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.

Rev. No.: 1 **Verification Method:** **Design Review:** √
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Purpose of Revision: Update system model and make a Q document

Initiating Documents	Resulting Document(s)	Key Design Input Docs.
Generic Letter 88-20	-	See References

Amends Calc(s): -

Supercedes Calc(s): -

Computer Software(Ver.): CAFTA

By: Marlon Kuan / MK / 3/15/94 **Rvw'd:** ~~D.W. Fouts~~ QF 12-22-94 N/A / / /

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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

ANO-2 EMERGENCY FEEDWATER SYSTEM

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[illegible] operation of the solenoid bypass [illegible]

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

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

supply line will close the condensate line isolation valves and simultaneously open the SWS supply valves.

The condensate storage tank is not expected to have sufficient volume to sustain the operation of the EFW during all modes of operation. The tank is continuously refilled by the operator from the second CST or from the Startup and Blowdown Demineralizer during EFW operation. In addition, water level in the CST is alarmed at low level, all other outlet flows except the supply to EFW, are isolated on low-low level.

During plant startup, hot standby, hot shutdown, and normal plant cooldown, the EFW is manually started and is under operator control.

EFAS signals to various components are summarized below:

COMPONENT	SIGNAL	RELAY
2CV-1026-2	OPEN	K624B
2CV-1076-1	OPEN	K625B
2CV-1039-1	OPEN	K725A
2CV-1037-1	OPEN	K724A
2CV-0340-2	OPEN	K113B, K303B
2SV-0205	OPEN	K113B, K303B
2SV-0317	OPEN	K113B, K303B
2CV-1025-1	OPEN	K624A
2CV-1075-1	OPEN	K625A
2CV-1036-2	OPEN	K725B
2CV-1038-2	OPEN	K724B
2CV-0714-1	CLOSE	K310A, K211A
2CV-0798-1	CLOSE	K310A, K211A
2CV-0716-1	OPEN	K310A, K402A
2CV-0789-1	CLOSE	K310A, K402A[1]
2CV-0711-2	OPEN	K310B, K402B
2CV-0795-2	CLOSE	K310B, K402B[1]
2P7B	START	K112A, K211A

To provide isolation of a ruptured steam generator, the appropriate valves receive a MSIS signal to CLOSE, provided no EFAS is present.

2.5 System Interfaces

The EFW system interfaces with the following systems:

AC Power

AC power is required for the motor-driven pump, and for injection valve operation. The gates used from the AC power fault tree are EA3, EB51, EB53, and EB63.

DC Power

DC Power is required for operation of valves in the steam supply lines to the turbine driven pump,

[1]Signal initiated on low pump suction pressure

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:

Attachment	Contents
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

3.1 List of Fault Tree Top Events

The following top events are modeled:

Q001: EFW FAILS TO PROVIDE FLOW TO 1 OF 2 SGs FROM 1 OF 2 PUMPS
Q501: EFW FAILS TO PROVIDE FLOW TO SGB FROM 1 OF 2 PUMPS

3.2 Success Criteria

The EFW system is successful if full flow is delivered to the specified steam generator from one pump train. This criterion includes the condition that low pressure in a specified steam generator will cause EFW flow to that steam generator to be isolated.

3.3 Modeling Assumptions

The following assumptions were made in the EFW system model:

1. Service Water is considered as a backup to the CST for EFW suction, since it is automatically actuated. The normal mode of operation is to continuously refill the CST, so that a demand on the second CST or on SW is not required.

2. Switching to the second CST is not modeled since it is a recovery action. A human failure event is included in the model for failure to refill the CST, since this is normal operating procedure. It is conservatively assumed that the second CST tank must be switched to for success. This is conservative because one CST contains enough capacity to cool the reactor to levels at which the shutdown heat exchangers will be able to keep the reactor cooled. The fault tree model assumes that the CST source of water fails if the second CST can't be switched to during the mission time. While conservative, this is not unreasonable, since switching to shutdown cooling would require a manual action as well. If the operator fails to switch to the alternate condensate storage tank, he may just as likely fail to switch to shutdown cooling. Failure to switch to the other CST is therefore considered failure of the CST as a source of water.

3. The Service Water backup is automatically actuated on low pressure in the normal pump suction lines. Valves 2CV-0711-2 and 2CV-0716-1 open to provide flow from the Service Water system, and valves 2CV-0789-1 and 2CV-0795-2 close to isolate the normal supply lines. A 'fails to close' failure is included for valves 2CV-0798-1 and 2CV-0795-2, since this is an automatic part of the switchover. However, in the fault tree model, these valves are not required to remain closed (i.e. a 'transfers open' failure is not included), since flow diversion to any of the condensate storage tanks would require multiple failures.

4. Operation of the solenoid bypass valve SV-0205 is assumed to be required for successful operation of the P7A turbine. The valve is required to initially open, but is not required to reclose for success.

5. Consideration of overspeed failures due to a failure of the time delay relay which sequences the steam admission valves (2CV-0340-2 and 2SV-0205) is included in the turbine-driven pump failure data.

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 negligable.

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

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

ATTACHMENT A

THIS ATTACHMENT HAS BEEN DELETED

ATTACHEMENT B

FAULT TREE BASIC EVENT DESCRIPTIONS

	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	NFEFWATOA				NO FLOW FROM TRAIN A TO SG A FLAG	R1:
47	NFEFWATOB				NO FLOW TO SGB FROM EFW PUMP TRAIN A FLAG	R1:
48	NFEFWBTOA				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	1		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

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	SXV2SW39AK	2	18	M	MANUAL VALVE 2SW-39A TRANSFERS CLOSED	R1:
227	SXV2SW39BK	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	XSEFWATOA		1		EXCESSIVE EFW FLOR FROM PUMP A TO SG A FLAG	R1:
234	XSEFWATOB		1		EXCESSIVE FLOW TO SG B FROM 2P7A FLAG	R1:
235	XSEFWBTOA		1		EXCESSIVE EFW FLOR FROM PUMP B TO SG A FLAG	R1:
236	XSEFWBTOB		1		EXCESSIVE FLOW TO SG B FROM 2P7B FLAG	R1:

ATTACHMENT C

FAULT TREE MODULE DESCRIPTIONS

\MATT\EFW\Q2R1PS.CUT CUTSET REPORT
Filter: 'ALL'

