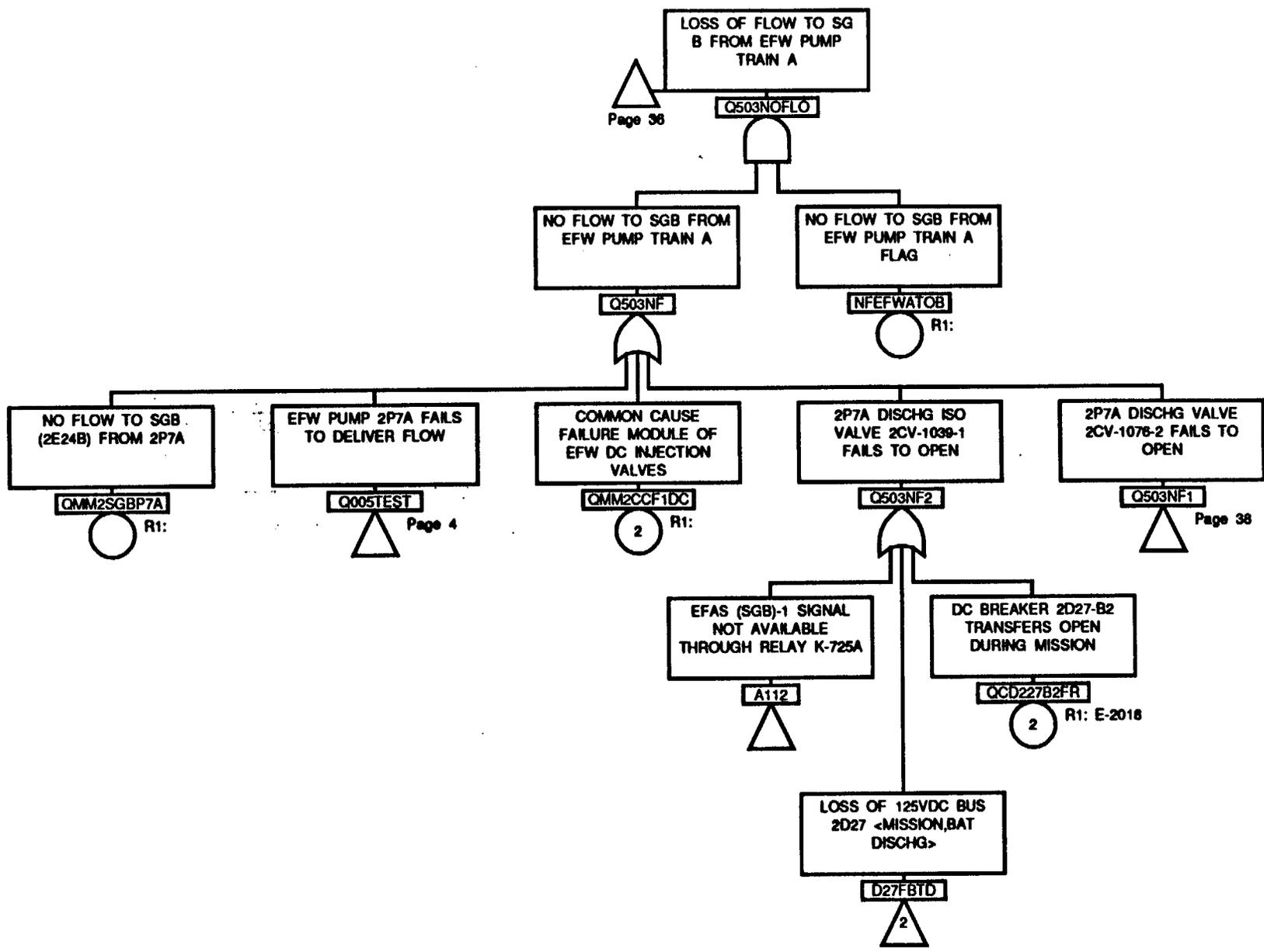


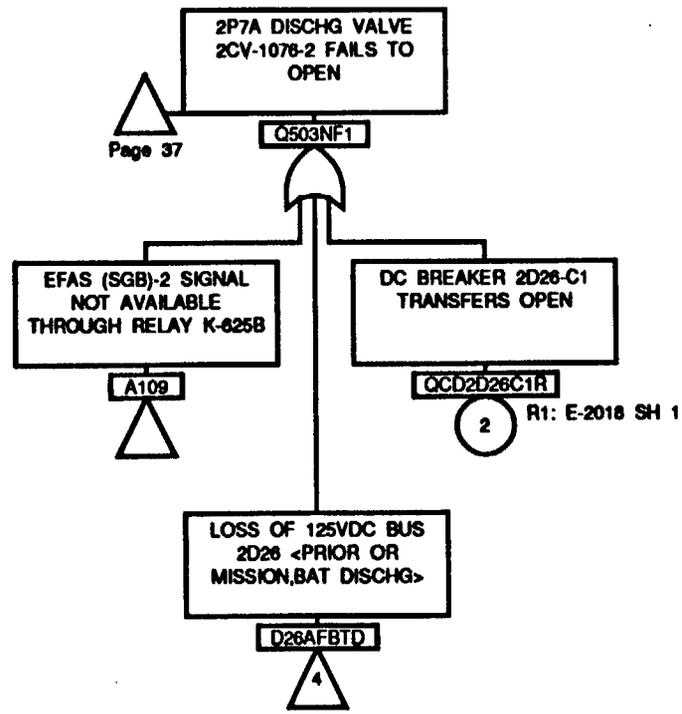


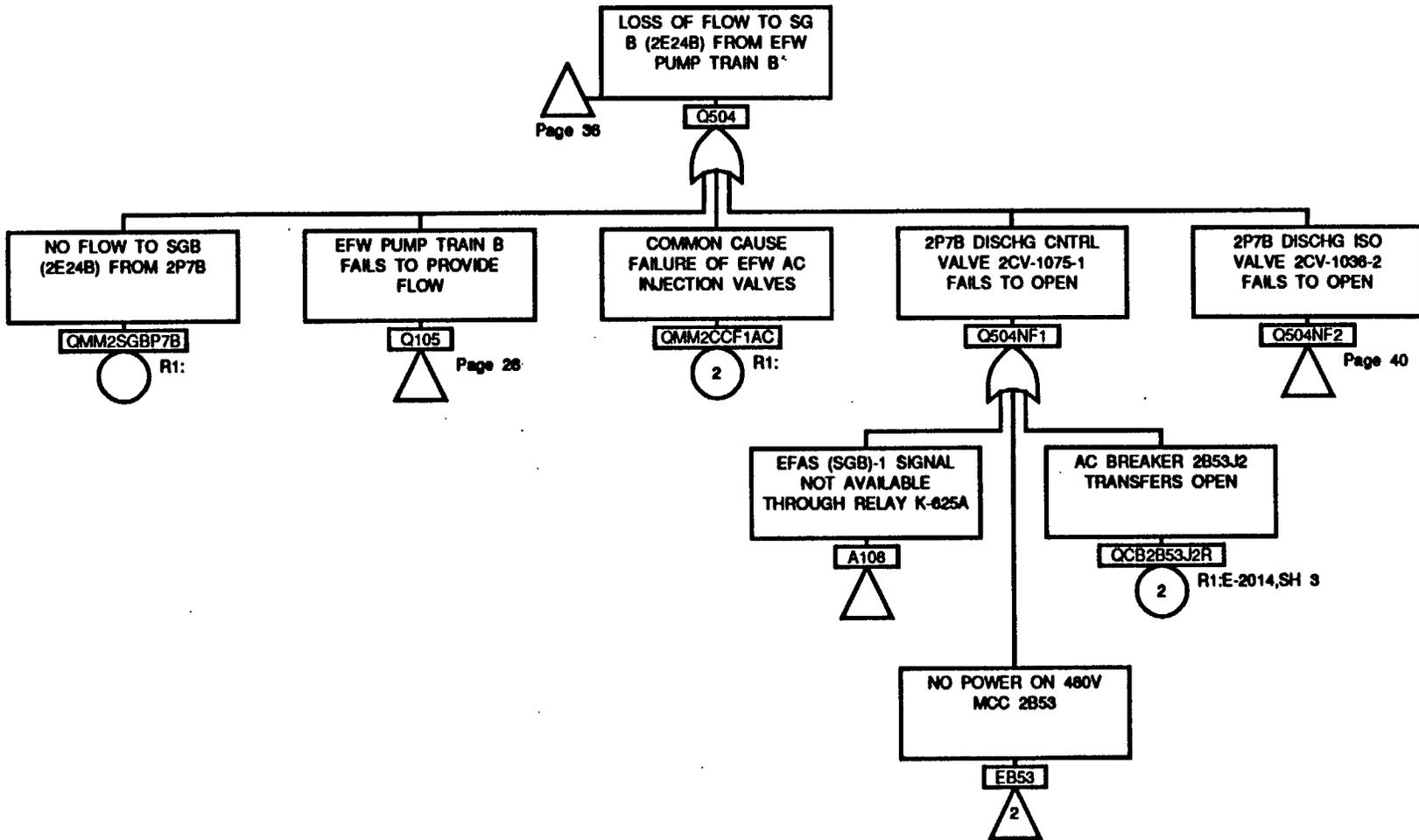
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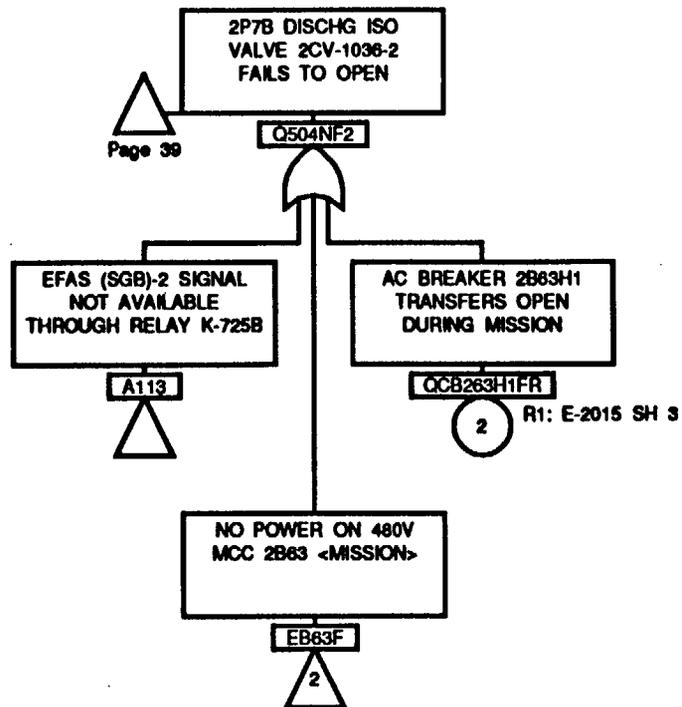
R1: E-2015