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

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)
```

```
    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
```

ATTACHMENT D

FAULT TREE MUTUALLY EXCLUSIVE EVENTS

The following events are mutually exclusive:

1) QTM2EFWTAF * QTM2EFWTBF

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.

ATTACHMENT F

SIMPLIFIED P&ID

FIGURE F-1 ANO-2 EMERGENCY FEEDWATER SYSTEM

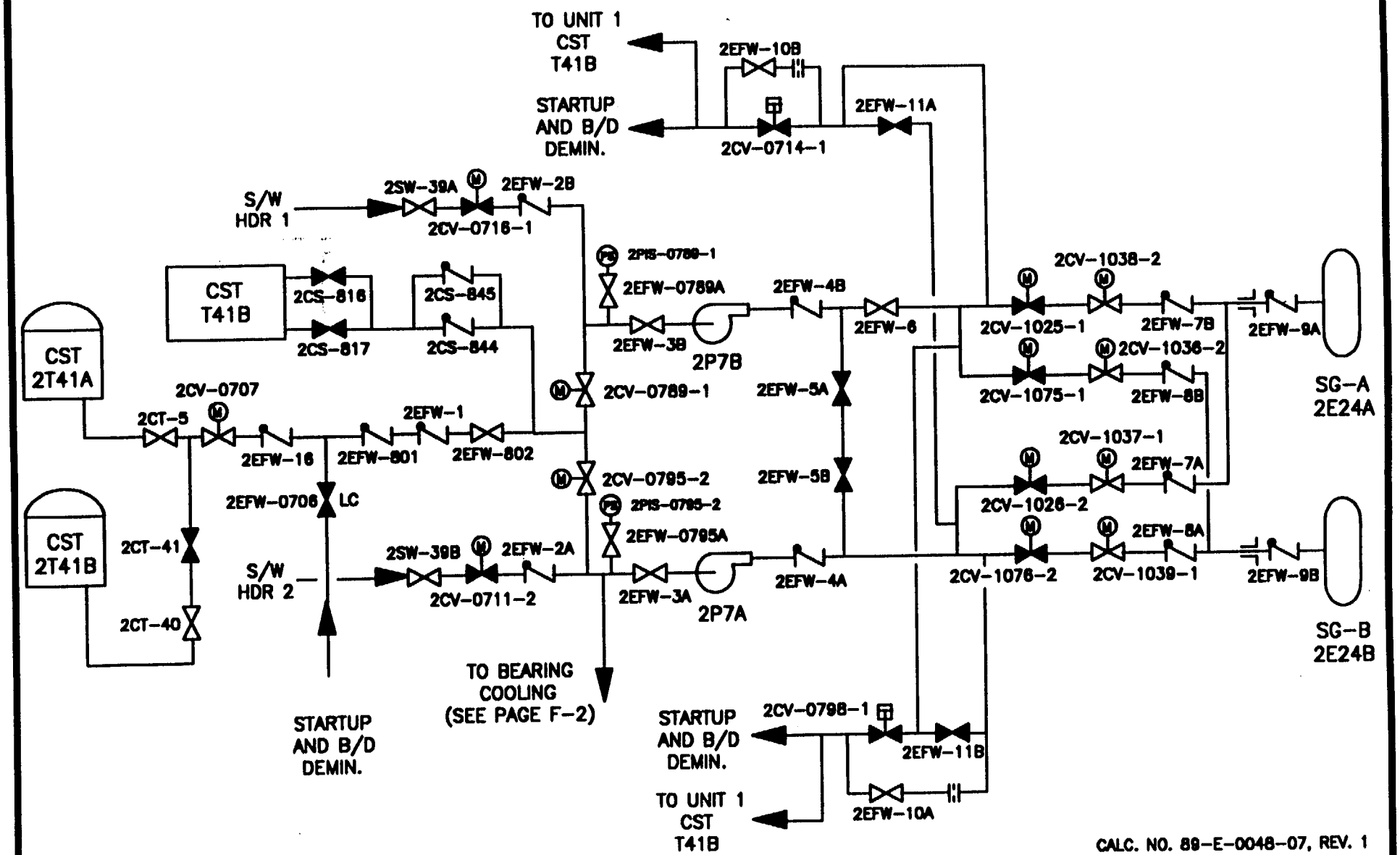
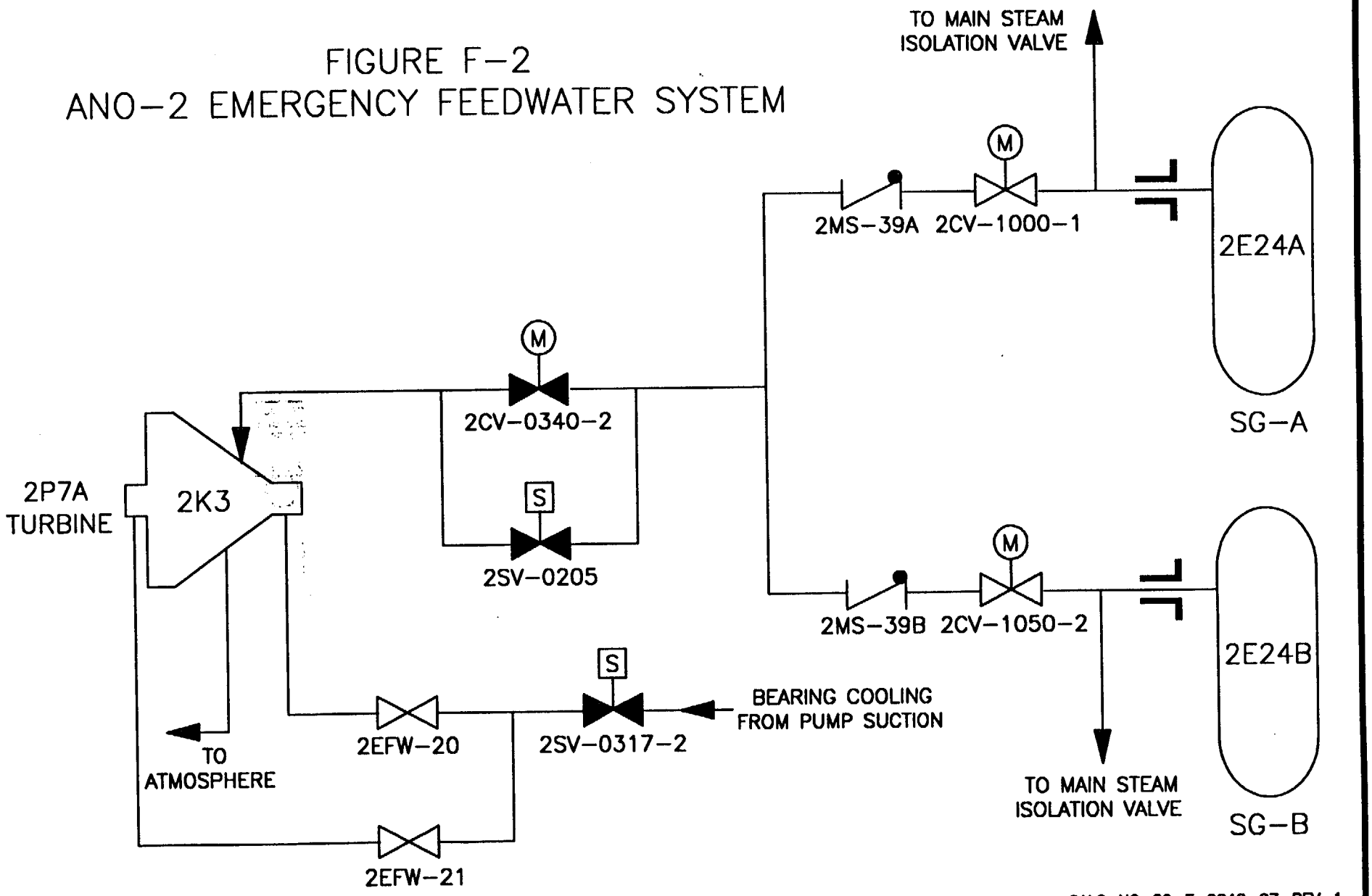


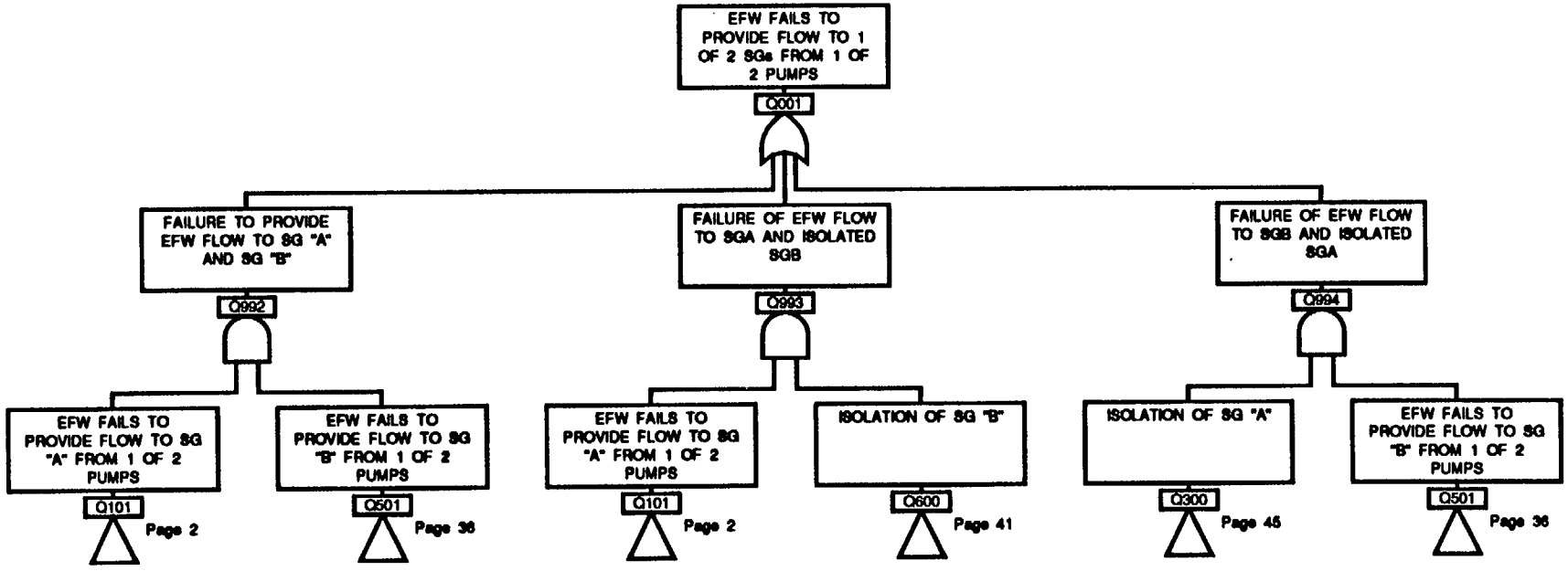
FIGURE F-2
ANO-2 EMERGENCY FEEDWATER SYSTEM

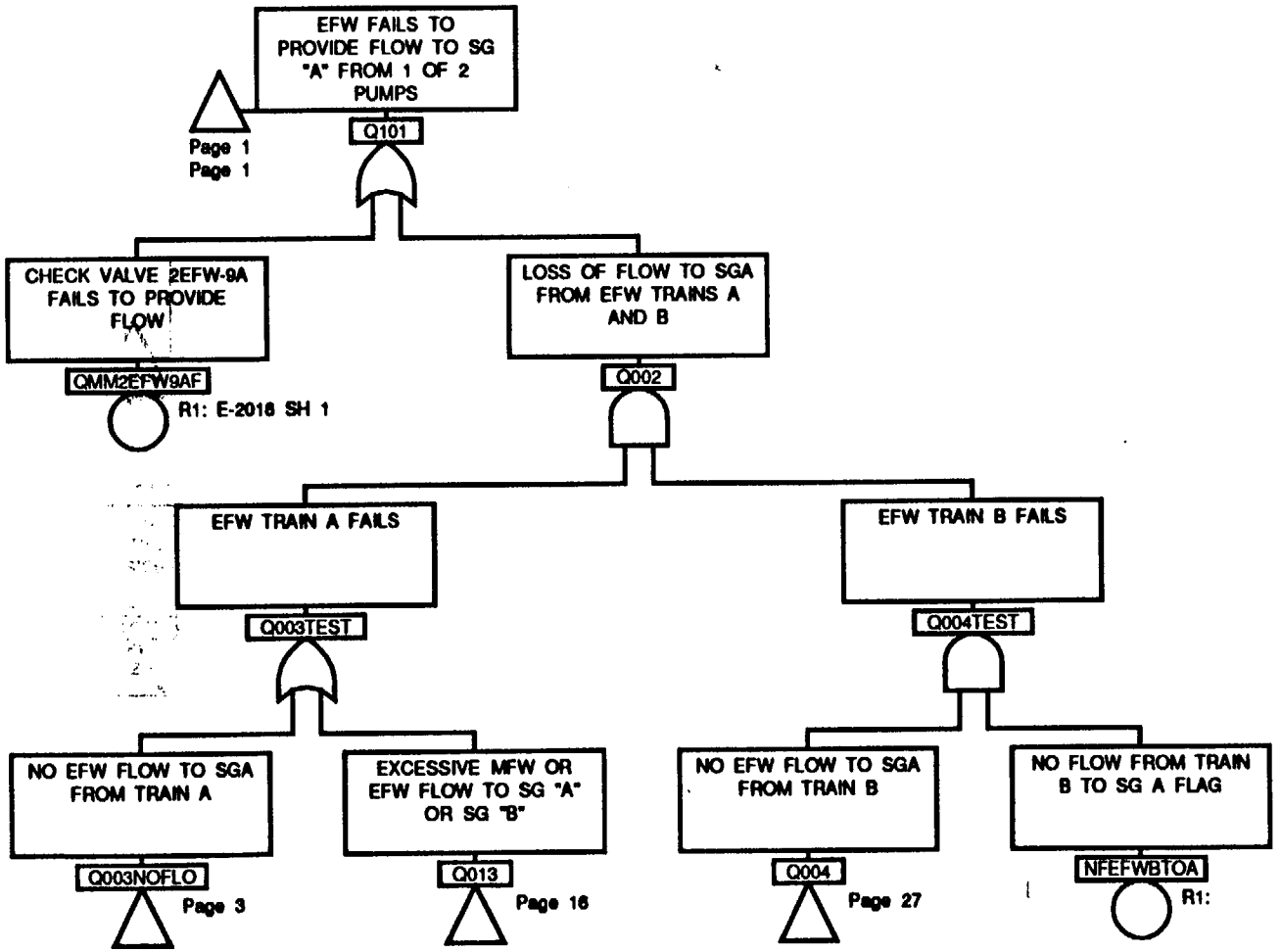


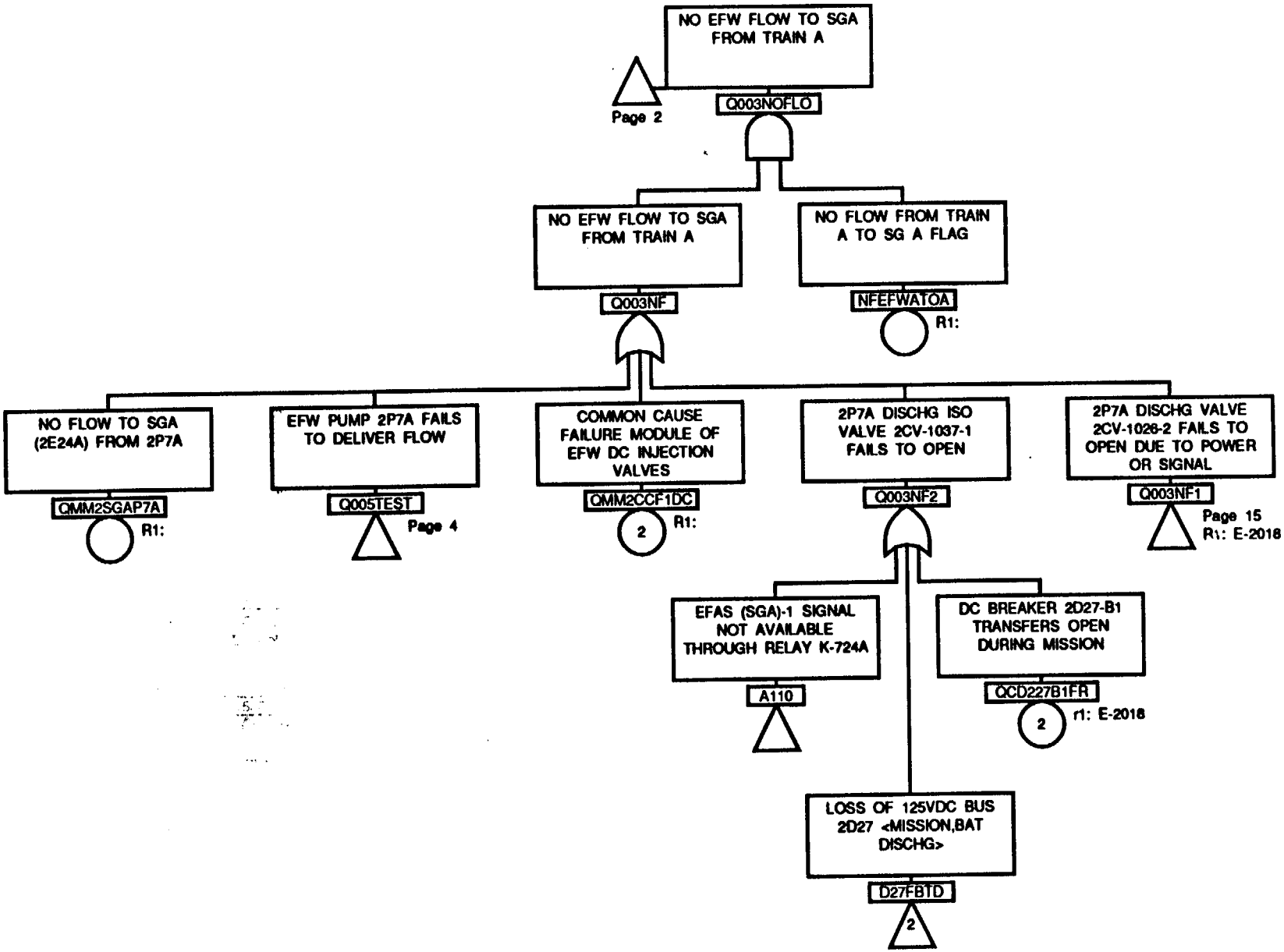
CALC. NO. 89-E-0048-07, REV. 1

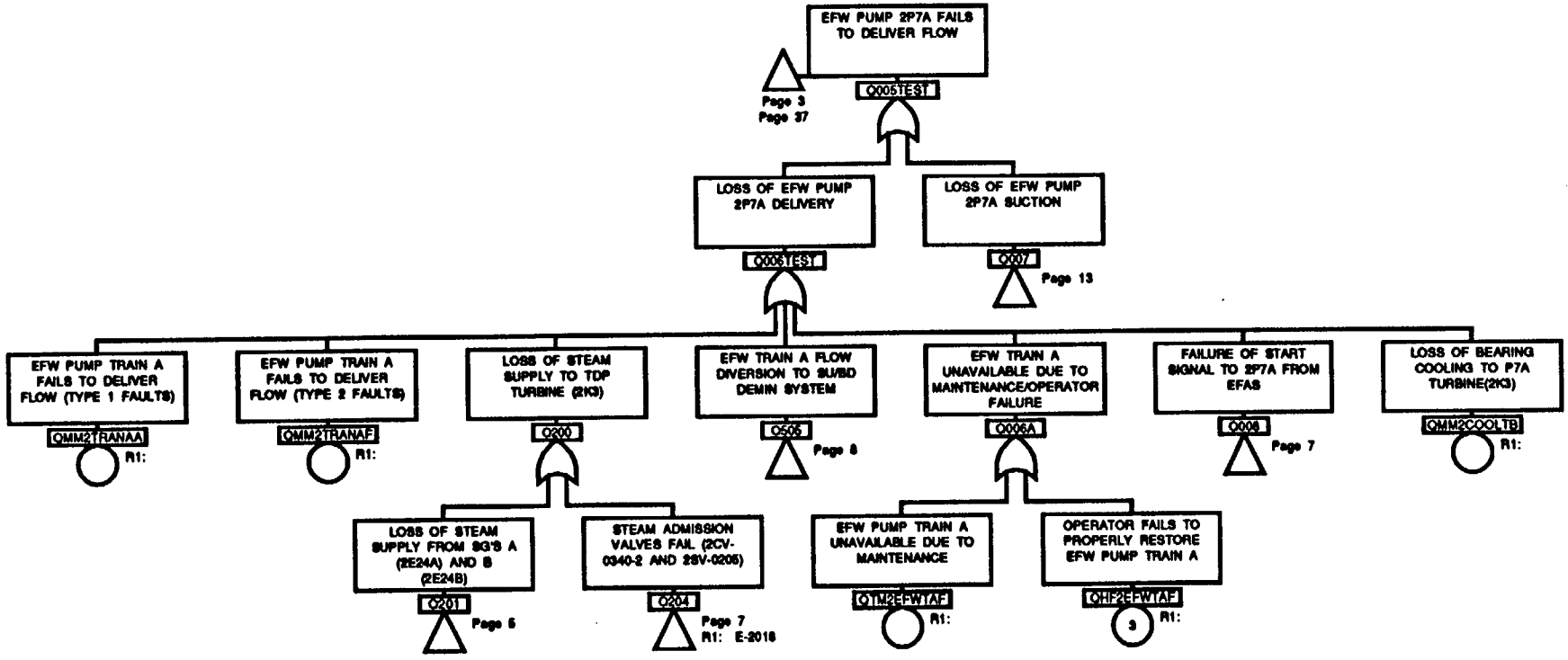
ATTACHMENT G

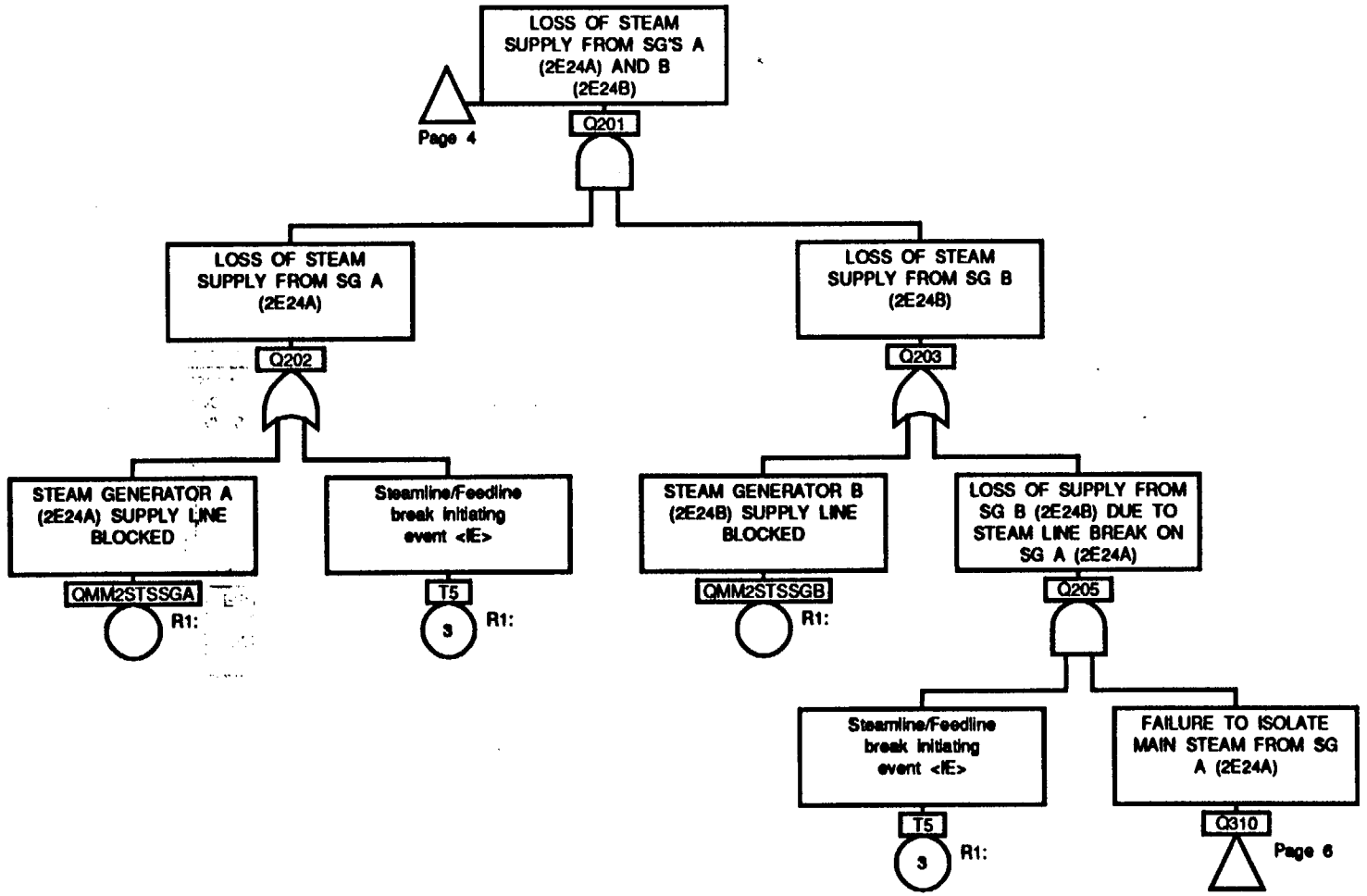
MODULAR FAULT TREE

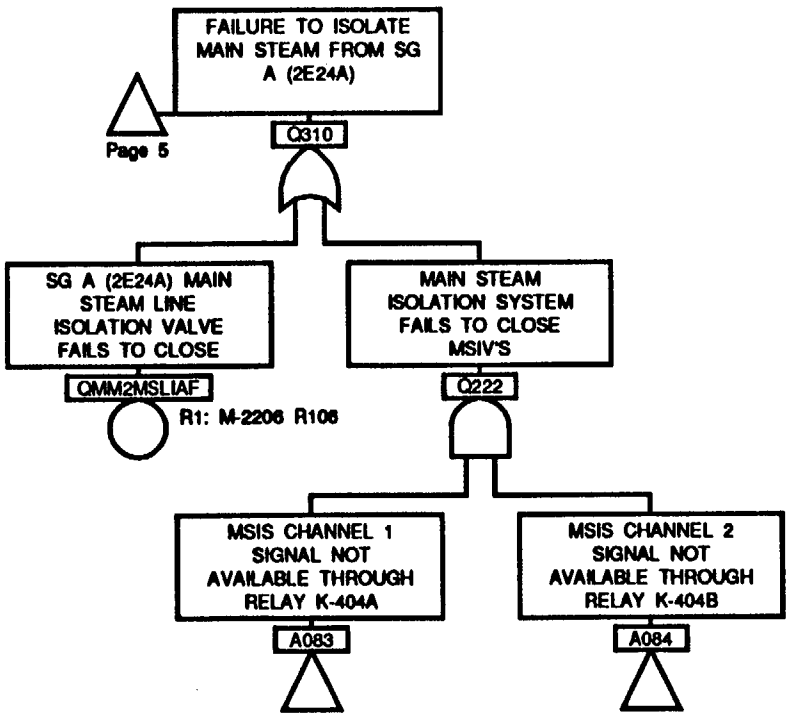

EFW FAILS TO PROVIDE FLOW TO 1 OF 2 SGs FROM 1 OF 2 PUMPS
Q001
FAILURE TO PROVIDE EFW FLOW TO SG "A" AND SG "B"
Q992
EFW FAILS TO PROVIDE FLOW TO SG "A" FROM 1 OF 2 PUMPS
Q101
Page 2
EFW FAILS TO PROVIDE FLOW TO SG "B" FROM 1 OF 2 PUMPS
Q501
Page 36
FAILURE OF EFW FLOW TO SGA AND ISOLATED SGB
Q993
EFW FAILS TO PROVIDE FLOW TO SG "A" FROM 1 OF 2 PUMPS
Q101
Page 2
ISOLATION OF SG "B"
Q600
Page 41
FAILURE OF EFW FLOW TO SGB AND ISOLATED SGA
Q994
ISOLATION OF SG "A"
Q300
Page 45
EFW FAILS TO PROVIDE FLOW TO SG "B" FROM 1 OF 2 PUMPS
Q501
Page 36

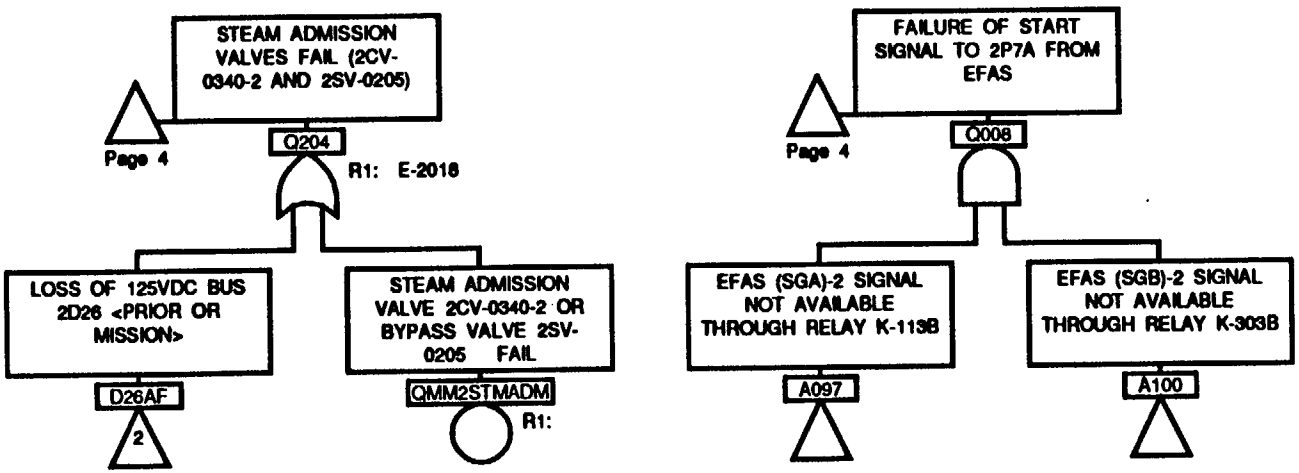

EFW FAILS TO PROVIDE FLOW TO SG "A" FROM 1 OF 2 PUMPS
Q101
Page 1
Page 1
CHECK VALVE 2EFW-9A FAILS TO PROVIDE FLOW
QMM2EFW9AF
R1: E-2018 SH 1
LOSS OF FLOW TO SGA FROM EFW TRAINS A AND B
Q002
EFW TRAIN A FAILS
Q003TEST
EFW TRAIN B FAILS
Q004TEST
NO EFW FLOW TO SGA FROM TRAIN A
Q003NOFLO
Page 3
EXCESSIVE MFW OR EFW FLOW TO SG "A" OR SG "B"
Q013
Page 16
NO EFW FLOW TO SGA FROM TRAIN B
Q004
Page 27
NO FLOW FROM TRAIN B TO SG A FLAG
NFEFWBTOA
R1:

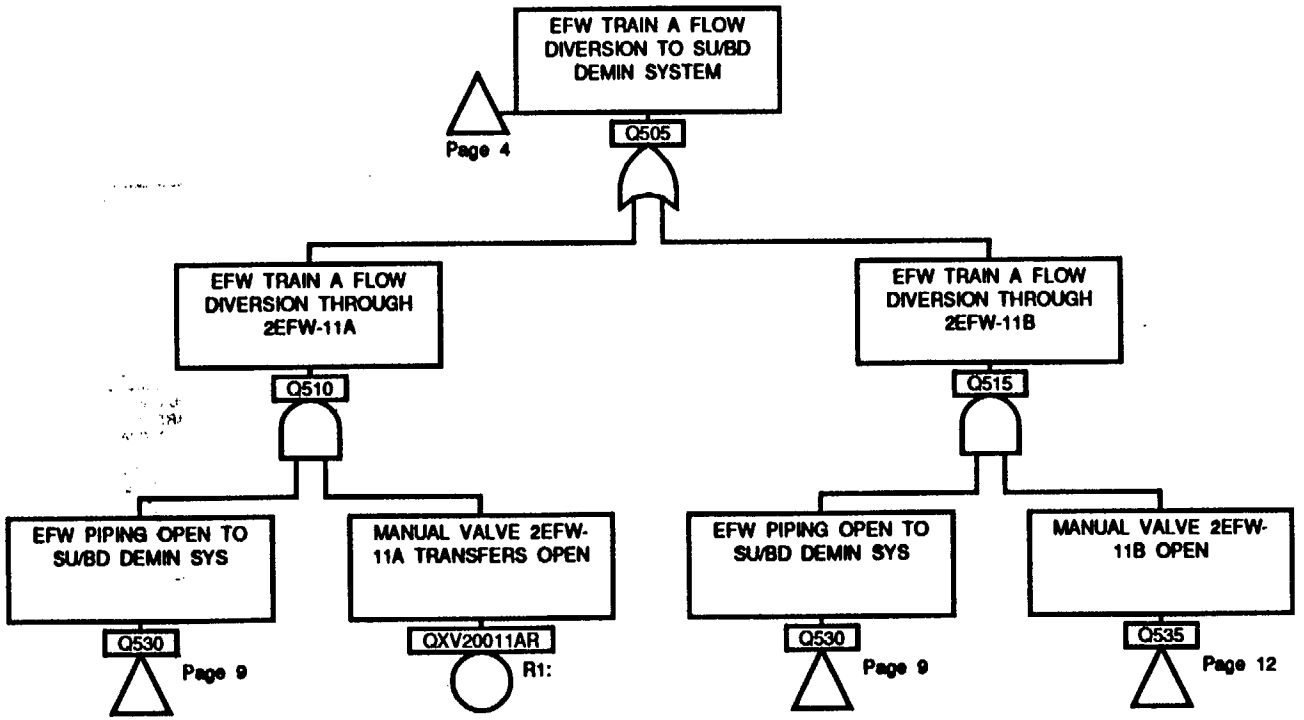

NO EFW FLOW TO SGA FROM TRAIN A
Page 2
Q003NOFLO
NO EFW FLOW TO SGA FROM TRAIN A
Q003NF
NO FLOW FROM TRAIN A TO SG A FLAG
NFEFWATOA
R1:
NO FLOW TO SGA (2E24A) FROM 2P7A
QMM2SGAP7A
R1:
EFW PUMP 2P7A FAILS TO DELIVER FLOW
Q005TEST
Page 4
COMMON CAUSE FAILURE MODULE OF EFW DC INJECTION VALVES
QMM2CCF1DC
2
R1:
2P7A DISCHG ISO VALVE 2CV-1037-1 FAILS TO OPEN
Q003NF2
2P7A DISCHG VALVE 2CV-1026-2 FAILS TO OPEN DUE TO POWER OR SIGNAL
Q003NF1
Page 15
R1: E-2018
EFAS (SGA)-1 SIGNAL NOT AVAILABLE THROUGH RELAY K-724A
A110
DC BREAKER 2D27-B1 TRANSFERS OPEN DURING MISSION
QCD227B1FR
2
r1: E-2018
LOSS OF 125VDC BUS 2D27 <MISSION,BAT DISCHG>
D27FBTD
2

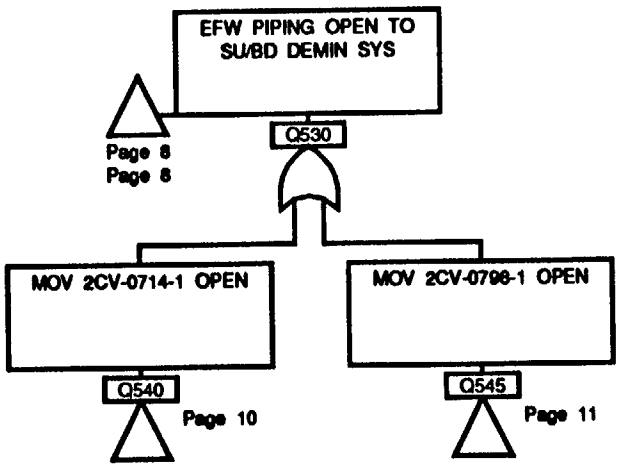

EFW PUMP 2P7A FAILS TO DELIVER FLOW
Q005TEST
Page 3
Page 37
LOSS OF EFW PUMP 2P7A DELIVERY
LOSS OF EFW PUMP 2P7A SUCTION
Q003TEST
Q007
Page 13
EFW PUMP TRAIN A FAILS TO DELIVER FLOW (TYPE 1 FAULTS)
EFW PUMP TRAIN A FAILS TO DELIVER FLOW (TYPE 2 FAULTS)
LOSS OF STEAM SUPPLY TO TDP TURBINE (2K3)