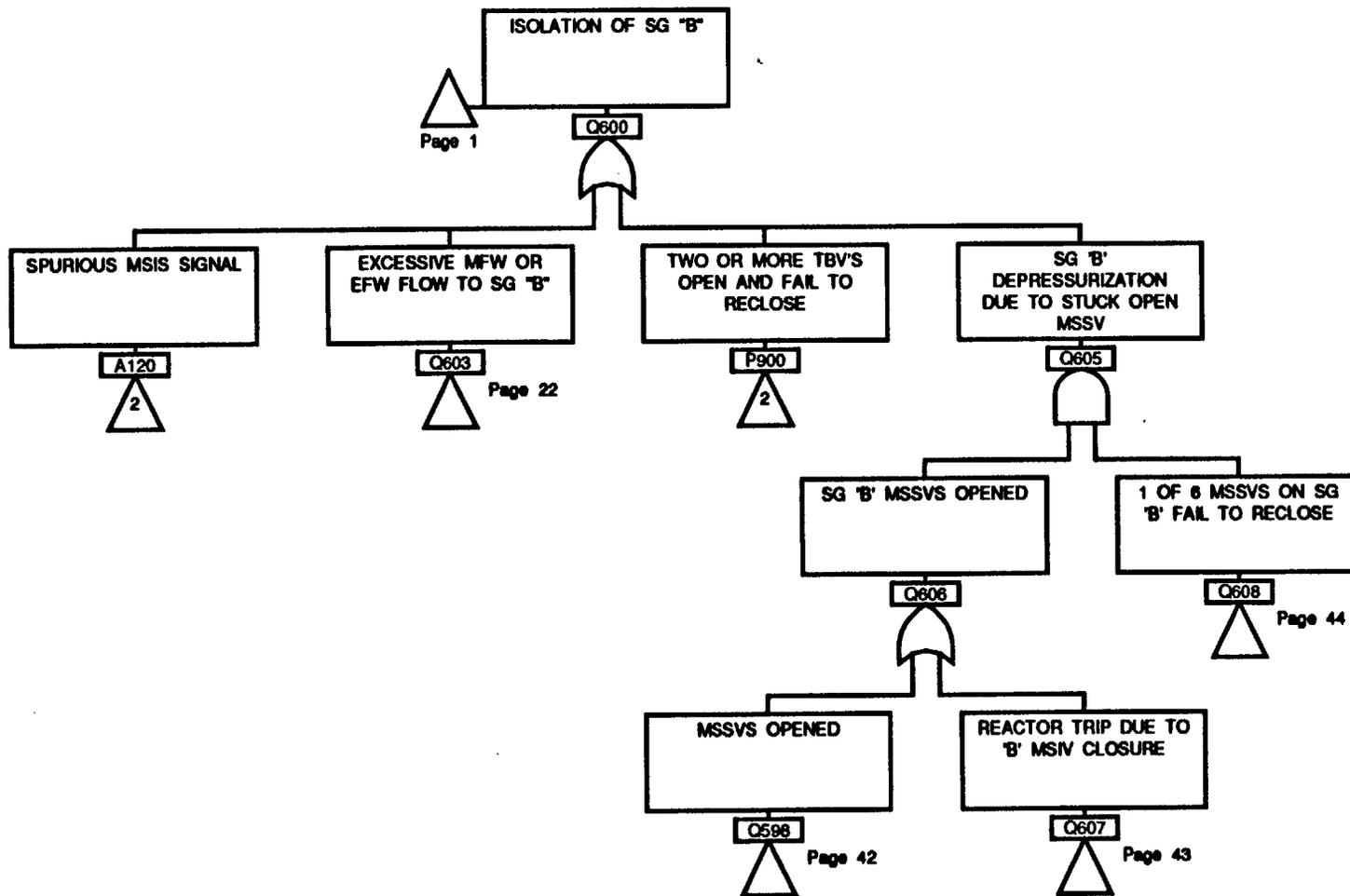


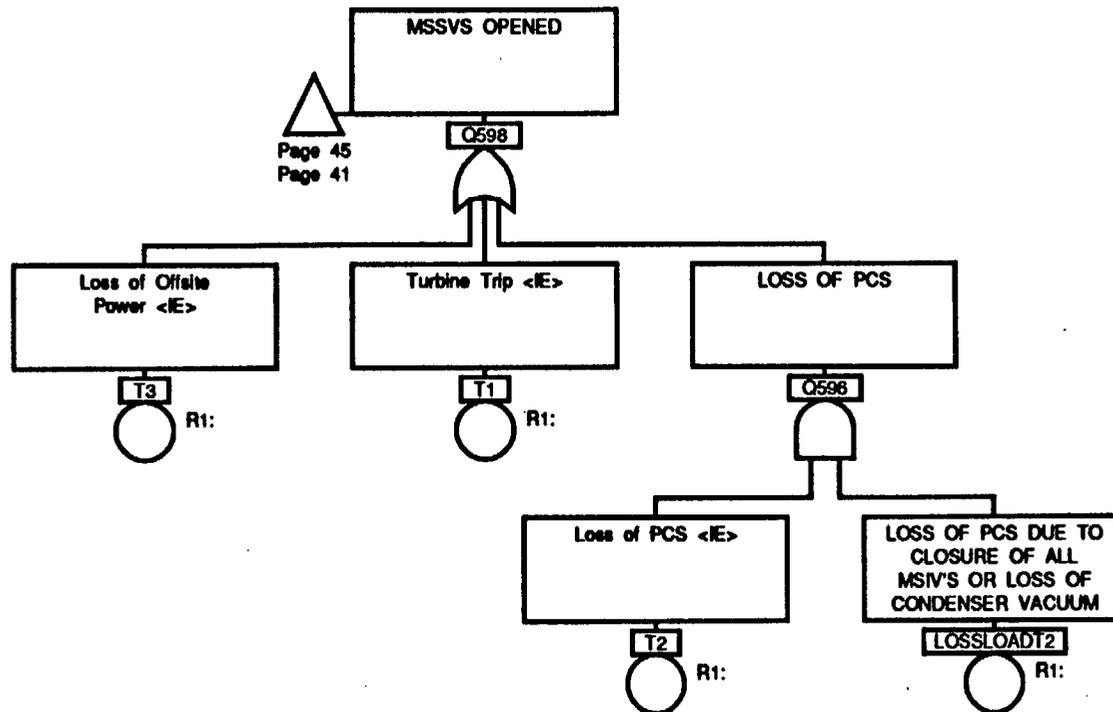


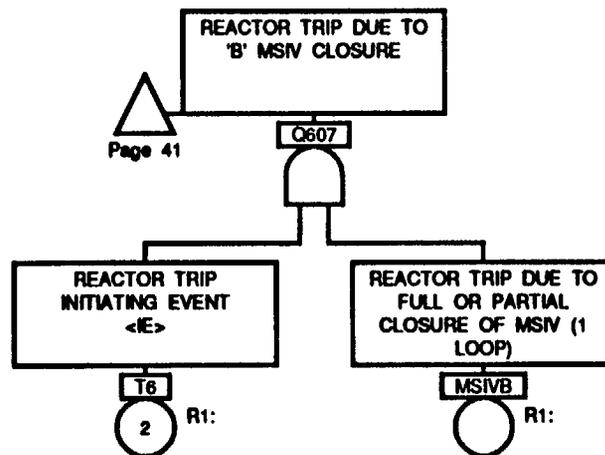




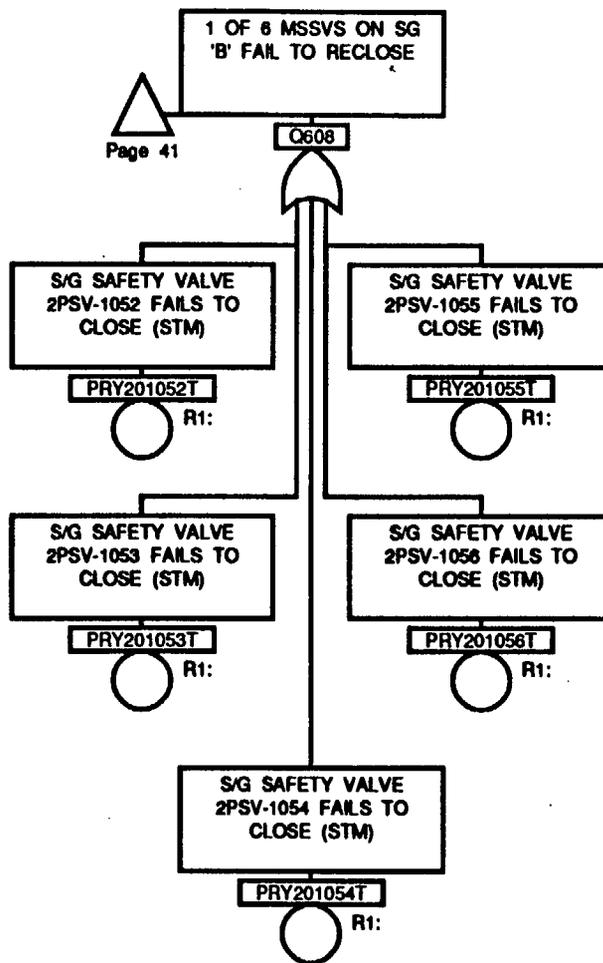
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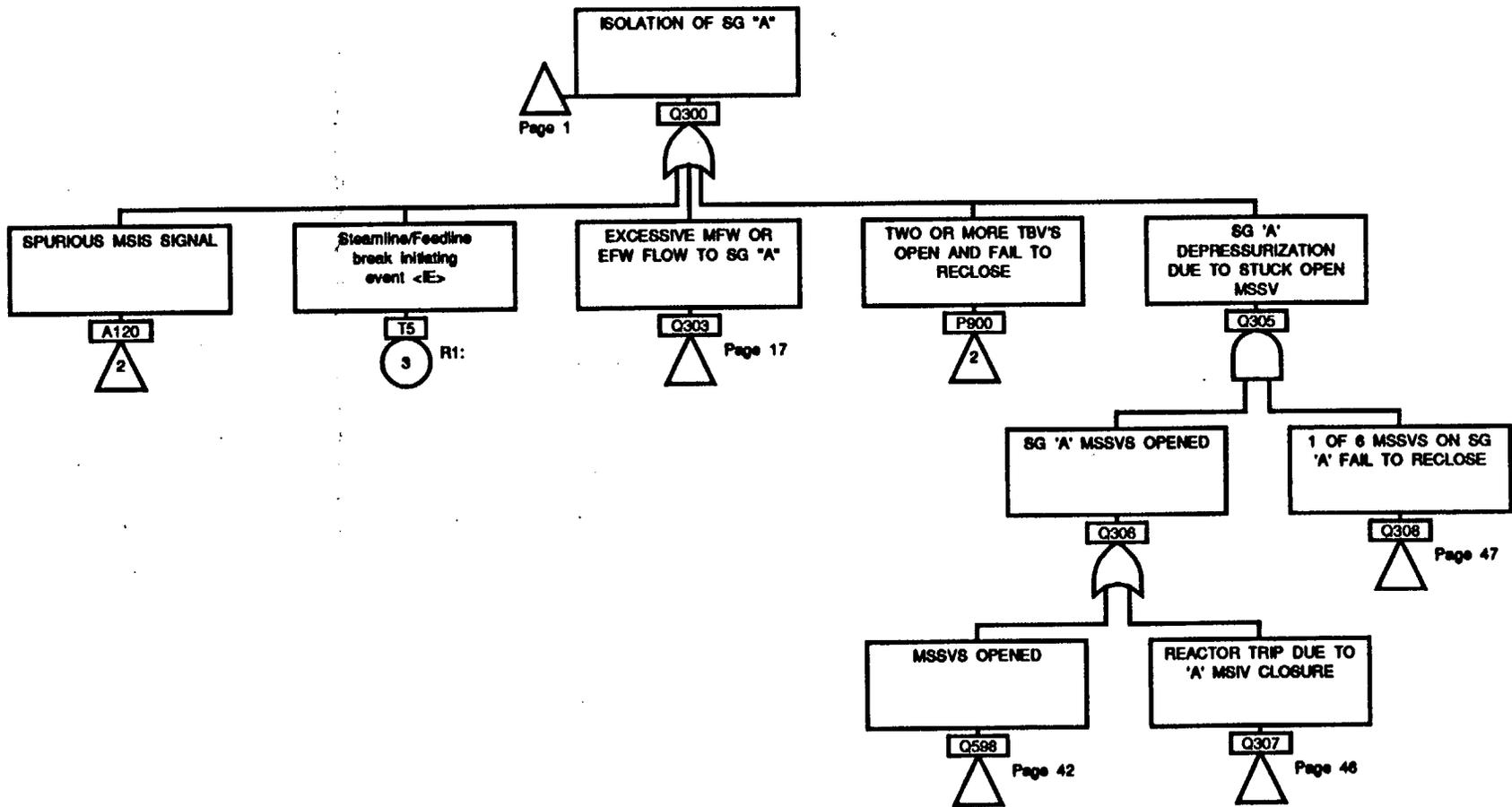


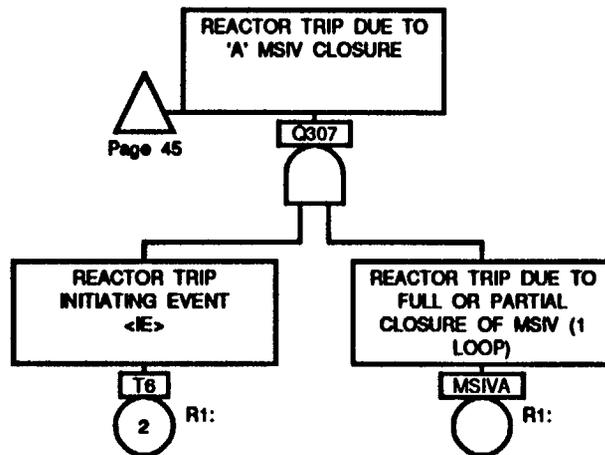




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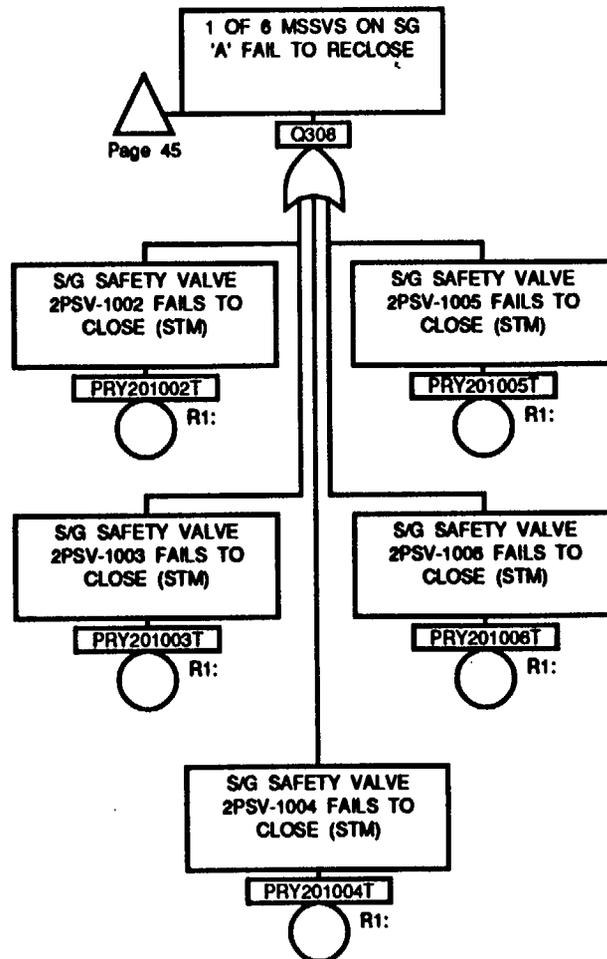






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Gate/Event Name	Page	Zone									
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A094	34	2	D27FBTD	37	4	Q003NF2	3	4	Q107	28	2
A097	7	3	DCD22304XR	29	2	Q003NOFLO	2	1	Q108	29	1
A098	32	2	EA3	29	1	Q003NOFLO	3	4	Q108	34	2
A098	34	1	EB51	27	4	Q003TEST	2	2	Q110	28	2
A100	7	4	EB53	28	4	Q004	2	3	Q111	28	4
A102	32	1	EB53	39	4	Q004	27	3	Q112	28	3
A102	34	3	EB63	18	1	Q004NF1	27	4	Q112	34	4
A103	13	3	EB63	23	1	Q004NF2	27	5	Q119	31	1
A104	34	4	EB63F	35	2	Q004NF2	35	2	Q119	31	3
A105	13	4	EB63F	40	2	Q004TEST	2	4	Q119	32	2
A106	27	4	EMM2B51XXX	19	2	Q005TEST	3	2	Q200	4	3
A106A	19	1	EMM2B53XXX	24	2	Q005TEST	4	4	Q201	4	3
A107	15	1	F008TEST	17	1	Q005TEST	37	2	Q201	5	2
A107A	21	1	F408TEST	22	1	Q006A	4	5	Q202	5	2
A108	39	4	LOSSLOADT2	42	3	Q006TEST	4	4	Q203	5	4
A108A	24	1	MSIVA	46	2	Q007	4	5	Q204	4	4
A109	38	1	MSIVB	43	2	Q007	13	3	Q204	7	2
A109A	26	1	NFEFWATO A	3	4	Q008	4	6	Q205	5	4
A110	3	4	NFEFWATOB	37	4	Q008	7	4	Q208	17	2
A110A	20	1	NFEFWBTOA	2	4	Q009	13	2	Q209	22	2
A111	35	1	NFEFWBTOB	36	4	Q009	14	2	Q211	18	2
A111A	18	1	P900	41	3	Q009	28	2	Q212	20	2
A112	37	4	P900	45	4	Q010	13	2	Q215	23	2
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A113	40	1	PRY201003T	47	1	Q012	13	3	Q222	6	2
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D26AF	7	1	PRY201053T	44	1	Q101	1	3	Q303	45	3
D26AF	13	4	PRY201054T	44	2	Q101	2	2	Q305	45	5
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D26AFBTD	21	1	PRY201056T	44	2	Q105	28	2	Q307	45	5
D26AFBTD	26	1	Q001	1	4	Q105	39	2	Q307	46	2
D26AFBTD	38	2	Q002	2	2	Q106	28	1	Q308	45	5
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Gate/Event Name	Page	Zone									
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Q501	1	2	Q546	31	2	Q715	24	2	QMM2CCF1AC	39	3
Q501	1	6	Q550	11	2	Q716	25	3	QMM2CCF1DC	3	3
Q501	36	2	Q556	11	1	Q716	26	2	QMM2CCF1DC	37	3
Q502	36	2	Q556	11	3	Q992	1	2	QMM2COOLTB	4	7
Q503NF	37	3	Q556	31	4	Q993	1	4	QMM2CSTNKA	14	2
Q503NF1	37	5	Q560	11	4	Q994	1	6	QMM2CSTNKF	14	2
Q503NF1	38	2	Q596	42	3	QAV200714C	31	2	QMM2CV1025	19	1
Q503NF2	37	4	Q598	41	3	QAV200714R	10	5	QMM2CV1026	21	2
Q503NOFLO	36	1	Q598	42	2	QAV200798C	31	4	QMM2CV1036	23	2
Q503NOFLO	37	4	Q598	45	4	QAV200798R	11	5	QMM2CV1037	20	2
Q503TEST	36	2	Q600	1	4	QCB263H1AR	23	2	QMM2CV1038	18	2
Q504	36	3	Q600	41	2	QCB263H1FR	23	2	QMM2CV1039	25	2
Q504	39	3	Q603	16	2	QCB263H1FR	40	2	QMM2CV1075	24	1
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Q504NF2	39	5	Q603	41	2	QCB263H3FR	18	2	QMM2EFW9AF	2	1
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Q505	4	4	Q607	41	4	QCB2B51N2R	27	4	QMM2PMSUCA	14	1
Q505	8	2	Q607	43	2	QCB2B53J2R	24	2	QMM2PMSUCF	14	1
Q506	29	1	Q608	41	4	QCB2B53J2R	39	4	QMM2SGAP7A	3	1
Q506	30	2	Q608	44	2	QCD227B1AR	20	2	QMM2SGAP7B	27	1
Q510	8	2	Q700	17	1	QCD227B1FR	3	4	QMM2SGBP7A	37	1
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Q530	8	3	Q701	17	3	QCD227B2FR	25	2	QMM2STSSGA	5	1
Q530	9	2	Q701	20	2	QCD227B2FR	37	4	QMM2STSSGB	5	3
Q535	8	4	Q701TEST	17	4	QCD2D26A4R	15	2	QMM2SWASUP	13	7
Q535	12	2	Q703	22	1	QCD2D26A4R	21	2	QMM2SWBSUP	28	3
Q540	9	1	Q703	23	2	QCD2D26C1R	26	2	QMM2TRANAA	4	1
Q540	10	4	Q703TEST	22	2	QCD2D26C1R	38	2	QMM2TRANAF	4	2
Q540	30	1	Q704	22	3	QHF2EFWTAF	4	6	QMM2TRANBA	29	2
Q542	10	2	Q704	25	2	QHF2EFWTAF	11	4	QMM2TRANBF	29	2
Q544	10	4	Q704TEST	22	4	QHF2EFWTAF	12	2	QMV200789K	28	1
Q545	9	2	Q711	18	3	QHF2EFWTBF	10	4	QMV2CV795K	13	1
Q545	11	4	Q711	19	2	QHF2EFWTBF	33	2	QSV200714C	31	2
Q545	30	2	Q712	20	3	QHF2REFILL	14	2	QSV200714R	10	6

<u>Gate/Event Name</u>	<u>Page</u>	<u>Zone</u>									
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QSV200798R	11	6									
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QTM2EFWTAT	11	2									
QTM2EFWTAT	12	2									
QTM2EFWTBF	33	1									
QTM2EFWTBT	10	2									
QXV20011AR	8	2									
QXV20011BR	12	1									
S101	28	4									
S201	13	5									
T1	42	2									
T2	42	2									
T3	42	1									
T5	5	2									
T5	5	4									
T5	45	2									
T6	43	1									
T6	46	1									
XSEFWATO	17	4									
XSEFWATO	22	4									
XSEFWBTO	17	2									
XSEFWBTO	22	2									

ATTACHMENT H
LIST OF COMPUTER FILES

Calculation No 89-E-0048-07
Revision 1
Date: 12/17/93

Prepared by:
Checked by:
Reviewed by:

M. M. Freeman



Page H-1 of 2

The following list of files on the attached floppy disk were used to develop this System Analysis Work Package, and are considered a part of the package:

CAFTA Fault Tree File:	Q2R1	CAF	7502	12-20-93	10:19a
CAFTA Basic Event File:	Q2R1	BE	55296	07-16-94	2:11p
CAFTA Type Code file:	Q2R1	TC	198656	07-16-94	2:11p
CAFTA gate file:	Q2R1	GT	19456	12-17-93	1:47p
Cafte Module Cutset File:	Q2R1	CUT	13324	10-14-93	9:05a
Figure F-1 Drawing file:	ANO2EFW1	DRW	24963	01-28-94	10:13a
Figure F-2 Drawing file:	ANO2EFW2	DRW	8231	10-13-93	4:24p
Word file documenting changes:	CHANGE	DOC	5748	12-17-93	2:55p
Word file of ERIN comments:	Q2R1ERIN	DOC	4990	12-17-93	5:09p
WORD file for SAWP text part 1:	Q2R12	DOC			
WORD file for SAWP text part 2:	Q2R11	DOC			

Attachment 1b

ANO-2 EFW Basic Event Listing

ANO-2 EFW Basic Event Listing
(Corresponds to Attachment B in the ANO-2 EFW SAWP (provided in Attachment 1a))

	NAME	DESC	PROB
33	DCD22304XR	DC BREAKER 72-2304 TRANSFERS OPEN	9.12E-05
39	EMM2B51XXX	480V MCC 2B51 FAULT MODULE	2.92E-05
40	EMM2B53XXX	480V MCC 2B53 FAULT MODULE	2.92E-05
43	LOSSLOADT2	LOSS OF PCS DUE TO CLOSURE OF ALL MSIV'S OR LOSS OF CONDENSER VACUUM	2.54E-01
44	MSIVA	REACTOR TRIP DUE TO FULL OR PARTIAL CLOSURE OF MSIV (1 LOOP)	8.50E-02
45	MSIVB	REACTOR TRIP DUE TO FULL OR PARTIAL CLOSURE OF MSIV (1 LOOP)	8.50E-02
46	NFEFWATO	NO FLOW FROM TRAIN A TO SG A FLAG	1.00E+00
47	NFEFWATOB	NO FLOW TO SGB FROM EFW PUMP TRAIN A FLAG	1.00E+00
48	NFEFWBTOA	NO FLOW FROM TRAIN B TO SG A FLAG	1.00E+00
49	NFEFWBTOB	NO FLOW TO SGB FROM TRAIN B FLAG	1.00E+00
50	P900	Note 1	Note 1
51	PAS210101C	AIR-OPERATED VALVE 2CV-1010-1 FAILS TO CLOSE	7.79E-04
52	PCV2MS39AK	CHECK VALVE 2MS-39A TRANSFERS CLOSED	7.34E-05
53	PCV2MS39AN	CHECK VALVE 2MS-39A FAILS TO OPEN	4.93E-04
54	PCV2MS39BK	CHECK VALVE 2MS-39B TRANSFERS CLOSED	7.34E-05
55	PCV2MS39BN	CHECK VALVE 2MS-39B FAILS TO OPEN	4.93E-04
56	PMV201000K	MOTOR-OPERATED VALVE 2CV-1000-1 TRANSFERS CLOSED	1.92E-03
57	PMV201050K	MOTOR-OPERATED VALVE 2CV-1050-2 TRANSFERS CLOSED	1.92E-03
58	PMV210401R	MOTOR-OPERATED VALVE 2CV-1040-1 TRANSFERS OPEN	1.28E-04
59	PMV2CV340K	MOTOR-OPERATED VALVE 2CV-0340-2 TRANSFERS CLOSED	1.28E-04
60	PMV2CV340N	MOTOR-OPERATED VALVE 2CV-0340-2 FAILS TO OPEN	9.19E-03
61	PRY201002T	S/G SAFETY VALVE 2PSV-1002 FAILS TO CLOSE (STM)	7.42E-03
62	PRY201003T	S/G SAFETY VALVE 2PSV-1003 FAILS TO CLOSE (STM)	7.42E-03
63	PRY201004T	S/G SAFETY VALVE 2PSV-1004 FAILS TO CLOSE (STM)	7.42E-03
64	PRY201005T	S/G SAFETY VALVE 2PSV-1005 FAILS TO CLOSE (STM)	7.42E-03
65	PRY201006T	S/G SAFETY VALVE 2PSV-1006 FAILS TO CLOSE (STM)	7.42E-03
66	PRY201052T	S/G SAFETY VALVE 2PSV-1052 FAILS TO CLOSE (STM)	7.42E-03
67	PRY201053T	S/G SAFETY VALVE 2PSV-1053 FAILS TO CLOSE (STM)	7.42E-03
68	PRY201054T	S/G SAFETY VALVE 2PSV-1054 FAILS TO CLOSE (STM)	7.42E-03
69	PRY201055T	S/G SAFETY VALVE 2PSV-1055 FAILS TO CLOSE (STM)	7.42E-03
70	PRY201056T	S/G SAFETY VALVE 2PSV-1056 FAILS TO CLOSE (STM)	7.42E-03
71	PSV2SV205N	SOLENOID VALVE 2SV-0205 FAILS TO OPEN	1.31E-03
72	QAV200714C	AIR-OPERATED VALVE 2CV-0714-1 FAILS TO CLOSE	2.09E-02
73	QAV200714R	AIR-OPERATED VALVE 2CV-0714-1 TRANSFERS OPEN	3.19E-04
74	QAV200798C	AIR-OPERATED VALVE 2CV-0798-1 FAILS TO CLOSE	2.09E-02
75	QAV200798R	AIR-OPERATED VALVE 2CV-0798-1 TRANSFERS OPEN	3.19E-04
76	QCB20A311R	AC BREAKER 2A311 TRANSFERS OPEN	3.35E-04
77	QCB263H1AR	AC BREAKER 2B63H1 TRANSFERS OPEN PRIOR TO MISSION	1.03E-03
78	QCB263H1FR	AC BREAKER 2B63H1 TRANSFERS OPEN DURING MISSION	2.23E-05
79	QCB263H3AR	AC BREAKER 2B63H3 TRANSFERS OPEN PRIOR TO MISSION	1.03E-03
80	QCB263H3FR	AC BREAKER 2B63H3 TRANSFERS OPEN DURING MISSION	2.23E-05
81	QCB2B51N2R	AC BREAKER 2B51N2 TRANSFERS OPEN	3.35E-04
82	QCB2B53D1R	AC BREAKER 2B53D1 TRANSFERS OPEN	3.35E-04
83	QCB2B53D2R	AC BREAKER 2B53D2 TRANSFERS OPEN	3.35E-04
84	QCB2B53J2R	AC BREAKER 2B53J2 TRANSFERS OPEN	3.35E-04
85	QCD227B1AR	DC BREAKER 2D27-B1 TRANSFERS OPEN PRIOR TO MISSION	4.19E-03
86	QCD227B1FR	DC BREAKER 2D27-B1 TRANSFERS OPEN DURING MISSION	9.12E-05
87	QCD227B2AR	DC BREAKER 2D27-B2 TRANSFERS OPEN PRIOR TO MISSION	4.19E-03
88	QCD227B2FR	DC BREAKER 2D27-B2 TRANSFERS OPEN DURING MISSION	9.12E-05
89	QCD2D26A4R	DC BREAKER 2D26-A4 TRANSFERS OPEN	1.37E-04
90	QCD2D26B1R	DC BREAKER 2D26-B1 TRANSFERS OPEN	1.37E-04
91	QCD2D26B2R	DC BREAKER 2D26-B2 TRANSFERS OPEN	1.37E-04
92	QCD2D26B3R	DC BREAKER 2D26-B3 TRANSFERS OPEN	1.37E-04
93	QCD2D26C1R	DC BREAKER 2D26-C1 TRANSFERS OPEN	1.37E-04
94	QCV200801K	CHECK VALVE 2EFW-801 TRANSFERS CLOSED	7.34E-05
95	QCV200801N	CHECK VALVE 2EFW-801 FAILS TO OPEN	4.93E-04
96	QCV2EFW01K	CHECK VALVE 2EFW-1 TRANSFERS CLOSED	7.34E-05
97	QCV2EFW01N	CHECK VALVE 2EFW-1 FAILS TO OPEN	4.93E-04
98	QCV2EFW16K	CHECK VALVE 2EFW-16 TRANSFERS CLOSED	7.34E-05
99	QCV2EFW16N	CHECK VALVE 2EFW-16 FAILS TO OPEN	4.93E-04