EFW TRAIN A FLOW DIVERSION TO SU/BD DEMIN SYSTEM
EFW TRAIN A UNAVAILABLE DUE TO MAINTENANCE/OPERATOR FAILURE
FAILURE OF START SIGNAL TO 2P7A FROM EFAS
LOSS OF BEARING COOLING TO P7A TURBINE(2K3)
QMM2TRANAA
QMM2TRANAF
Q200
Q505
Page 8
Q006A
Q008
Page 7
QMM2COOLTB
R1:
LOSS OF STEAM SUPPLY FROM SG'S A (2E24A) AND B (2E24B)
STEAM ADMISSION VALVES FAIL (2CV-0340-2 AND 2SV-0205)
EFW PUMP TRAIN A UNAVAILABLE DUE TO MAINTENANCE
OPERATOR FAILS TO PROPERLY RESTORE EFW PUMP TRAIN A
Q201
Page 5
Q204
Page 7
R1: E-2018
QTM2EFWTAF
QHF2EFWTAF
3

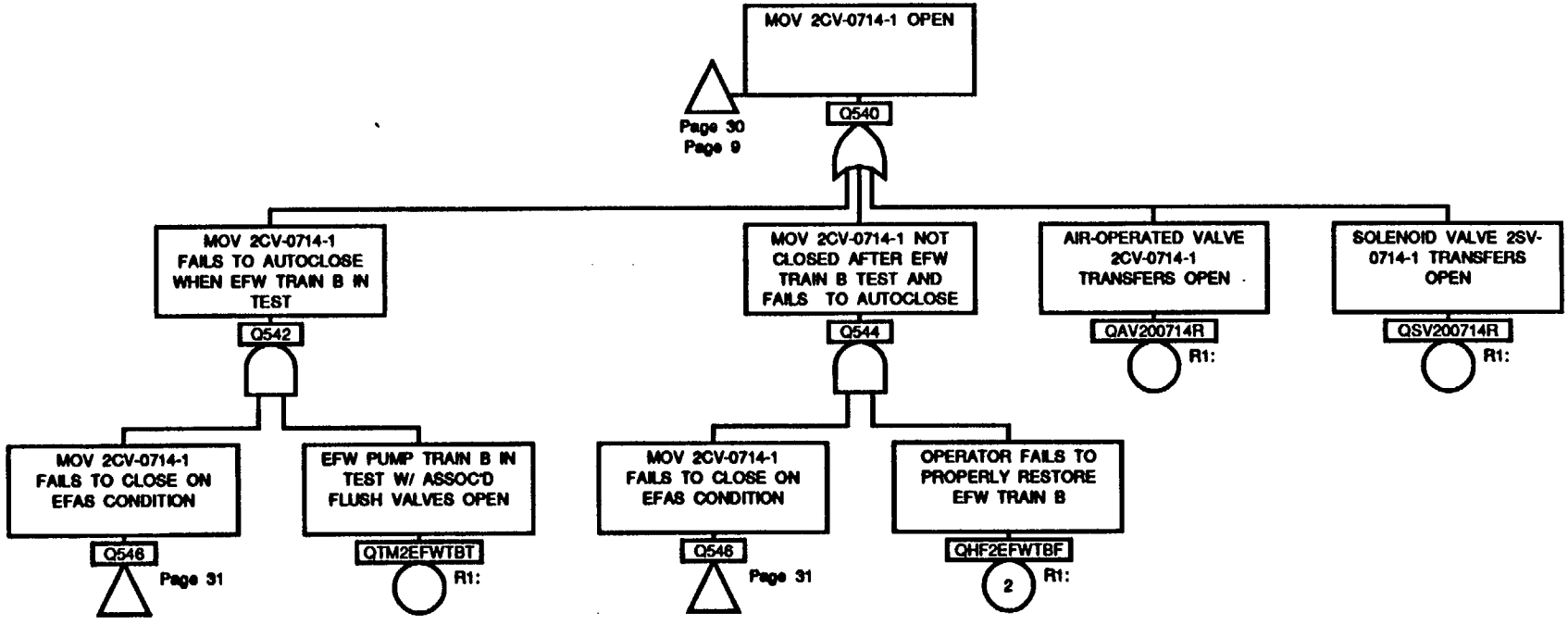

LOSS OF STEAM SUPPLY FROM SG'S A (2E24A) AND B (2E24B)
Page 4
Q201
LOSS OF STEAM SUPPLY FROM SG A (2E24A)
Q202
LOSS OF STEAM SUPPLY FROM SG B (2E24B)
Q203
STEAM GENERATOR A (2E24A) SUPPLY LINE BLOCKED
QMM2STSSGA
R1:
Steamline/Feedline break initiating event <IE>
T5
3
R1:
STEAM GENERATOR B (2E24B) SUPPLY LINE BLOCKED
QMM2STSSGB
R1:
LOSS OF SUPPLY FROM SG B (2E24B) DUE TO STEAM LINE BREAK ON SG A (2E24A)
Q205
Steamline/Feedline break initiating event <IE>
T5
3
R1:
FAILURE TO ISOLATE MAIN STEAM FROM SG A (2E24A)
Q310
Page 6

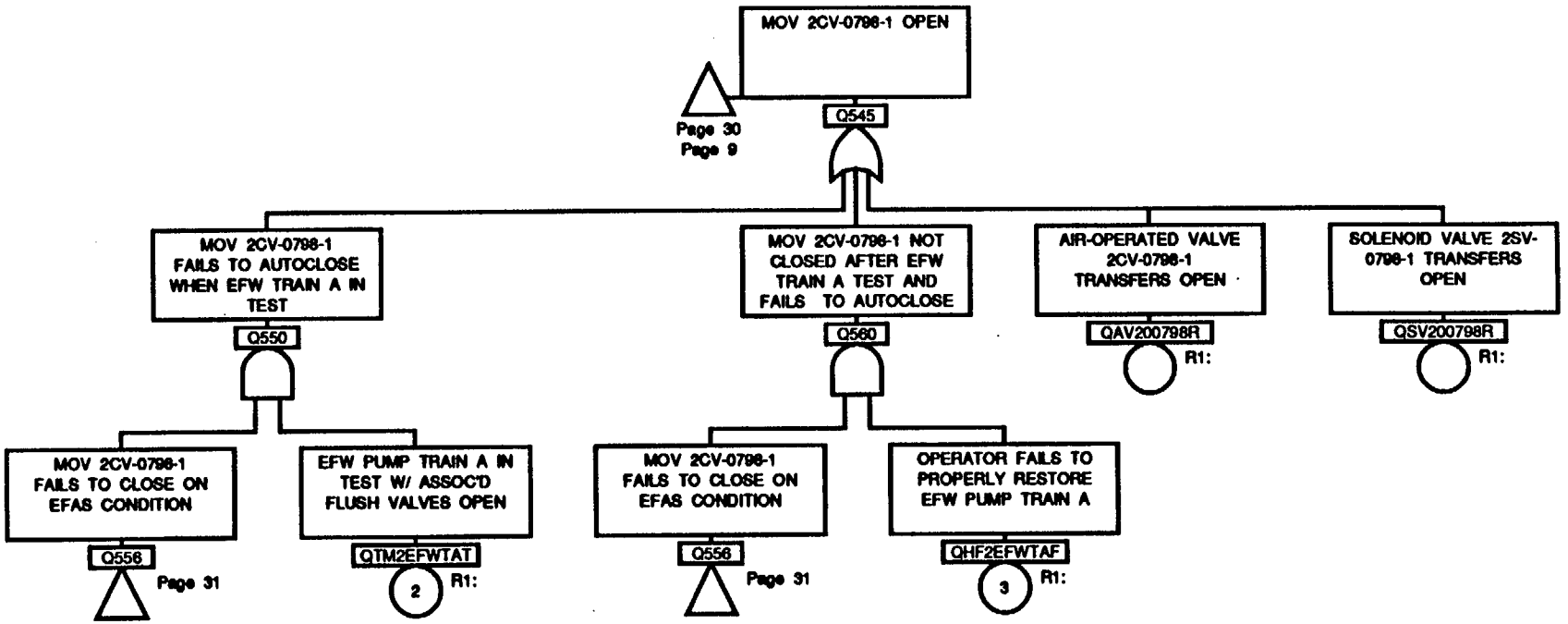

FAILURE TO ISOLATE MAIN STEAM FROM SG A (2E24A)
Q310
Page 5
SG A (2E24A) MAIN STEAM LINE ISOLATION VALVE FAILS TO CLOSE
QMM2MSLIAF
R1: M-2206 R106
MAIN STEAM ISOLATION SYSTEM FAILS TO CLOSE MSIV'S
Q222
MSIS CHANNEL 1 SIGNAL NOT AVAILABLE THROUGH RELAY K-404A
A083
MSIS CHANNEL 2 SIGNAL NOT AVAILABLE THROUGH RELAY K-404B
A084