	NAME	DESC	PROB
100	QCV2EFW2AK	CHECK VALVE 2EFW-2A TRANSFERS CLOSED	7.34E-05
101	QCV2EFW2AN	CHECK VALVE 2EFW-2A FAILS TO OPEN	4.93E-04
102	QCV2EFW2BK	CHECK VALVE 2EFW-2B TRANSFERS CLOSED	7.34E-05
103	QCV2EFW2BN	CHECK VALVE 2EFW-2B FAILS TO OPEN	4.93E-04
104	QCV2EFW4AK	CHECK VALVE 2EFW-4A TRANSFERS CLOSED	7.34E-05
105	QCV2EFW4AN	CHECK VALVE 2EFW-4A FAILS TO OPEN	4.93E-04
106	QCV2EFW4BK	CHECK VALVE 2EFW-4B TRANSFERS CLOSED	7.34E-05
107	QCV2EFW4BN	CHECK VALVE 2EFW-4B FAILS TO OPEN	4.93E-04
108	QCV2EFW7AK	CHECK VALVE 2EFW-7A TRANSFERS CLOSED	7.34E-05
109	QCV2EFW7AN	CHECK VALVE 2EFW-7A FAILS TO OPEN	4.93E-04
110	QCV2EFW7BK	CHECK VALVE 2EFW-7B TRANSFERS CLOSED	7.34E-05
111	QCV2EFW7BN	CHECK VALVE 2EFW-7B FAILS TO OPEN	4.93E-04
112	QCV2EFW8AK	CHECK VALVE 2EFW-8A TRANSFERS CLOSED	7.34E-05
113	QCV2EFW8AN	CHECK VALVE 2EFW-8A FAILS TO OPEN	4.93E-04
114	QCV2EFW8BK	CHECK VALVE 2EFW-8B TRANSFERS CLOSED	7.34E-05
115	QCV2EFW8BN	CHECK VALVE 2EFW-8B FAILS TO OPEN	4.93E-04
116	QCV2EFW9AK	CHECK VALVE 2EFW-9A TRANSFERS CLOSED	7.34E-05
117	QCV2EFW9AN	CHECK VALVE 2EFW-9A FAILS TO OPEN	4.93E-04
118	QCV2EFW9BK	CHECK VALVE 2EFW-9B TRANSFERS CLOSED	7.34E-05
119	QCV2EFW9BN	CHECK VALVE 2EFW-9B FAILS TO OPEN	4.93E-04
120	QHF2EFWTA	OPERATOR FAILS TO PROPERLY RESTORE EFW PUMP TRAIN A	4.20E-04
121	QHF2EFWTB	OPERATOR FAILS TO PROPERLY RESTORE EFW TRAIN B	4.20E-04
122	QHF2REFILL	OPERATORS FAIL TO ALIGN EFW SUCTION TO ALTERNATE CONDENSATE STORAGE TANK	1.20E-02
123	QMM2CCF003	CCF MODULE FOR SERVICE WATER SUCTION VALVES	7.06E-04
124	QMM2CCF1AC	COMMON CAUSE FAILURE OF EFW AC INJECTION VALVES	7.06E-04
125	QMM2CCF1DC	COMMON CAUSE FAILURE MODULE OF EFW DC INJECTION VALVES	7.06E-04
126	QMM2COOLT	LOSS OF BEARING COOLING TO P7A TURBINE(2K3)	2.53E-03
127	QMM2CSTNKA	NO FLOW FROM CST (TYPE-1 FAULTS)	2.97E-03
128	QMM2CSTNKF	NO FLOW FROM CST (TYPE-2 FAULTS)	2.06E-04
129	QMM2CV1025	FAILURE TO CLOSE SGA (2E24A) INJECTION VALVE 2CV-1025-1	9.31E-03
130	QMM2CV1026	FAILURE TO CLOSE SGA (2E24A) INJECTION VALVE 2CV-1026-2	9.31E-03
131	QMM2CV1036	FAILURE TO CLOSE SGB (2E24B) INJECTION VALVE 2CV-1036-2	9.31E-03
132	QMM2CV1037	FAILURE TO CLOSE SGA (2E24A) INJECTION VALVE 2CV-1037-1	9.31E-03
133	QMM2CV1038	FAILURE TO CLOSE SGA (2E24A) INJECTION VALVE 2CV-1038-2	9.31E-03
134	QMM2CV1039	FAILURE TO CLOSE SGB (2E24B) INJECTION VALVE 2CV-1039-1	9.31E-03
135	QMM2CV1075	FAILURE TO CLOSE SGB (2E24B) INJECTION VALVE 2CV-1075-1	9.31E-03
136	QMM2CV1076	FAILURE TO CLOSE SGB (2E24B) INJECTION VALVE 2CV-1076-2	9.31E-03
137	QMM2EFW9AF	CHECK VALVE 2EFW-9A FAILS TO PROVIDE FLOW	5.66E-04
138	QMM2EFW9BF	CHECK VALVE 2EFW-9B FAILS TO PROVIDE FLOW	5.66E-04
139	QMM2MSLIA	SG A (2E24A) MAIN STEAM LINE ISOLATION VALVE FAILS TO CLOSE	8.12E-04
140	QMM2PMSUCA	NO FLOW THROUGH COMMON PUMP SUCTION LINE (TYPE-1 FAULTS)	1.55E-03
141	QMM2PMSUCF	NO FLOW THROUGH COMMON PUMP SUCTION LINE (TYPE-2 FAULTS)	4.58E-04
142	QMM2SGAP7A	NO FLOW TO SGA (2E24A) FROM 2P7A	1.56E-02
143	QMM2SGAP7B	NO FLOW TO SGA (2E24A) FROM 2P7B	1.56E-02
144	QMM2SGBP7A	NO FLOW TO SGB (2E24B) FROM 2P7A	1.56E-02
145	QMM2SGBP7B	NO FLOW TO SGB (2E24B) FROM 2P7B	1.56E-02
146	QMM2STMADM	STEAM ADMISSION VALVE 2CV-0340-2 OR BYPASS VALVE 2SV-0205 FAIL	1.08E-02
147	QMM2STSSGA	STEAM GENERATOR A (2E24A) SUPPLY LINE BLOCKED	2.48E-03
148	QMM2STSSGB	STEAM GENERATOR B (2E24B) SUPPLY LINE BLOCKED	2.48E-03
149	QMM2SWASUP	LOSS OF SUPPLY FROM SW TO TRAIN A	2.99E-02
150	QMM2SWBSUP	LOSS OF SUPPLY FROM SW TO TRAIN B DUE TO BREAKERS AND VALVES	3.03E-02
151	QMM2TRANAA	EFW PUMP TRAIN A FAILS TO DELIVER FLOW (TYPE 1 FAULTS)	7.73E-03
152	QMM2TRANAF	EFW PUMP TRAIN A FAILS TO DELIVER FLOW (TYPE 2 FAULTS)	1.44E-01
153	QMM2TRANBA	EFW PUMP TRAIN B FAILS TO DELIVER FLOW (TYPE 1 FAULTS)	3.14E-03
154	QMM2TRANBF	EFW PUMP TRAIN B FAILS TO DELIVER FLOW (TYPE 2 FAULTS)	2.41E-03
155	QMP202P7BA	MOTOR-DRIVEN PUMP 2P7B FAILS TO START	2.32E-03
156	QMP202P7BF	MOTOR-DRIVEN PUMP 2P7B FAILS TO RUN	6.43E-04
157	QMV200711K	MOTOR-OPERATED VALVE 2CV-0711-2 TRANSFERS CLOSED	1.28E-04
158	QMV200711N	MOTOR-OPERATED VALVE 2CV-0711-2 FAILS TO OPEN	9.19E-03
159	QMV200716K	MOTOR-OPERATED VALVE 2CV-0716-1 TRANSFERS CLOSED	1.28E-04
160	QMV200716N	MOTOR-OPERATED VALVE 2CV-0716-1 FAILS TO OPEN	9.19E-03
161	QMV200789C	MOTOR-OPERATED VALVE 2CV-0789-1 FAILS TO CLOSE	9.19E-03
162	QMV200789K	MOTOR-OPERATED VALVE 2CV-0789-1 TRANSFERS CLOSED	3.82E-03

	NAME	DESC	PROB
163	QMV200795C	MOTOR-OPERATED VALVE 2CV-0795-2 FAILS TO CLOSE	9.19E-03
164	QMV201025C	MOTOR-OPERATED VALVE 2CV-1025-1 FAILS TO CLOSE	9.19E-03
165	QMV201025K	MOTOR-OPERATED VALVE 2CV-1025-1 TRANSFERS CLOSED	1.28E-04
166	QMV201025N	MOTOR-OPERATED VALVE 2CV-1025-1 FAILS TO OPEN	9.19E-03
167	QMV201025R	MOTOR-OPERATED VALVE 2CV-1025-1 TRANSFERS OPEN	1.28E-04
168	QMV201026C	MOTOR-OPERATED VALVE 2CV-1026-2 FAILS TO CLOSE	9.19E-03
169	QMV201026K	MOTOR-OPERATED VALVE 2CV-1026-2 TRANSFERS CLOSED	1.28E-04
170	QMV201026N	MOTOR-OPERATED VALVE 2CV-1026-2 FAILS TO OPEN	9.19E-03
171	QMV201026R	MOTOR-OPERATED VALVE 2CV-1026-2 TRANSFERS OPEN	1.28E-04
172	QMV201036C	MOTOR-OPERATED VALVE 2CV-1036-2 FAILS TO CLOSE	9.19E-03
173	QMV201036K	MOTOR-OPERATED VALVE 2CV-1036-2 TRANSFERS CLOSED	5.75E-03
174	QMV201036R	MOTOR-OPERATED VALVE 2CV-1036-2 TRANSFERS OPEN	1.28E-04
175	QMV201037C	MOTOR-OPERATED VALVE 2CV-1037-1 FAILS TO CLOSE	9.19E-03
176	QMV201037K	MOTOR-OPERATED VALVE 2CV-1037-1 TRANSFERS CLOSED	5.75E-03
177	QMV201037R	MOTOR-OPERATED VALVE 2CV-1037-1 TRANSFERS OPEN	1.28E-04
178	QMV201038C	MOTOR-OPERATED VALVE 2CV-1038-2 FAILS TO CLOSE	9.19E-03
179	QMV201038K	MOTOR-OPERATED VALVE 2CV-1038-2 TRANSFERS CLOSED	5.75E-03
180	QMV201038R	MOTOR-OPERATED VALVE 2CV-1038-2 TRANSFERS OPEN	1.28E-04
181	QMV201039C	MOTOR-OPERATED VALVE 2CV-1039-1 FAILS TO CLOSE	9.19E-03
182	QMV201039K	MOTOR-OPERATED VALVE 2CV-1039-1 TRANSFERS CLOSED	5.75E-03
183	QMV201039R	MOTOR-OPERATED VALVE 2CV-1039-1 TRANSFERS OPEN	1.28E-04
184	QMV201075C	MOTOR-OPERATED VALVE 2CV-1075-1 FAILS TO CLOSE	9.19E-03
185	QMV201075K	MOTOR-OPERATED VALVE 2CV-1075-1 TRANSFERS CLOSED	1.28E-04
186	QMV201075N	MOTOR-OPERATED VALVE 2CV-1075-1 FAILS TO OPEN	9.19E-03
187	QMV201075R	MOTOR-OPERATED VALVE 2CV-1075-1 TRANSFERS OPEN	1.28E-04
188	QMV201076C	MOTOR-OPERATED VALVE 2CV-1076-2 FAILS TO CLOSE	9.19E-03
189	QMV201076K	MOTOR-OPERATED VALVE 2CV-1076-2 TRANSFERS CLOSED	1.28E-04
190	QMV201076N	MOTOR-OPERATED VALVE 2CV-1076-2 FAILS TO OPEN	9.19E-03
191	QMV201076R	MOTOR-OPERATED VALVE 2CV-1076-2 TRANSFERS OPEN	1.28E-04
192	QMV2CCFBFS	BETA FACTOR FOR EFW MOV S	7.69E-02
193	QMV2CV707K	MOTOR-OPERATED VALVE 2EFW-0707 TRANSFERS CLOSED	1.92E-03
194	QMV2CV795K	MOTOR-OPERATED VALVE 2CV-0795-2 TRANSFERS CLOSED	1.92E-03
195	QPS200789D	PRESSURE SWITCH 2PIS-0789-1 FAILS TO RESPOND	4.50E-05
196	QPS200795D	PRESSURE SWITCH 2PIS-0795-2 FAILS TO RESPOND	4.50E-05
197	QSV200714C	SOLENOID VALVE 2SV-0714-1 FAILS TO CLOSE	1.31E-03
198	QSV200714R	SOLENOID VALVE 2SV-0714-1 TRANSFERS OPEN	8.76E-05
199	QSV200798C	SOLENOID VALVE 2SV-0798-1 FAILS TO CLOSE	1.31E-03
200	QSV200798R	SOLENOID VALVE 2SV-0798-1 TRANSFERS OPEN	8.76E-05
201	QSV2SV317K	SOLENOID VALVE 2SV-0317-2 TRANSFERS CLOSED	8.76E-05
202	QSV2SV317N	SOLENOID VALVE 2SV-0317-2 FAILS TO OPEN	1.31E-03
203	QTK2CT41AJ	CST TANK 2T41A RUPTURE OR LEAKAGE	1.32E-04
204	QTM2EFWTAF	EFW PUMP TRAIN A UNAVAILABLE DUE TO MAINTENANCE	9.09E-03
205	QTM2EFWTAT	EFW PUMP TRAIN A IN TEST W/ ASSOC'D FLUSH VALVES OPEN	4.57E-04
206	QTM2EFWTBF	EFW PUMP TRAIN B UNAVAILABLE DUE TO MAINTENANCE	1.53E-03
207	QTM2EFWTBT	EFW PUMP TRAIN B IN TEST W/ ASSOC'D FLUSH VALVES OPEN	4.57E-04
208	QTP202P7AA	TURBINE-DRIVEN PUMP 2P7A FAILS TO START	7.24E-03
209	QTP202P7AF	TURBINE-DRIVEN PUMP 2P7A FAILS TO RUN	1.43E-01
210	QXV20011AR	MANUAL VALVE 2EFW-11A TRANSFERS OPEN	6.22E-04
211	QXV20011BR	MANUAL VALVE 2EFW-11B TRANSFERS OPEN	6.22E-04
212	QXV200802K	MANUAL VALVE 2EFW-802 TRANSFERS CLOSED	5.65E-04
213	QXV2CT005K	MANUAL VALVE 2CT-5 TRANSFERS CLOSED	5.65E-04
214	QXV2CV706R	MANUAL VALVE 2EFW-0706 TRANSFERS OPEN	3.11E-04
215	QXV2EF10AK	MANUAL VALVE 2EFW-10A TRANSFERS CLOSED	5.65E-04
216	QXV2EF10BK	MANUAL VALVE 2EFW-10B TRANSFERS CLOSED	5.65E-04
217	QXV2EF789K	MANUAL VALVE 2EFW-0789A TRANSFERS CLOSED	6.22E-04
218	QXV2EF795K	MANUAL VALVE 2EFW-0795A TRANSFERS CLOSED	6.22E-04
219	QXV2EFW06K	MANUAL VALVE 2EFW-6 TRANSFERS CLOSED	5.65E-04
220	QXV2EFW20K	MANUAL VALVE 2EFW-20 TRANSFERS CLOSED	5.65E-04
221	QXV2EFW21K	MANUAL VALVE 2EFW-21 TRANSFERS CLOSED	5.65E-04
222	QXV2EFW3AK	MANUAL VALVE 2EFW-3A TRANSFERS CLOSED	5.65E-04
223	QXV2EFW3BK	MANUAL VALVE 2EFW-3B TRANSFERS CLOSED	5.65E-04
224	S101	SERVICE WATER LOOP 1 NOT AVAILABLE	Note 1
225	S201	SERVICE WATER LOOP 2 NOT AVAILABLE	Note 1
226	SXV2SW39AK	MANUAL VALVE 2SW-39A TRANSFERS CLOSED	1.02E-02

	NAME	DESC	PROB
227	SXV2SW39BK	MANUAL VALVE 2SW-39B TRANSFERS CLOSED	1.02E-02 (Note 2)
228	T1	TURBINE TRIP <IE>	5.40E-01 (Note 2)
229	T2	LOSS OF PCS <IE>	1.80E-01 (Note 2)
230	T3	LOSS OF OFFSITE POWER <IE>	3.68E-02 (Note 2)
231	T5	STEAMLINE/FEEDLINE BREAK INITIATING EVENT <IE>	1.10E-03 (Note 2)
232	T6	REACTOR TRIP INITIATING EVENT <IE>	1.44E+00 (Note 2)
233	XSEFWATO A	EXCESSIVE EFW FLOR FROM PUMP A TO SG A FLAG	1.00E+00 (Note 3)
234	XSEFWATO B	EXCESSIVE FLOW TO SG B FROM 2P7A FLAG	1.00E+00 (Note 3)
235	XSEFWBTO A	EXCESSIVE EFW FLOR FROM PUMP B TO SG A FLAG	1.00E+00 (Note 3)
236	XSEFWBTO B	EXCESSIVE FLOW TO SG B FROM 2P7B FLAG	1.00E+00 (Note 3)

Note 1: Events P900, S101, and S201 are gates not basic events; thus, these events have no basic event probabilities.

Note 2: Events T1, T2, T3, T5 and T6 are initiating events; their values are frequencies (/x-yr) not probabilities.

Note 3: Events XSEFWATO A, XSEFWATO B, XSEFWBTO A, and XSEFWBTO B are conditional flag events.

Attachment 1c

Recovery Events AFWFEEDREC and AFWFEEDRES

CALC NO. 89-E-0048.22 REV

hpp.B

17-151

REV	DATE	BY	CHK
0	1/18/92	hpp.B	JMA

HUMAN FAILURE RECORD SHEET
In-Control Room Model

1. EVENT: AFWFEEDREC

2. EVENT IDENTIFICATION

2.1 Descriptor Operator fails to start and align the AFW pump after loss of both EFW trains.
2.2 Comment

3. EVENT CATEGORIZATION

3.1 Event type post-initiator recovery
3.2 Location of action(s) in control room
3.3 Failure mode mistake

4. METHOD USED SAIC TRC system

5. INPUT PARAMETERS

5.1 Type of behavior		response
5.2 Presence of burden		no
5.3 SLI (0.0 to 1.0)	nominal is 0.5	default
5.4 Median time (min), m1	default is 4	default
5.5 Model error factor, f1	generic is 3.2	default
5.6 Model uncert. error factor, fU	generic is 1.68	default
5.7 Available time (min), t		55

6. CALCULATED PARAMETERS

6.1 Behavior factor	1.0
6.2 SLI factor	1.0
6.3 Burden factor	1.0
6.4 Adjusted median response time, m = m1 item 6.1 item 6.2	4.0
6.5 Adjusted model error factor, fR = f1 x item 6.3	3.2

7. EVENT OCCURENCE PROBABILISTIC ESTIMATES

7.1 Mean (explicitly includes associated equipment failures)	1.0E-02
7.2 95th percentile	3.3E-03
7.3 5th percentile	2.5E-05
7.4 Error Factor (see E44)	15.00

8. ASSOCIATED EQUIPMENT RELIABILITY TREATMENT

8.1 Human reliability event mean failure probability	4.5E-04
8.2 Associated equipment reliability limited (1=yes,0=no)	1
8.3 Associated equipment failure probability (see E52)	0.01
8.4 Combined human and equipment failure probability	0.01044832

AFWFEEEDREC

This recovery makes use of the auxiliary feedwater system when both EFW trains are disabled. Since power is supplied from 2A1, offsite power (2A1) must be available. Even if cutset events disable the EFW flowpaths that are available to AFW, the MFW flowpath is still available. The MFW flowpath is not, however, available if the cutset includes any failures that cause the MFW regulating valves to close. This recovery is not valid for cutsets in SBLOCA or SGTR sequences.

REV	DATE	BY	CHK
0	7/10/92	D/K	Q/M

App. B

19 151

Questions for Operations

The PRA of the plant has identified the following activity as a possible action taken by operators, auxiliary operators, technicians, or maintenance personnel. Please provide answers to the related questions.

Event ID	<u>AFWFEEOREC</u>
Description of the activity	<u>Operator fails to start and align the AFw pumps after loss of both EFw trains</u>
Standard items	<ol style="list-style-type: none"> Who will perform the action? <u>RO</u> What procedure will be used? <u>EOP</u> How will the completion of the activity be recorded? <u>Station log</u>
Specific questions	<ol style="list-style-type: none"> An estimate of the available time [whether from T/L analyses or a guess] for each event. An indication of whether the action can be performed in the control room or not. If ex-control room, an estimate [guess] from operations as to how long the action would likely take as well as any hazards on the way, e.g., poor lighting, difficult access, personnel hazards such as heat, water, etc., and anything else that would inhibit the performance of the action. <p><u>1. 55 min.</u></p> <p><u>2. in control room</u></p>
Comments	

Date _____

SNL NO. R 9 - F - 00 - 8 - 2 2 REV

App. B - 20 - 151

REV	DATE	BY	CHK
0	7/10/92	B Hu	Qmm

HUMAN FAILURE RECORD SHEET
In-Control Room Model

1. EVENT AFWFEEDRES

2. EVENT IDENTIFICATION

2.1 Descriptor Operator fails to start and align the AFW pump after loss of both EFW trains with SBLOCA or SGTR.
2.2 Comment

3. EVENT CATEGORIZATION

3.1 Event type post-initiator recovery
3.2 Location of action(s) in control room
3.3 Failure mode mistake

4. METHOD USED SAIC TRC system

5. INPUT PARAMETERS

5.1 Type of behavior response
5.2 Presence of burden no
5.3 SLI (0.0 to 1.0) nominal is 0.5 default
5.4 Median time (min), m1 default is 4 default
5.5 Model error factor, f1 generic is 3.2 default
5.6 Model uncert. error factor, fU generic is 1.68 default
5.7 Available time (min), t 30

6. CALCULATED PARAMETERS

6.1 Behavior factor 1.0
6.2 SLI factor 1.0
6.3 Burden factor 1.0
6.4 Adjusted median response time, m = m1 item 6.1 item 6.2 4.0
6.5 Adjusted model error factor, fR = f1 x item 6.3 3.2

7. EVENT OCCURENCE PROBABILISTIC ESTIMATES

7.1 Mean (explicitly includes associated equipment failures) 1.6E-02
7.2 95th percentile 2.7E-02
7.3 5th percentile 5.3E-04
7.4 Error Factor (see E44) 15.00

8. ASSOCIATED EQUIPMENT RELIABILITY TREATMENT

8.1 Human reliability event mean failure probability 5.6E-03
8.2 Associated equipment reliability limited (1=yes,0=no) 1
8.3 Associated equipment failure probability (see E52) 0.01
8.4 Combined human and equipment failure probability 0.01557065

AFWREEDRES

This recovery is the same as AFWFEEDREC except that less time is available for completion because it is only used for cutsets in SBLOCA or SGTR sequences.