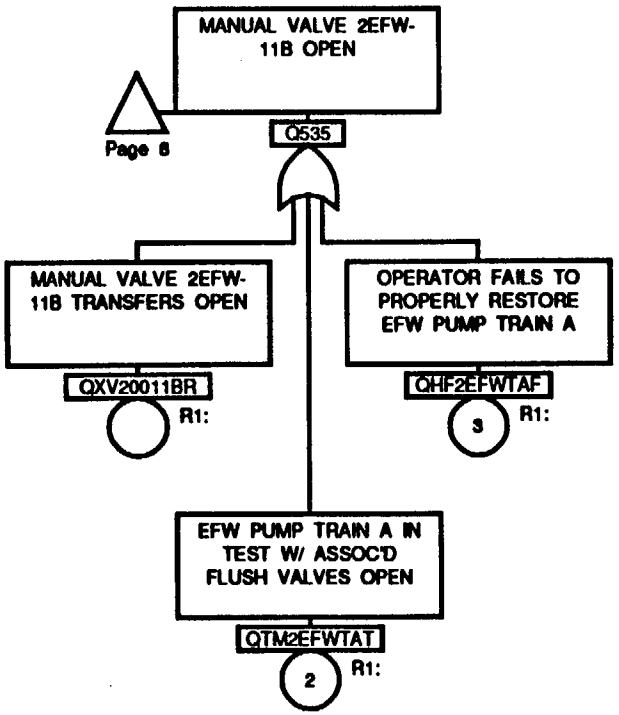

STEAM ADMISSION VALVES FAIL (2CV-0340-2 AND 2SV-0205)
Page 4
Q204
R1: E-2016
LOSS OF 125VDC BUS 2D26 <PRIOR OR MISSION>
D26AF
2
STEAM ADMISSION VALVE 2CV-0340-2 OR BYPASS VALVE 2SV-0205 FAIL
QMM2STMADM
R1:
FAILURE OF START SIGNAL TO 2P7A FROM EFAS
Page 4
Q008
EFAS (SGA)-2 SIGNAL NOT AVAILABLE THROUGH RELAY K-113B
A097
EFAS (SGB)-2 SIGNAL NOT AVAILABLE THROUGH RELAY K-303B
A100

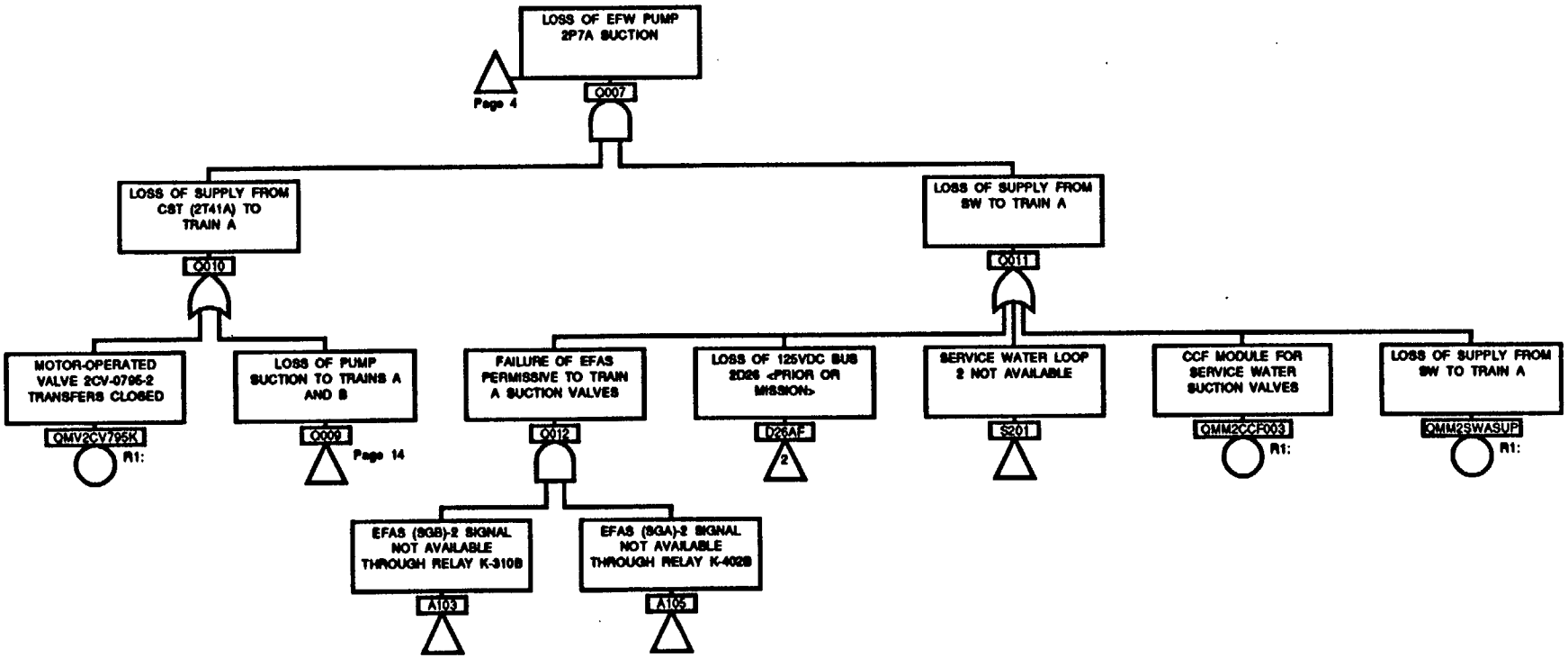

EFW TRAIN A FLOW DIVERSION TO SU/BD DEMIN SYSTEM
Q505
Page 4
EFW TRAIN A FLOW DIVERSION THROUGH 2EFW-11A
Q510
EFW TRAIN A FLOW DIVERSION THROUGH 2EFW-11B
Q515
EFW PIPING OPEN TO SU/BD DEMIN SYS
Q530
Page 9
MANUAL VALVE 2EFW-11A TRANSFERS OPEN
QXV20011AR
R1:
EFW PIPING OPEN TO SU/BD DEMIN SYS
Q530
Page 9
MANUAL VALVE 2EFW-11B OPEN
Q535
Page 12

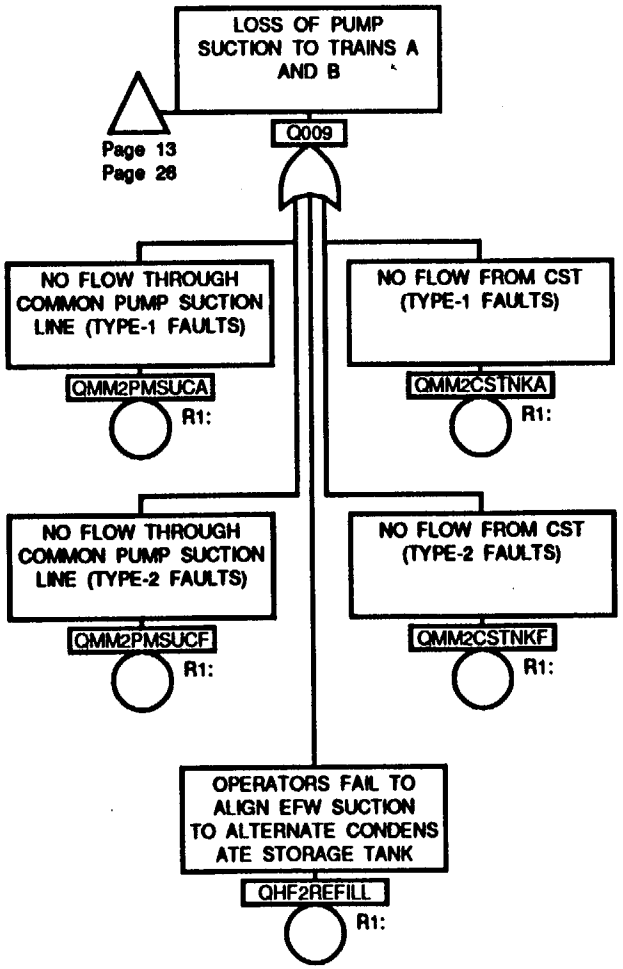

EFW PIPING OPEN TO SU/BD DEMIN SYS
Page 8
Page 8
Q530
MOV 2CV-0714-1 OPEN
MOV 2CV-0798-1 OPEN
Q540
Page 10
Q545
Page 11

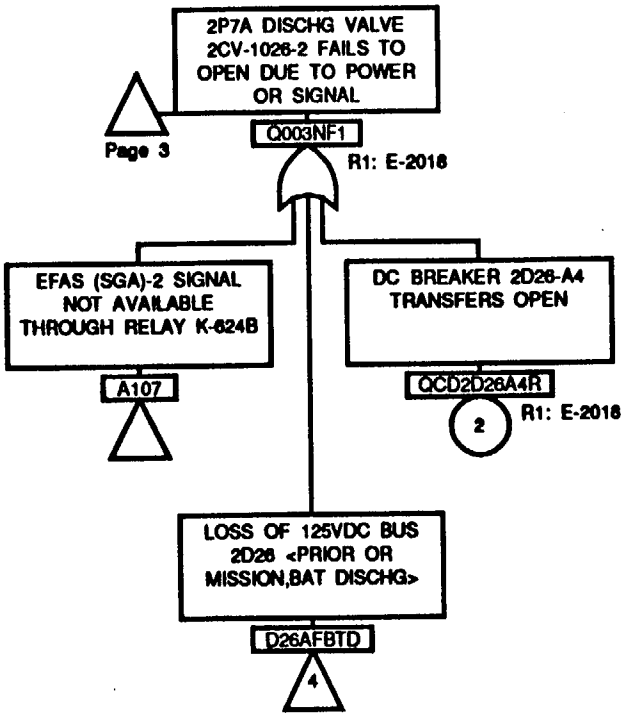

MOV 2CV-0714-1 OPEN
Page 30
Page 9
Q540
MOV 2CV-0714-1 FAILS TO AUTOCLOSE WHEN EFW TRAIN B IN TEST
Q542
MOV 2CV-0714-1 NOT CLOSED AFTER EFW TRAIN B TEST AND FAILS TO AUTOCLOSE
Q544
AIR-OPERATED VALVE 2CV-0714-1 TRANSFERS OPEN
QAV200714R
R1:
SOLENOID VALVE 2SV-0714-1 TRANSFERS OPEN
QSV200714R
R1:
MOV 2CV-0714-1 FAILS TO CLOSE ON EFAS CONDITION
Q546
Page 31
EFW PUMP TRAIN B IN TEST W/ ASSOC'D FLUSH VALVES OPEN
QTM2EFWTBT
R1:
MOV 2CV-0714-1 FAILS TO CLOSE ON EFAS CONDITION