REV	DATE	BY	CHK
0	7/10/02	ADK	JM

App. B - 22 - 151

Questions for Operations

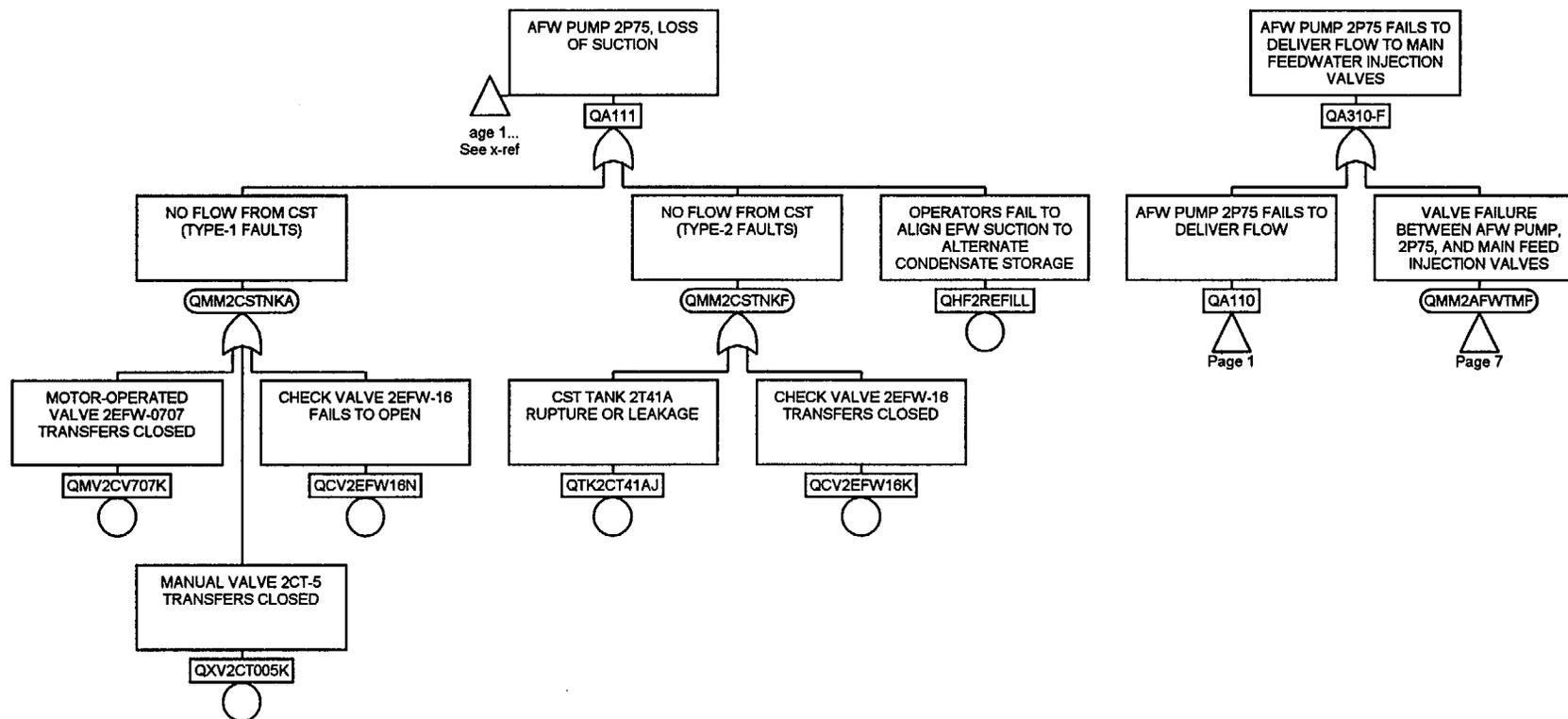
The PRA of the plant has identified the following activity as a possible action taken by operators, auxiliary operators, technicians, or maintenance personnel. Please provide answers to the related questions.

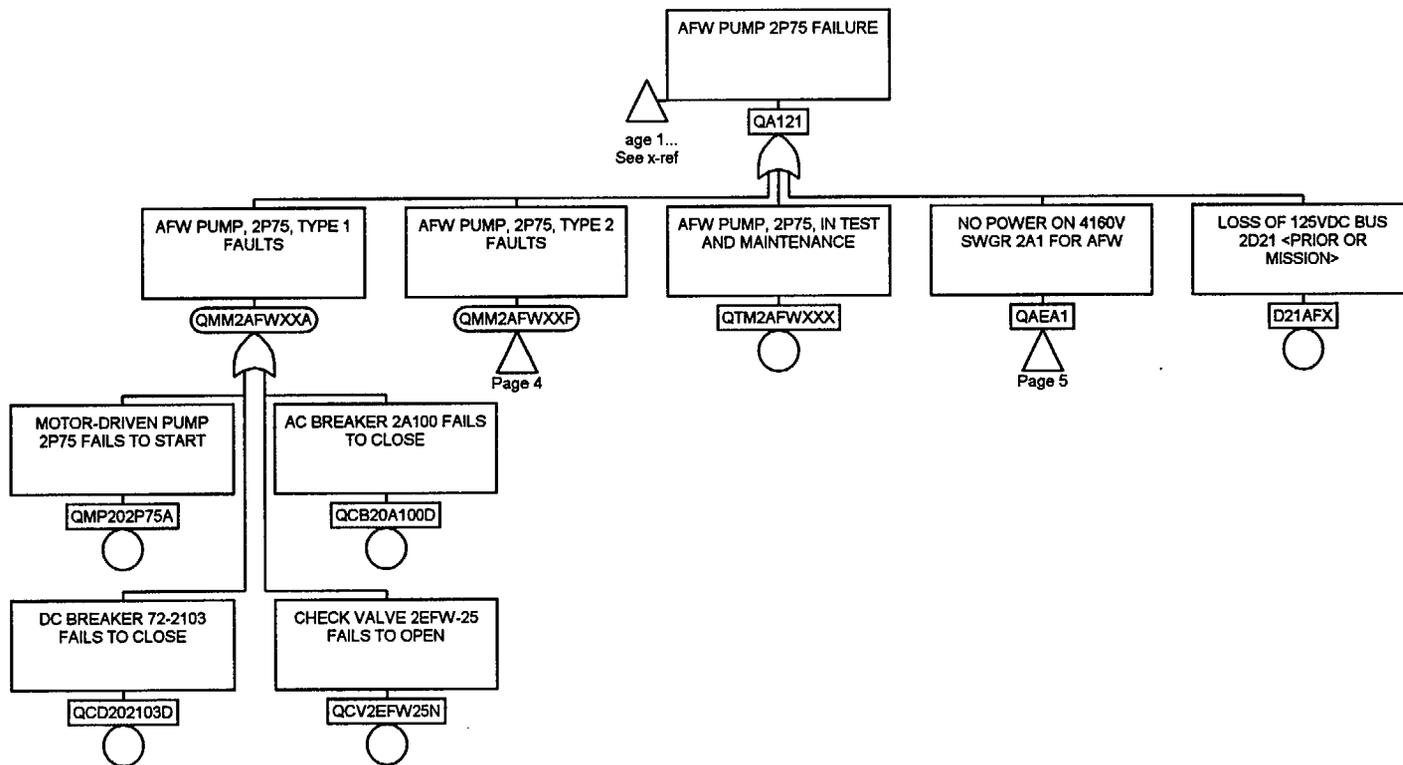
Event ID	<u>AFuFEEDRES</u>
Description of the activity	<u>Same as AFuFEEDREC</u>
Standard Items	<ol style="list-style-type: none"> 1. Who will perform the action? _____ 2. What procedure will be used? _____ 3. How will the completion of the activity be recorded? _____
Specific questions	<ol style="list-style-type: none"> 1. An estimate of the available time (whether from T/L analyses or a guess) for each event. 2. An indication of whether the action can be performed in the control room or not. 3. If ex-control room, an estimate (guess) from operations as to how long the action would likely take as well as any hazards on the way, e.g., poor lighting, difficult access, personnel hazards such as heat, water, etc., and anything else that would inhibit the performance of the action. <p><u>1.30 min.</u></p>
Comments	_____

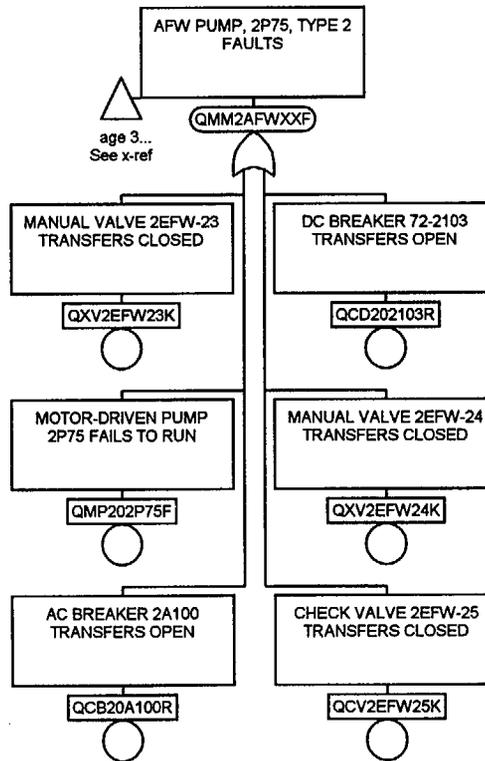
Date _____

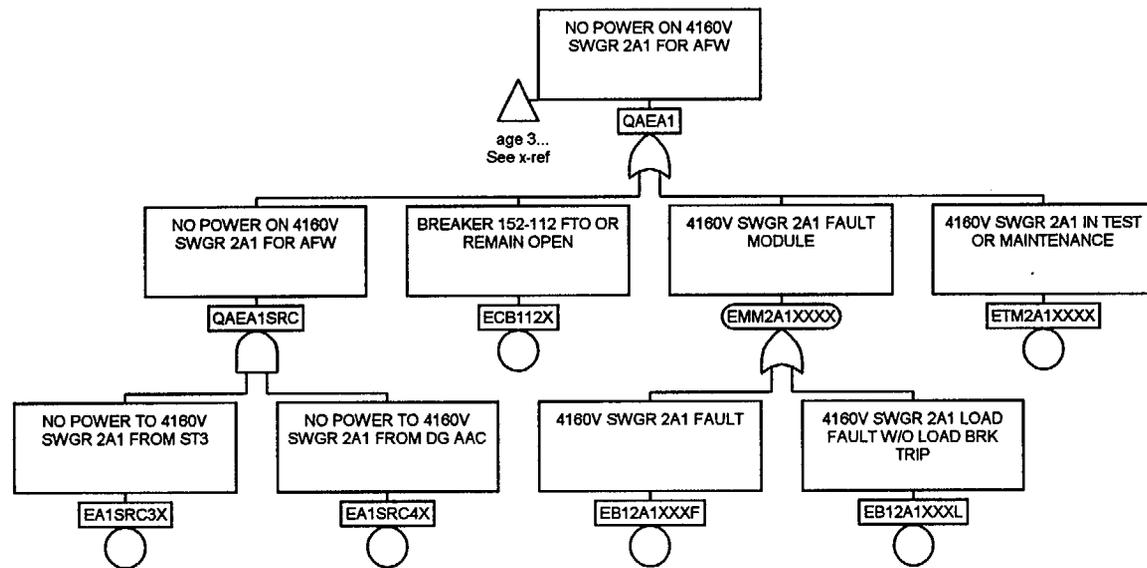
Attachment 1d

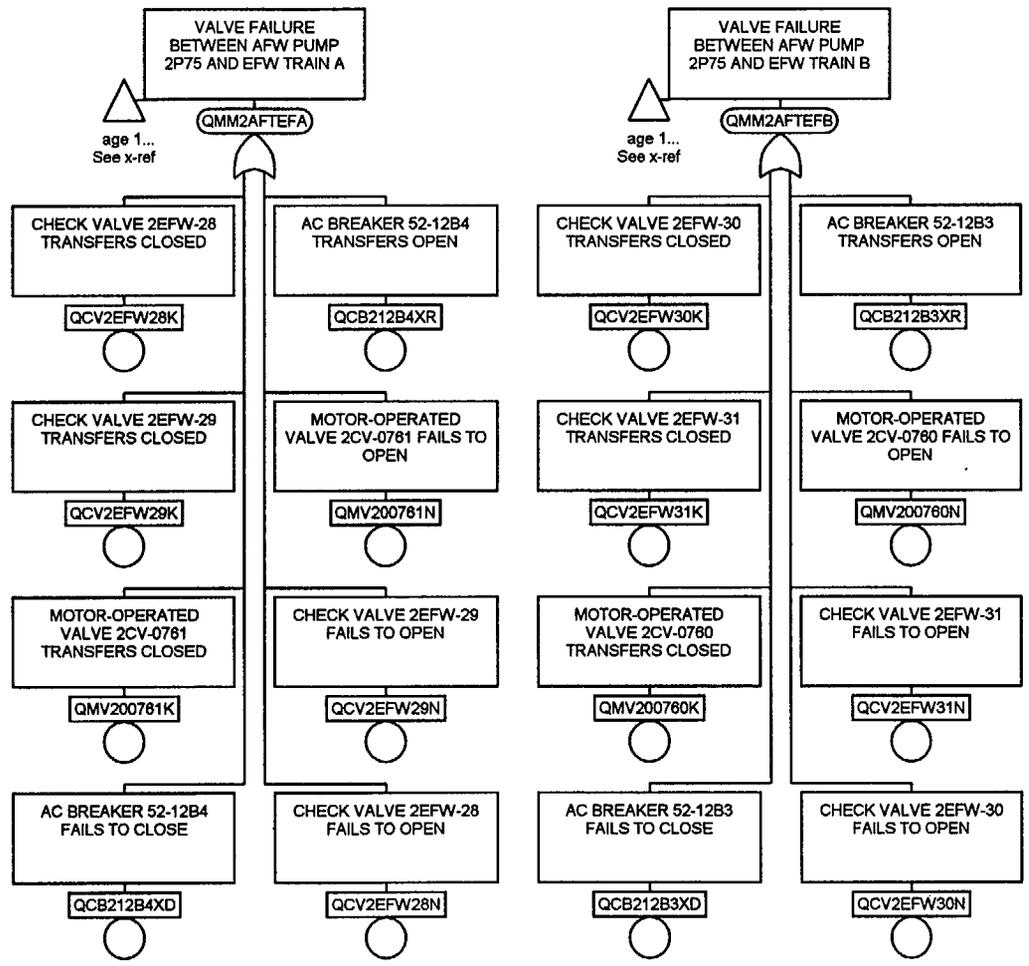
ANO-2 AFW System Fault Tree

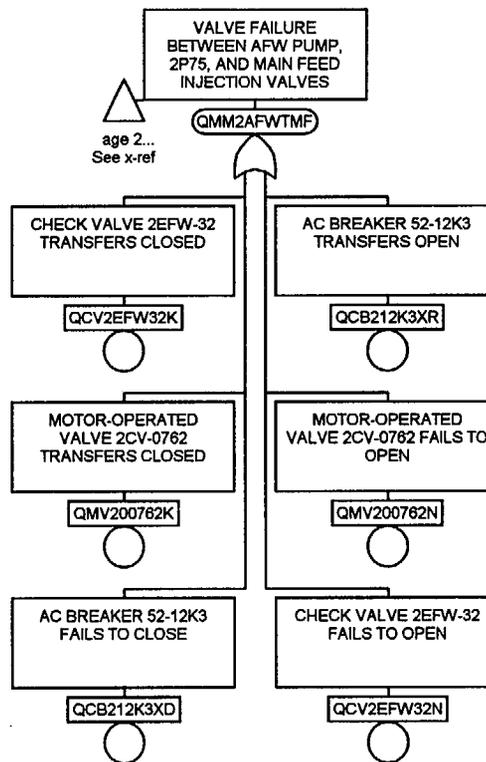












Name	Page	Zone	Name	Page	Zone	Name	Page	Zone	
D21AFX	3	6	QMM2AFTEFB	6	4				
EA1SRC3X	5	1	QMM2AFWTMF	2	7				
EA1SRC4X	5	2	QMM2AFWTMF	7	2				
EB12A1XXXXF	5	3	QMM2AFWXXA	3	2				
EB12A1XXXXL	5	4	QMM2AFWXXF	3	3				
EB12X	1	2	QMM2AFWXXF	4	2				
ECB112X	5	3	QMM2CSTNKA	2	2				
EMM2A1XXXX	5	4	QMM2CSTNKF	2	4				
ETM2A1XXXX	5	5	QMP202P75A	3	1				
QA110	1	2	QMP202P75F	4	1				
QA110	1	4	QMV200760K	6	3				
QA110	2	6	QMV200760N	6	4				
QA110-F	1	2	QMV200761K	6	1				
QA111	1	1	QMV200761N	6	2				
QA111	2	3	QMV200762K	7	1				
QA121	1	1	QMV200762N	7	2				
QA121	3	4	QMV2CV707K	2	1				
QA210-F	1	4	QRECAFW	1	2				
QA310-F	2	6	QTK2CT41AJ	2	3				
QAEA1	3	5	QTM2AFWXXX	3	4				
QAEA1	5	3	QXV2CT005K	2	2				
QAEA1SRC	5	2	QXV2EFW23K	4	1				
QCB20A100D	3	2	QXV2EFW24K	4	2				
QCB20A100R	4	1							
QCB212B3XD	6	3							
QCB212B3XR	6	4							
QCB212B4XD	6	1							
QCB212B4XR	6	2							
QCB212K3XD	7	1							
QCB212K3XR	7	2							
QCD202103D	3	1							
QCD202103R	4	2							
QCV2EFW16K	2	4							
QCV2EFW16N	2	2							
QCV2EFW25K	4	2							
QCV2EFW25N	3	2							
QCV2EFW28K	6	1							
QCV2EFW28N	6	2							
QCV2EFW29K	6	1							
QCV2EFW29N	6	2							
QCV2EFW30K	6	3							
QCV2EFW30N	6	4							
QCV2EFW31K	6	3							
QCV2EFW31N	6	4							
QCV2EFW32K	7	1							
QCV2EFW32N	7	2							
QHF2REFILL	2	5							
QMM2AFTEFA	1	3							
QMM2AFTEFA	6	2							
QMM2AFTEFB	1	5							

Attachment 1e

ANO-2 AFW Basic Event Listing

Basic Event Listing Associated with the ANO-2 AFW System Fault Tree

Basic Event Name	Probability	Description
D21AFX	Note 1	LOSS OF 125VDC BUS 2D21 <PRIOR OR MISSION>
EA1SRC3X	Note 1	NO POWER TO 4160V SWGR 2A1 FROM ST3
EA1SRC4X	Note 1	NO POWER TO 4160V SWGR 2A1 FROM DG AAC
EB12A1XXXF	1.08E-06	4160V SWGR 2A1 FAULT
EB12A1XXXL	5.90E-07	4160V SWGR 2A1 LOAD FAULT W/O LOAD BRK TRIP
EB12X	Note 1	NO POWER ON 480V MCC 2B12
ECB112X	Note 1	BREAKER 152-112 FTO OR REMAIN OPEN
ETM2A1XXXX	Note 2	4160V SWGR 2A1 IN TEST OR MAINTENANCE
QCB20A100D	6.45E-04	AC BREAKER 2A100 FAILS TO CLOSE
QCB20A100R	2.23E-05	AC BREAKER 2A100 TRANSFERS OPEN
QCB212B3XD	6.45E-04	AC BREAKER 52-12B3 FAILS TO CLOSE
QCB212B3XR	2.23E-05	AC BREAKER 52-12B3 TRANSFERS OPEN
QCB212B4XD	6.45E-04	AC BREAKER 52-12B4 FAILS TO CLOSE
QCB212B4XR	2.23E-05	AC BREAKER 52-12B4 TRANSFERS OPEN
QCB212K3XD	6.45E-04	AC BREAKER 52-12K3 FAILS TO CLOSE
QCB212K3XR	2.23E-05	AC BREAKER 52-12K3 TRANSFERS OPEN
QCD202103D	8.83E-04	DC BREAKER 72-2103 FAILS TO CLOSE
QCD202103R	9.12E-05	DC BREAKER 72-2103 TRANSFERS OPEN
QCV2EFW16K	7.34E-05	CHECK VALVE 2EFW-16 TRANSFERS CLOSED
QCV2EFW16N	4.93E-04	CHECK VALVE 2EFW-16 FAILS TO OPEN
QCV2EFW25K	7.34E-05	CHECK VALVE 2EFW-25 TRANSFERS CLOSED
QCV2EFW25N	4.93E-04	CHECK VALVE 2EFW-25 FAILS TO OPEN
QCV2EFW28K	7.34E-05	CHECK VALVE 2EFW-28 TRANSFERS CLOSED
QCV2EFW28N	4.93E-04	CHECK VALVE 2EFW-28 FAILS TO OPEN
QCV2EFW29K	7.34E-05	CHECK VALVE 2EFW-29 TRANSFERS CLOSED
QCV2EFW29N	4.93E-04	CHECK VALVE 2EFW-29 FAILS TO OPEN
QCV2EFW30K	7.34E-05	CHECK VALVE 2EFW-30 TRANSFERS CLOSED
QCV2EFW30N	4.93E-04	CHECK VALVE 2EFW-30 FAILS TO OPEN
QCV2EFW31K	7.34E-05	CHECK VALVE 2EFW-31 TRANSFERS CLOSED
QCV2EFW31N	4.93E-04	CHECK VALVE 2EFW-31 FAILS TO OPEN
QCV2EFW32K	7.34E-05	CHECK VALVE 2EFW-32 TRANSFERS CLOSED
QCV2EFW32N	4.93E-04	CHECK VALVE 2EFW-32 FAILS TO OPEN
QHF2REFILL	1.20E-02	OPERATORS FAIL TO ALIGN EFW SUCTION TO ALTERNATE CONDENSATE STORAGE TANK
QMP202P75A	2.32E-03	MOTOR-DRIVEN PUMP 2P75 FAILS TO START
QMP202P75F	6.43E-04	MOTOR-DRIVEN PUMP 2P75 FAILS TO RUN
QMV200760K	1.28E-04	MOTOR-OPERATED VALVE 2CV-0760 TRANSFERS CLOSED
QMV200760N	9.19E-03	MOTOR-OPERATED VALVE 2CV-0760 FAILS TO OPEN
QMV200761K	1.28E-04	MOTOR-OPERATED VALVE 2CV-0761 TRANSFERS CLOSED
QMV200761N	9.19E-03	MOTOR-OPERATED VALVE 2CV-0761 FAILS TO OPEN
QMV200762K	1.28E-04	MOTOR-OPERATED VALVE 2CV-0762 TRANSFERS CLOSED
QMV200762N	9.19E-03	MOTOR-OPERATED VALVE 2CV-0762 FAILS TO OPEN
QMV2CV707K	1.92E-03	MOTOR-OPERATED VALVE 2EFW-0707 TRANSFERS CLOSED
QRECAFW	1.60E-02	OPERATOR FAILS TO START AFW PUMP
QTK2CT41AJ	1.32E-04	CST TANK 2T41A RUPTURE OR LEAKAGE
QTM2AFWXXX	Note 2	AFW PUMP, 2P75, IN TEST AND MAINTENANCE
QXV2CT005K	5.65E-04	MANUAL VALVE 2CT-5 TRANSFERS CLOSED
QXV2EFW23K	3.77E-05	MANUAL VALVE 2EFW-23 TRANSFERS CLOSED

Basic Event Name	Probability	Description
QXV2EFW24K	3.77E-05	MANUAL VALVE 2EFW-24 TRANSFERS CLOSED

Note 1 This event is a transfer event to another system.

Note 2 This event is a maintenance unavailability event.

Attachment 2

2P99 Steam Generator "B" Eggcrate Flaw Data

The operational assessment for the time period following 2P99 utilized a single cycle model to predict the expected flaw population at the end of the interval. The model used five POD curves and randomly sampled from each to obtain a POD for each flaw size modeled. The five POD curves were from a site specific performance demonstration performed by ANO. To generator the requested information, a "composite" curve which is the POD curve used for the post-2R13 operational assessment, was used and the POD determined at each flaw's maximum reported depth. The values are provided in the attached table.

Also provided is the data taken from the EPRI crack draw program. This software uses the rotating pancake coil (RPC) data and assigns a depth at small intervals along the flaw. These values are then averaged to develop the percent degraded area or average depth. The average depth is used in the EPRI screening process to select in-situ candidates.

Explanation of the Use of the EPRI DRAW Program during 2P99

The main objective for use of the EPRI DRAW program is to develop the percent degraded area (or average depth) to be used in the in-situ selection process.

The input for the program can be data from the EddyNet analysis report, from text files created with a text editor or from a spreadsheet program such as Excel. It is important to note that the DRAW program does not perform any manipulation of the eddy current data but is only a tool to graphically represent the characteristics of an indication. Downloading the EddyNet analysis report to a PC and using a spreadsheet program to graph the results will perform the same function.

During the 2P99 outage, indications were initially screened as possible in-situ candidates using the field RPC data, which is performed by the resolution analyst. These report entries become part of the permanent database. Indications that met the screening criteria at this step in the process were then sized with the DRAW program. This sizing requires that an analyst measure a percent through wall depth for each hit of the indication during the RPC examination. The process requires the analyst assign a percent through wall (% TW) value to integrated parts of the flaw. If a hit measures 0% TW, it is not recorded. To locate the ends of the indication the 0% TW measurement preceding the first hit and the 0% TW following the last hit are measured and recorded. From this the DRAW program calculates the length of the indication. During the RPC field sizing process, the analyst is not measuring each RPC hit to see if it measures greater than 0% through wall but identified the start and stop of the indication from the terrain map.