Q546
Page 31
OPERATOR FAILS TO PROPERLY RESTORE EFW TRAIN B
QHF2EFWTBF
2
R1:

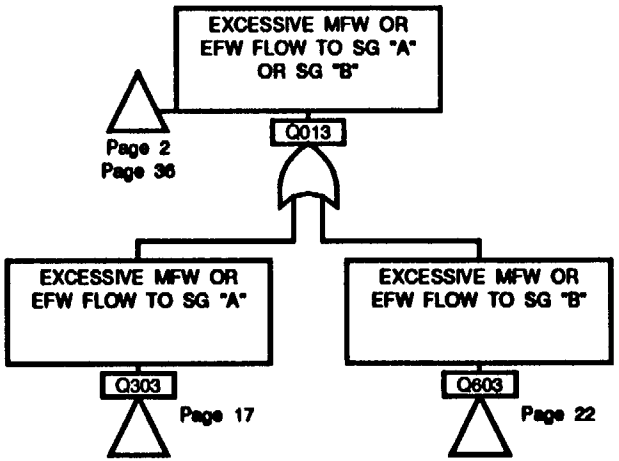

MOV 2CV-0798-1 OPEN
Q545
Page 30
Page 9
MOV 2CV-0798-1 FAILS TO AUTOCLOSE WHEN EFW TRAIN A IN TEST
Q550
MOV 2CV-0798-1 FAILS TO CLOSE ON EFAS CONDITION
Q556
Page 31
EFW PUMP TRAIN A IN TEST W/ ASSOC'D FLUSH VALVES OPEN
QTM2EFWTAT
2
R1:
MOV 2CV-0798-1 NOT CLOSED AFTER EFW TRAIN A TEST AND FAILS TO AUTOCLOSE
Q560
MOV 2CV-0798-1 FAILS TO CLOSE ON EFAS CONDITION
Q556
Page 31
OPERATOR FAILS TO PROPERLY RESTORE EFW PUMP TRAIN A
QHF2EFWTAF
3
R1:
AIR-OPERATED VALVE 2CV-0798-1 TRANSFERS OPEN
QAV200798R
R1:
SOLENOID VALVE 2SV-0798-1 TRANSFERS OPEN
QSV200798R
R1:

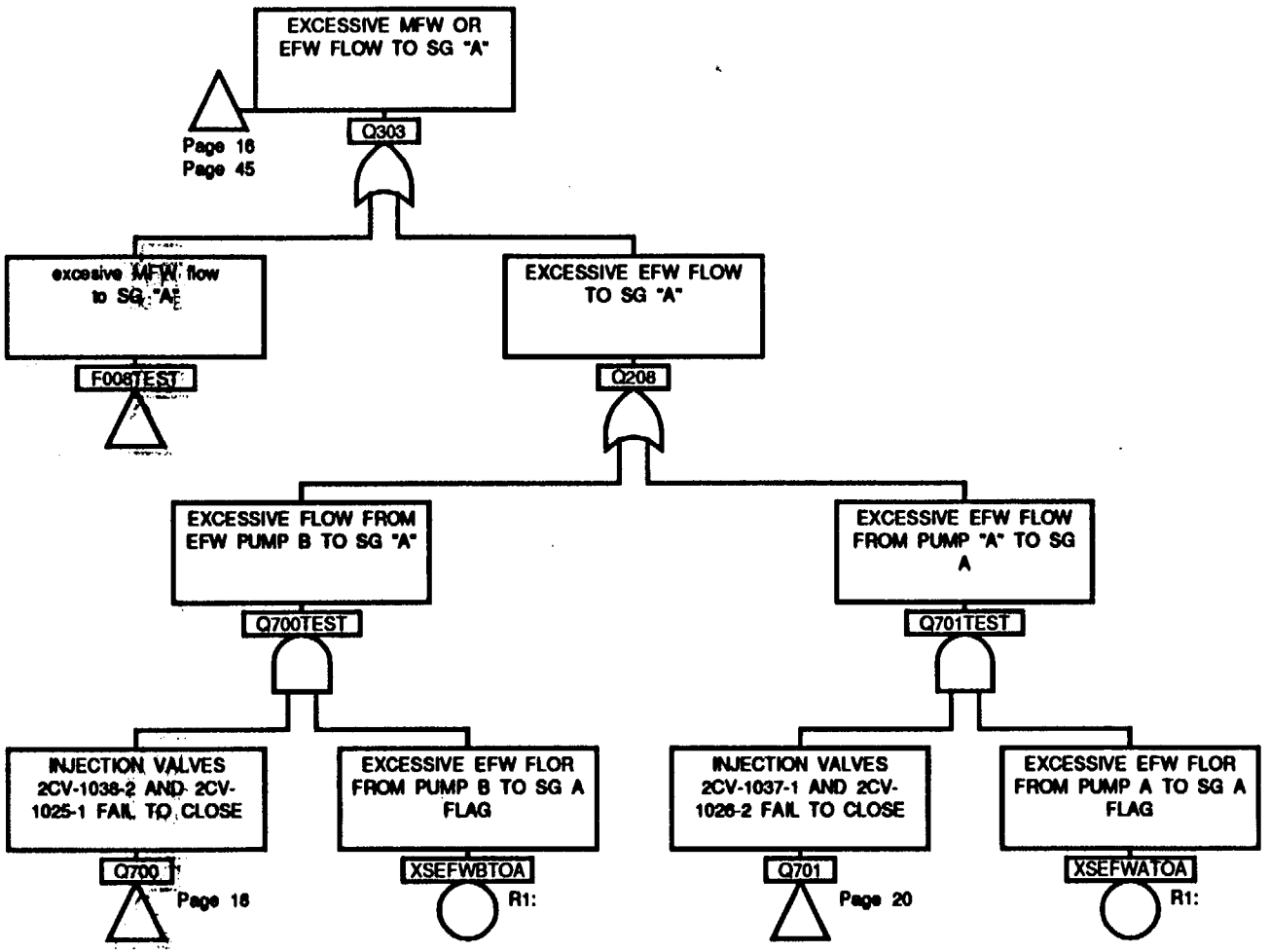

MANUAL VALVE 2EFW-11B OPEN
Page 8
Q535
MANUAL VALVE 2EFW-11B TRANSFERS OPEN
QXV20011BR
R1:
OPERATOR FAILS TO PROPERLY RESTORE EFW PUMP TRAIN A
QHF2EFWTAF
3
R1:
EFW PUMP TRAIN A IN TEST W/ ASSOC'D FLUSH VALVES OPEN
QTM2EFWTAT
2
R1:

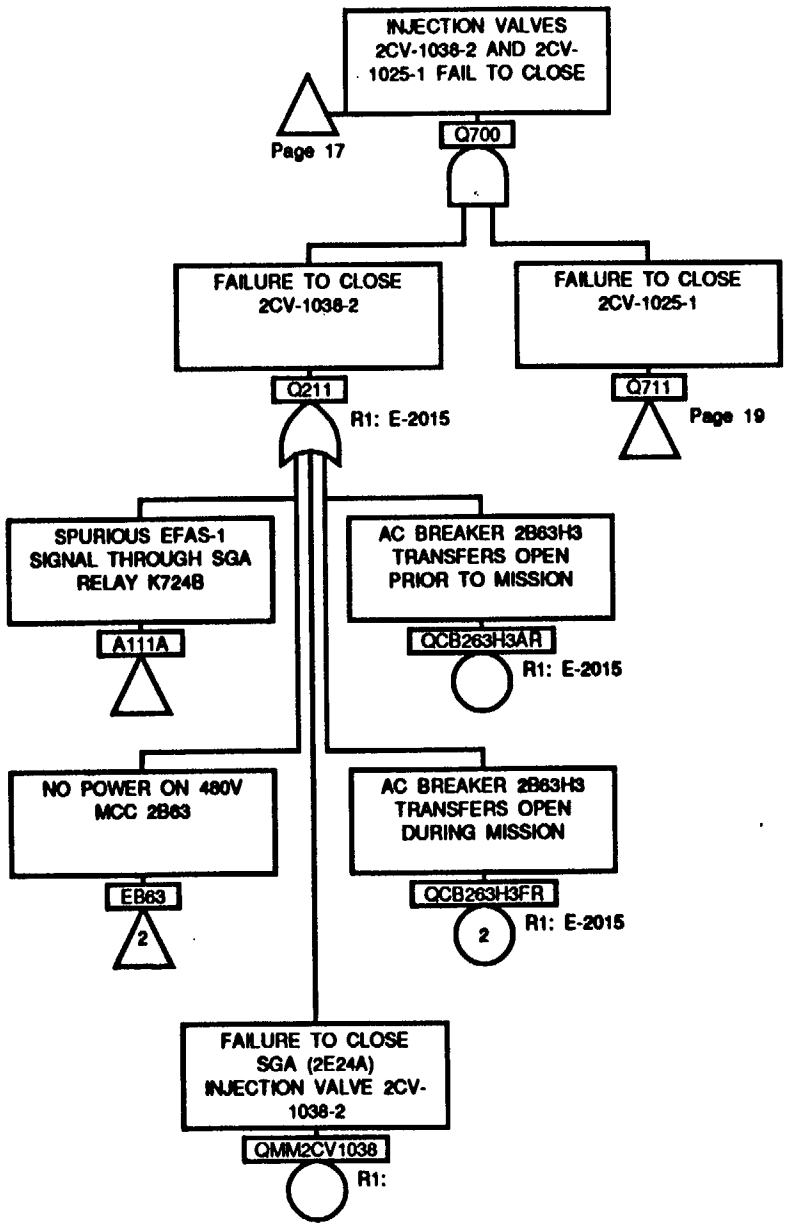

LOSS OF EFW PUMP 2P7A SUCTION
Page 4
Q007
LOSS OF SUPPLY FROM CST (2T41A) TO TRAIN A
Q010
LOSS OF SUPPLY FROM SW TO TRAIN A
Q011
MOTOR-OPERATED VALVE 2CV-0795-2 TRANSFERS CLOSED
QMV2CV795K
R1:
LOSS OF PUMP SUCTION TO TRAINS A AND B
Q009
Page 14
FAILURE OF EFAS PERMISSIVE TO TRAIN A SUCTION VALVES
Q012
LOSS OF 125VDC BUS 2D26 <PRIOR OR MISSION>
D26AF
2
SERVICE WATER LOOP 2 NOT AVAILABLE
S201
CCF MODULE FOR SERVICE WATER SUCTION VALVES
QMM2CCF003
R1:
LOSS OF SUPPLY FROM SW TO TRAIN A
QMM2SWASUP
R1:
EFAS (SGB)-2 SIGNAL NOT AVAILABLE THROUGH RELAY K-310B
A103
EFAS (SGA)-2 SIGNAL NOT AVAILABLE THROUGH RELAY K-402B
A105

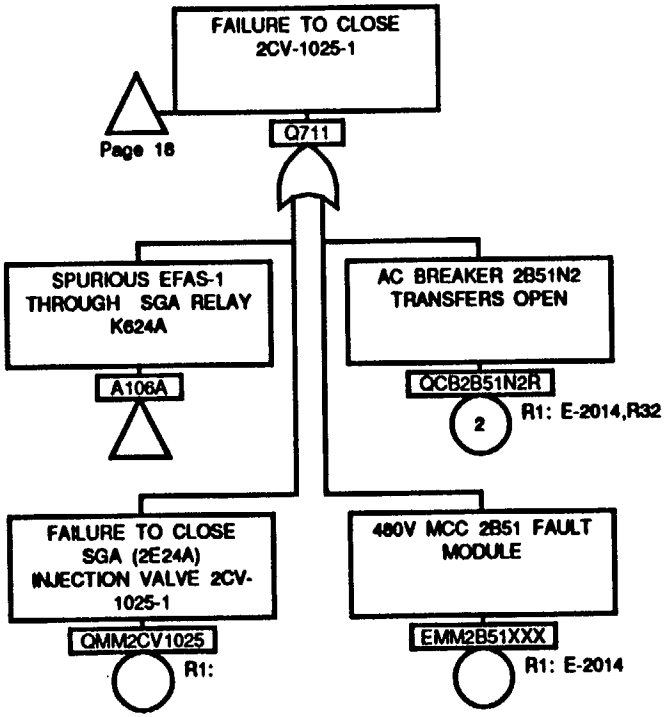

LOSS OF PUMP SUCTION TO TRAINS A AND B
Q009
Page 13
Page 26
NO FLOW THROUGH COMMON PUMP SUCTION LINE (TYPE-1 FAULTS)
QMM2PMSUCA
R1:
NO FLOW FROM CST (TYPE-1 FAULTS)
QMM2CSTNKA
R1:
NO FLOW THROUGH COMMON PUMP SUCTION LINE (TYPE-2 FAULTS)
QMM2PMSUCF
R1:
NO FLOW FROM CST (TYPE-2 FAULTS)
QMM2CSTNKF
R1:
OPERATORS FAIL TO ALIGN EFW SUCTION TO ALTERNATE CONDENS ATE STORAGE TANK
QHF2REFILL
R1:

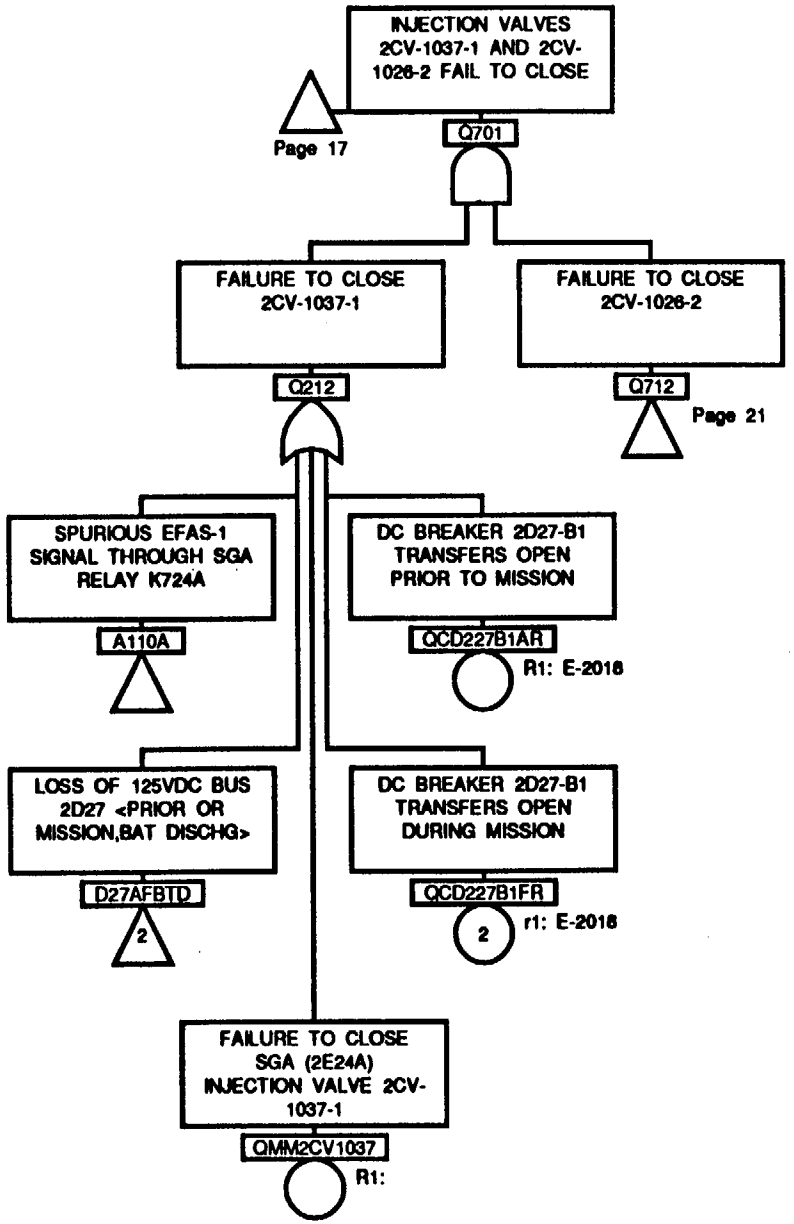

2P7A DISCHG VALVE 2CV-1026-2 FAILS TO OPEN DUE TO POWER OR SIGNAL
Q003NF1
R1: E-2018
Page 3
EFAS (SGA)-2 SIGNAL NOT AVAILABLE THROUGH RELAY K-624B
A107
DC BREAKER 2D26-A4 TRANSFERS OPEN
QCD2D26A4R
R1: E-2018
2
LOSS OF 125VDC BUS 2D26 <PRIOR OR MISSION,BAT DISCHG>
D26AFBTD
4

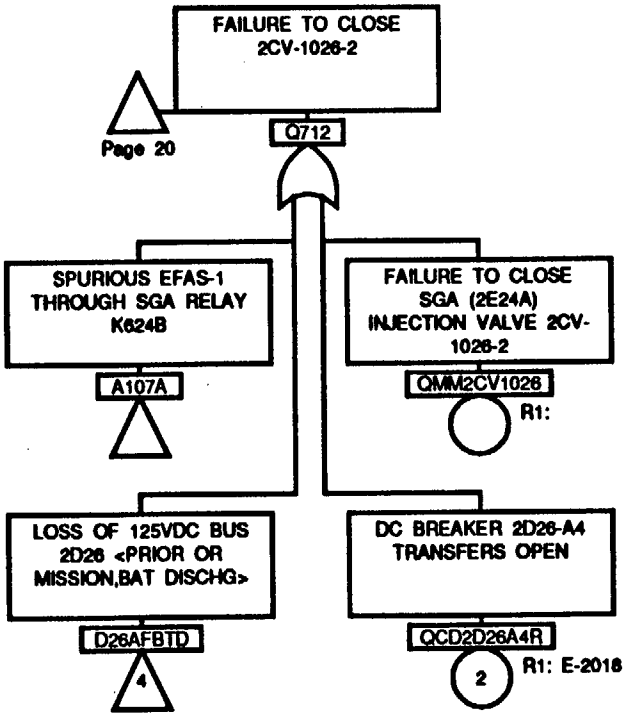

EXCESSIVE MFW OR EFW FLOW TO SG "A" OR SG "B"
Q013
Page 2
Page 36
EXCESSIVE MFW OR EFW FLOW TO SG "A"
Q303
Page 17
EXCESSIVE MFW OR EFW FLOW TO SG "B"
Q603
Page 22

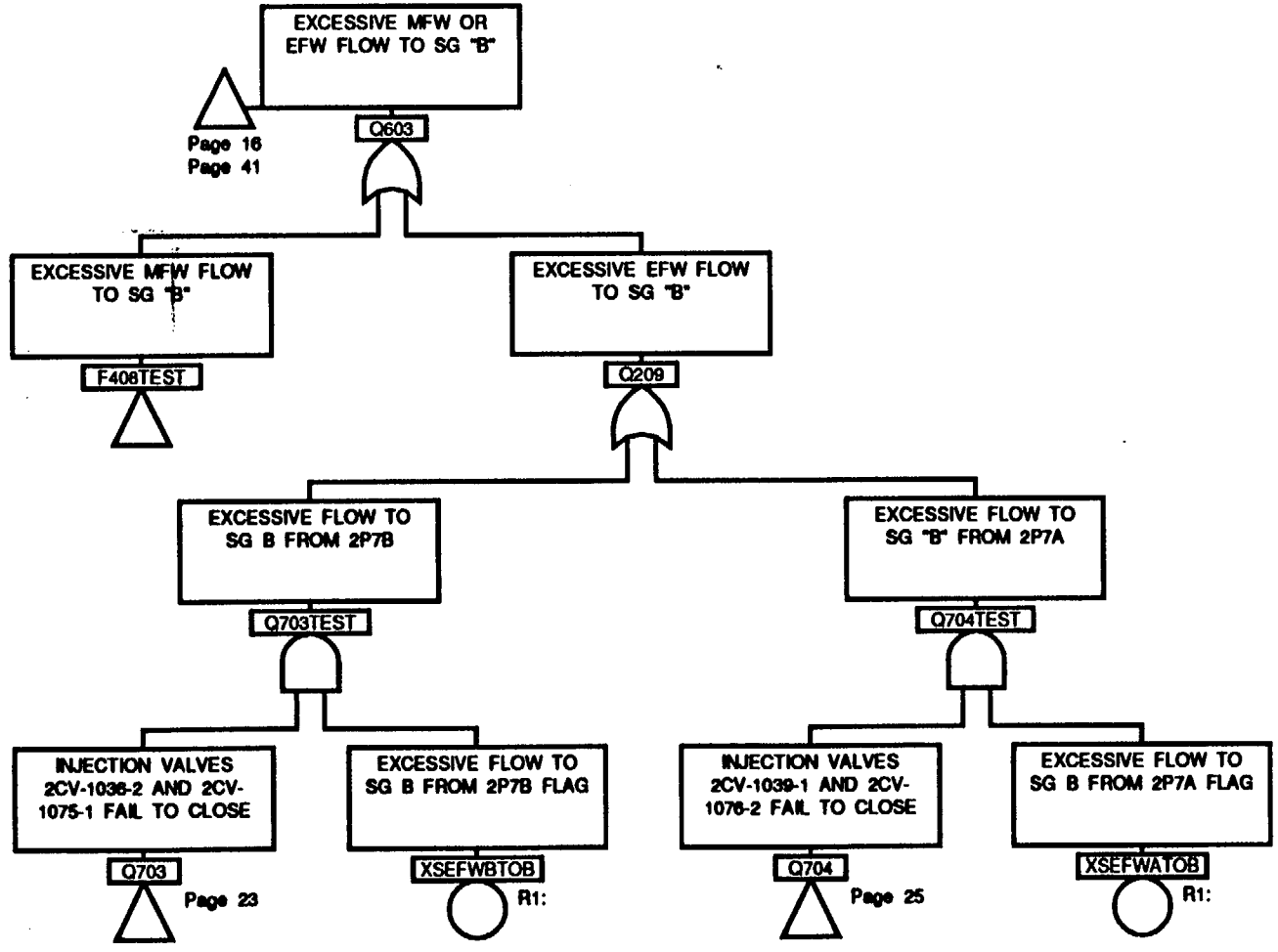

EXCESSIVE MFW OR EFW FLOW TO SG "A"
Q303
Page 16
Page 45
excesive MFW flow to SG "A"
F008TEST
EXCESSIVE EFW FLOW TO SG "A"
Q208
EXCESSIVE FLOW FROM EFW PUMP B TO SG "A"
Q700TEST
EXCESSIVE EFW FLOW FROM PUMP "A" TO SG A
Q701TEST
INJECTION VALVES 2CV-1038-2 AND 2CV-1025-1 FAIL TO CLOSE
Q700
Page 16
EXCESSIVE EFW FLOR FROM PUMP B TO SG A FLAG