Arkansas Nuclear One Unit-2 Steam Generator "B" 2P99 Eggcrate Data
Lengths are Based on 0.115 Pancake Coil as Full Length
Including Draw Lengths and Depths

	ROW	TUBE	IND	%TW (max.)	LENGTH	LOCATION	POD Value	Draw Length	Draw Depth (max.)
1	8	134	SAI	91	0.56	01H +0.53	0.99	0.51	97
2	10	150	SAI	89	0.59	03H +0.37	0.99		
3	5	153	SAI	88	0.59	07H +0.42	0.99		
4	32	100	SAI	87	0.52	01H +0.28	0.99		
5	47	145	SAI	86	0.41	02H +0.55	0.98		
6	44	72	SAI	85	0.45	01H +0.05	0.98		
7	32	108	SAI	83	0.68	01H -0.58	0.98		
8	49	77	SAI	81	0.39	01H +0.73	0.98		
9	32	108	SAI	80	0.55	01H -0.10	0.98		
10	72	72	SAI	80	0.77	02H -0.34	0.98	0.82 ^(Note 1)	96
11	53	83	SAI	78	0.64	01H +0.01	0.97	0.64	99
12	33	71	SAI	74	0.69	01H +0.23	0.96	0.59	90
13	102	110	SAI	74	1.55	02H -0.20	0.96	1.24	100
14	38	144	SAI	73	0.36	03H -0.59	0.96		
15	77	125	SAI	73	0.82	02H +0.34	0.96		
16	7	61	SAI	72	0.46	02H +0.56	0.95		
17	32	148	SAI	72	0.56	03H +0.52	0.95		
18	40	56	SAI	71	0.39	03H +0.49	0.95		
19	16	140	SAI	69	0.72	03H +0.46	0.94		
20	17	49	SAI	69	0.77	06H +0.15	0.94		
21	11	155	SAI	68	0.4	02H +0.75	0.94		
22	47	93	SAI	68	0.97	01H -0.04	0.94		
23	84	76	SAI	68	0.49	01H +0.43	0.94		
24	102	98	SAI	68	0.60	02H +0.18	0.94		
25	7	113	SAI	67	0.33	01H +0.62	0.93		
26	11	13	SAI	67	0.54	03H +0.01	0.93		
27	63	123	SAI	67	0.59	02H +0.39	0.93		

	ROW	TUBE	IND	%TW (max.)	LENGTH	LOCATION	POD Value	Draw Length	Draw Depth (max.)
28	67	119	SAI	67	0.31	01H -0.11	0.93		
29	119	65	SAI	67	0.57	04H +0.51	0.93	0.17	96
30	21	109	SAI	66	0.52	01H +0.67	0.92		
31	32	46	SAI	66	0.62	02H +0.38	0.92		
32	48	52	MAI	66	0.51	01H +0.45	0.92		
33	57	83	SAI	65	0.49	01H +0.40	0.92		
34	68	112	SAI	65	0.69	02H +0.01	0.92		
35	104	116	SAI	65	0.23	01H -0.50	0.92		
36	115	65	SAI	65	0.41	02H +0.39	0.92		
37	7	119	SAI	64	0.29	01H +0.20	0.91		
38	12	148	SAI	64	0.53	02H +0.16	0.91		
39	13	55	SAI	64	0.59	01H -0.12	0.91		
40	63	115	SAI	64	0.64	01H +0.11	0.91		
41	65	125	SAI	64	0.46	02H -0.65	0.91		
42	75	85	SAI	64	0.67	03H +0.68	0.91		
43	1	51	SAI	63	0.95	04H +0.04	0.90		
44	9	127	SAI	63	0.36	01H -0.32	0.90		
45	26	40	SAI	63	0.64	02H +0.63	0.90		
46	28	36	SAI	63	0.49	02H +0.43	0.90		
47	36	36	SAI	63	1.03	02H -0.15	0.90	0.94	91
48	42	38	SAI	63	0.39	01H +0.09	0.90		
49	62	36	SAI	63	0.59	03H +0.74	0.90		
50	47	91	SAI	62	0.91	01H +0.33	0.89		
51	92	102	SAI	62	0.35	02H +0.64	0.89		
52	106	90	SAI	62	0.61	02H -0.44	0.89		
53	5	21	SAI	61	0.43	03H +0.02	0.88		
54	9	115	SAI	61	0.78	01H +0.42	0.88		
55	11	143	SAI	61	0.39	01H -0.08	0.88		
56	12	56	SAI	61	0.54	02H +0.80	0.88	0.49	94
57	23	55	SAI	61	1.39	02H -0.35	0.88	1.15	100
58	120	114	SAI	61	0.28	03H +0.82	0.88		
59	8	148	SAI	60	0.65	01H +0.72	0.87		
60	33	109	SAI	60	0.81	01H -0.45	0.87		

	ROW	TUBE	IND	%TW (max.)	LENGTH	LOCATION	POD Value	Draw Length	Draw Depth (max.)
61	58	106	SAI	60	0.55	01H -0.76	0.87		
62	67	111	SAI	60	0.59	01H -0.39	0.87		
63	104	100	SAI	60	0.85	02H +0.37	0.87		
64	106	90	SAI	60	0.71	02H +0.61	0.87		
65	9	115	SAI	59	0.49	01H -0.47	0.86		
66	28	36	SAI	59	0.44	02H -0.19	0.86		
67	28	44	SAI	59	1.58	01H -0.58	0.86	0.75	94
68	29	123	SAI	59	0.84	04H +0.49	0.86		
69	38	110	MAI	59	0.89	01H +0.72	0.86		
70	60	108	SAI	59	1.08	01H +0.71	0.86		
71	67	57	SAI	58	0.43	01H +0.73	0.85		
72	77	113	SAI	58	0.56	01H +0.45	0.85		
73	4	20	SAI	57	0.71	01H -0.52	0.83		
74	4	28	SAI	57	0.72	01H -0.74	0.83		
75	10	150	MAI	57	0.46	01H +0.71	0.83		
76	66	28	SAI	57	0.36	02H -0.65	0.83		
77	12	62	SAI	56	0.44	01H +0.48	0.81		
78	12	106	SAI	56	0.78	01H +0.47	0.81		
79	33	71	SAI	56	0.42	01H -0.12	0.81		
80	40	116	SAI	56	0.59	01H +0.70	0.81		
81	4	156	SAI	55	0.83	02H -0.19	0.80		
82	6	116	SAI	55	0.55	01H -0.12	0.80		
83	20	52	SAI	55	0.51	01H +0.45	0.80		
84	32	24	SAI	55	0.28	01H +0.41	0.80		
85	32	108	SAI	55	0.49	01H +0.17	0.80		
86	37	95	SAI	55	0.99	01H -0.48	0.80		
87	38	114	SAI	55	0.42	02H +0.23	0.80		
88	42	38	SAI	55	0.70	01H +0.65	0.80		
89	68	44	SAI	55	0.98	03H +0.03	0.80		
90	6	136	SAI	54	0.38	01H -0.39	0.78		
91	20	132	SAI	54	0.46	02H -0.07	0.78		
92	45	89	SAI	54	0.39	01H +0.68	0.78		
93	75	89	SAI	54	0.49	02H +0.83	0.78		

	ROW	TUBE	IND	%TW (max.)	LENGTH	LOCATION	POD Value	Draw Length	Draw Depth (max.)
	94	1	51	SAI	53	0.62	03H +0.26	0.76	
	95	10	16	SAI	53	0.94	02H +0.04	0.76	
	96	48	96	SAI	53	0.96	01H -0.35	0.76	
	97	60	108	SAI	53	1.14	01H +0.27	0.76	
	98	75	91	SAI	53	0.56	02H +0.12	0.76	
	99	89	51	SAI	53	0.38	01H +0.10	0.76	
	100	95	45	SAI	53	0.43	02H +0.38	0.76	
	101	102	98	SAI	53	0.35	01H +0.46	0.76	
	102	40	116	SAI	52	0.46	01H +0.54	0.73	
	103	52	36	SAI	51	0.75	01H +0.59	0.71	
	104	4	150	SAI	50	0.43	01H +0.82	0.68	
	105	9	125	SAI	50	0.46	01H +0.43	0.68	
	106	12	30	SAI	50	0.44	01H +0.53	0.68	
	107	13	31	SAI	50	0.85	02H -0.48	0.68	
	108	35	33	SAI	50	0.18	03H +0.36	0.68	
	109	46	126	SAI	50	0.44	01H +0.57	0.68	
	110	47	93	SAI	50	0.76	01H -0.40	0.68	
	111	48	52	MAI	50	0.66	01H +0.30	0.68	
	112	53	109	SAI	50	0.57	01H -0.62	0.68	
	113	75	45	SAI	50	0.4	02H -0.40	0.68	
	114	33	117	SAI	49	0.42	05H +0.54	0.65	
	115	36	116	SAI	49	0.78	01H +0.65	0.65	
	116	84	116	SAI	49	0.82	02H +0.58	0.65	
	117	24	136	SAI	48	0.31	03H +0.28	0.62	
	118	34	52	SAI	48	0.43	06H +0.51	0.62	
	119	58	106	SAI	48	0.55	01H -0.76	0.62	
	120	65	97	SAI	48	0.58	02H -0.51	0.62	
	121	84	112	SAI	48	0.79	02H +0.51	0.62	
	122	12	106	SAI	47	0.85	01H -0.40	0.59	
	123	121	113	SAI	47	0.25	01H -0.62	0.59	
	124	13	57	SAI	46	0.39	01H +0.78	0.56	
	125	89	73	SAI	46	0.67	02H +0.17	0.56	0.4
	126	83	109	SAI	45	0.3	01H +0.77	0.53	94

	ROW	TUBE	IND	%TW (max.)	LENGTH	LOCATION	POD Value	Draw Length	Draw Depth (max.)
127	92	100	SAI	45	0.68	02H +0.58	0.53		
128	5	3	SAI	44	0.87	01H +0.01	0.49		
129	86	104	SAI	44	0.42	01H -0.48	0.49		
130	4	156	SAI	43	0.5	02H +0.76	0.46		
131	31	49	SAI	43	0.77	01H +0.20	0.46		
132	14	112	SAI	42	0.59	04H +0.59	0.42		
133	16	118	SAI	42	0.81	01H +0.78	0.42		
134	18	126	SAI	42	0.56	01H +0.73	0.42		
135	23	143	SAI	42	0.27	01H -0.32	0.42		
136	23	143	SAI	42	0.80	02H -0.04	0.42		
137	45	69	SAI	41	0.44	02H -0.30	0.38		
138	7	119	SAI	40	0.29	01H -0.06	0.35		
139	24	24	SAI	40	0.26	01H +0.26	0.35		
140	31	125	SAI	40	0.59	01H -0.27	0.35		
141	36	116	SAI	40	0.72	01H +0.25	0.35		
142	49	19	SAI	40	0.34	04H +0.66	0.35		
143	60	44	SAI	40	0.9	02H +0.02	0.35		
144	117	89	SAI	40	0.42	01H -0.44	0.35		
145	84	112	SAI	39	0.37	02H -0.62	0.31		
146	3	57	SAI	38	0.59	01H -0.74	0.28		
147	6	140	SAI	38	0.36	02H -0.49	0.28		
148	52	82	SAI	38	0.34	01H -0.10	0.28		
149	83	109	SAI	38	0.45	01H -0.32	0.28		
150	123	99	SAI	38	0.59	01H -0.35	0.28		
151	4	150	SAI	37	0.75	01H -0.44	0.25		
152	16	140	SAI	37	0.71	02H +0.68	0.25		
153	74	66	SAI	36	0.65	01H +0.52	0.22		
154	2	34	SAI	35	0.94	02H -0.45	0.19		
155	36	116	SAI	35	0.39	01H +0.87	0.19		
156	39	111	SAI	35	0.29	01H +0.79	0.19		
157	42	78	SAI	35	0.72	01H +0.80	0.19		
158	42	142	SAI	34	0.41	01H +0.54	0.16		
159	38	110	MAI	32	0.54	01H +0.51	0.12		

	ROW	TUBE	IND	%TW (max.)	LENGTH	LOCATION	POD Value	Draw Length	Draw Depth (max.)
160	10	148	SAI	31	0.33	01H +0.80	0.10		
161	27	127	SAI	30	0.62	04H +0.65	0.08		
162	77	83	SAI	30	0.38	02H -0.10	0.08		
163	136	88	SAI	30	0.44	01H +0.40	0.08		
164	52	82	SAI	28	0.67	01H +0.22	0.05		
165	6	138	MAI	25	0.28	01H +0.65	0.03		
166	10	150	MAI	25	0.38	01H +0.35	0.03		
167	26	144	SAI	25	0.31	01H -0.39	0.03		
168	16	140	SAI	23	0.23	03H +0.31	0.02		
169	23	143	SAI	23	0.25	01H +0.81	0.02		
170	65	119	SAI	19	0.53	01H -0.62	0.00		
171	61	115	SAI	17	0.62	02H +0.59	0.00		
172	8	128	SAI	15	0.52	01H +0.80	0.00		
173	16	116	SAI	14	0.65	05H +0.61	0.00		
174	27	127	SAI	14	0.82	02H +0.67	0.00		
175	9	127	SAI	12	0.39	01H +0.95	0.00		
176	3	141	SAI	7	0.45	01H +0.33	0.00		
177	6	138	MAI	6	0.4	01H +0.73	0.00		
178	1	137	SAI	5	0.59	01H -0.35	0.00		
179	86	118	SAI	5	0.52	01H +0.39	0.00		
180	34	130	SAI	2	0.48	02H +0.52	0.00		
181	11	135	SAI	1	0.33	03H -0.24	0.00		
182	11	143	SAI	1	0.33	01H +0.69	0.00		
183	55	95	SAI	1	0.75	01H +0.11	0.00		

Note 1: Tube 72-72 received additional analysis following the outage. The resulting length measurement was 1.42".