XSEFWBTOA
R1:
INJECTION VALVES 2CV-1037-1 AND 2CV-1026-2 FAIL TO CLOSE
Q701
Page 20
EXCESSIVE EFW FLOR FROM PUMP A TO SG A FLAG
XSEFWATOA
R1:

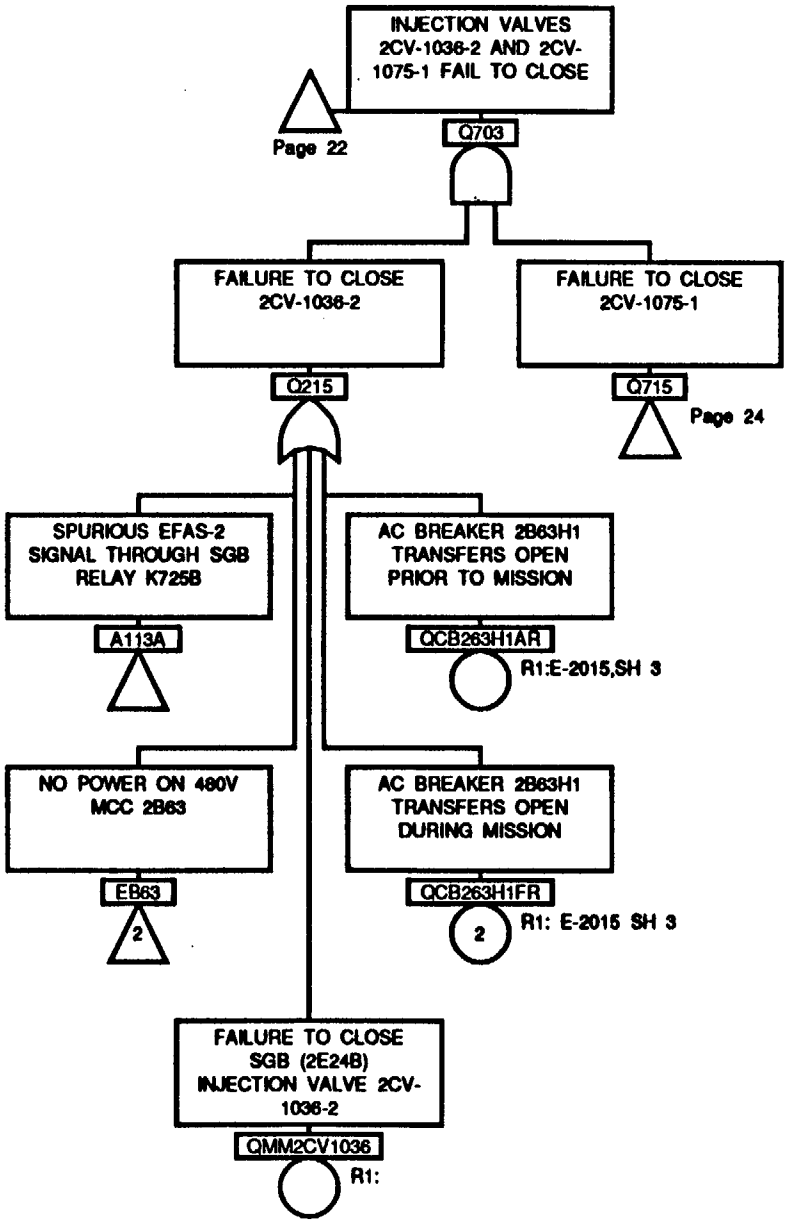

INJECTION VALVES 2CV-1038-2 AND 2CV-1025-1 FAIL TO CLOSE
Page 17
Q700
FAILURE TO CLOSE 2CV-1038-2
FAILURE TO CLOSE 2CV-1025-1
Q211
R1: E-2015
Q711
Page 19
SPURIOUS EFAS-1 SIGNAL THROUGH SGA RELAY K724B
AC BREAKER 2B63H3 TRANSFERS OPEN PRIOR TO MISSION
A111A
QCB263H3AR
R1: E-2015
NO POWER ON 480V MCC 2B63
AC BREAKER 2B63H3 TRANSFERS OPEN DURING MISSION
EB63
2
QCB263H3FR
2
R1: E-2015
FAILURE TO CLOSE SGA (2E24A) INJECTION VALVE 2CV-1038-2
QMM2CV1038
R1:

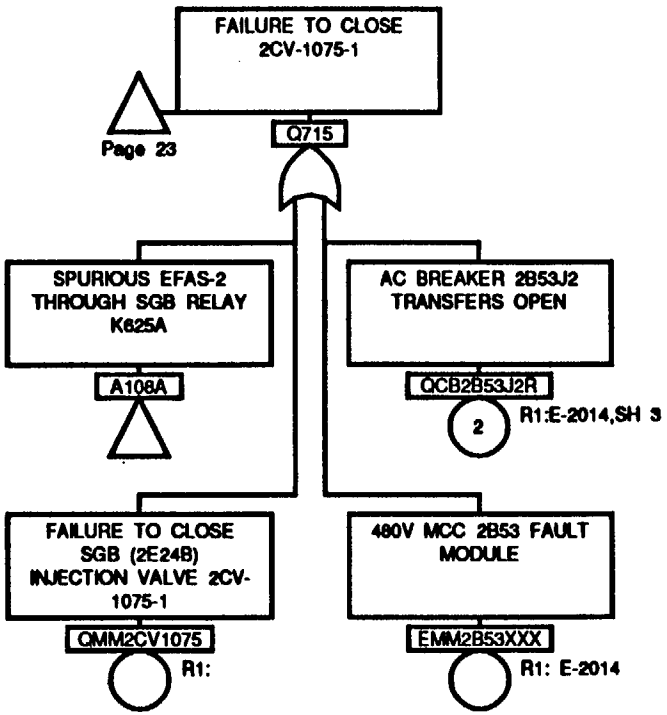

FAILURE TO CLOSE
2CV-1025-1
Page 18
Q711
SPURIOUS EFAS-1
THROUGH SGA RELAY
K624A
A106A
AC BREAKER 2B51N2
TRANSFERS OPEN
QCB2B51N2R
2
R1: E-2014,R32
FAILURE TO CLOSE
SGA (2E24A)
INJECTION VALVE 2CV-
1025-1
QMM2CV1025
R1:
480V MCC 2B51 FAULT
MODULE
EMM2B51XXX
R1: E-2014

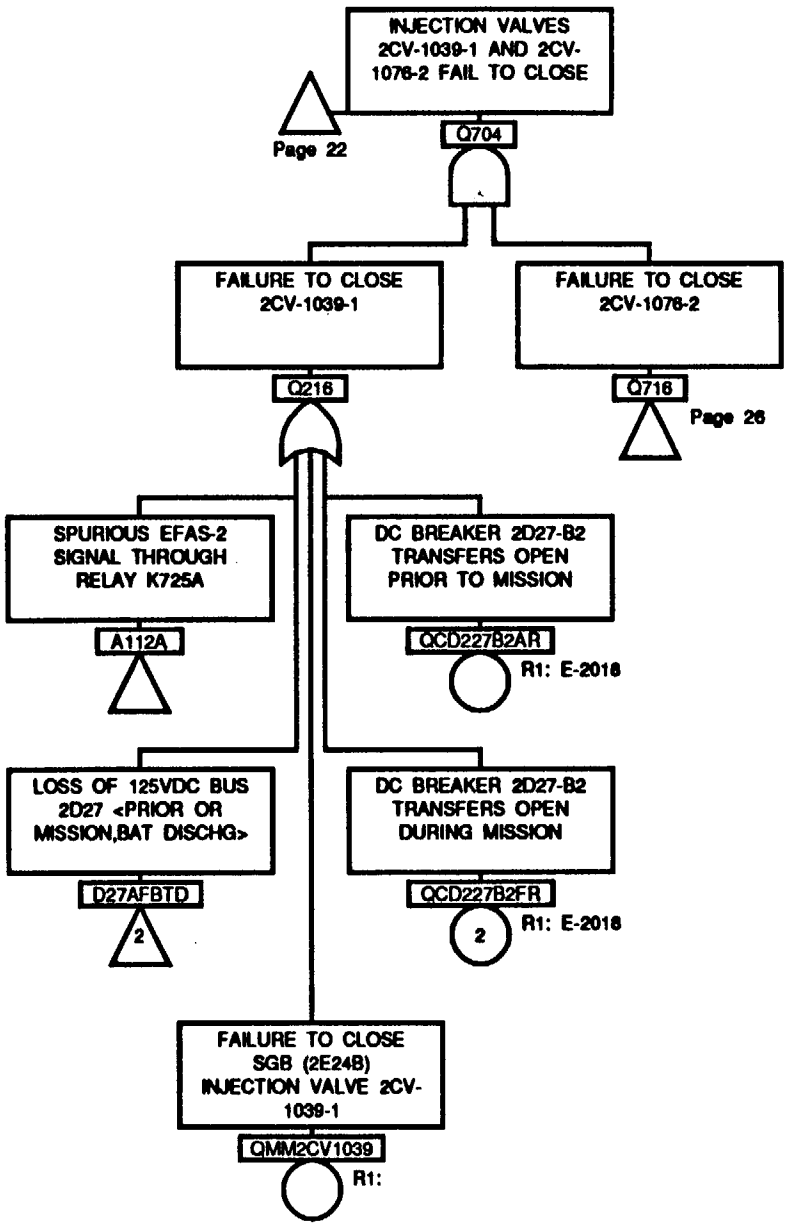

INJECTION VALVES 2CV-1037-1 AND 2CV-1026-2 FAIL TO CLOSE
Page 17
Q701
FAILURE TO CLOSE 2CV-1037-1
FAILURE TO CLOSE 2CV-1026-2
Q212
Q712
Page 21
SPURIOUS EFAS-1 SIGNAL THROUGH SGA RELAY K724A
DC BREAKER 2D27-B1 TRANSFERS OPEN PRIOR TO MISSION
A110A
QCD227B1AR
R1: E-2018
LOSS OF 125VDC BUS 2D27 <PRIOR OR MISSION,BAT DISCHG>
DC BREAKER 2D27-B1 TRANSFERS OPEN DURING MISSION
D27AFBTD
2
QCD227B1FR
2
r1: E-2018
FAILURE TO CLOSE SGA (2E24A) INJECTION VALVE 2CV-1037-1
QMM2CV1037
R1:

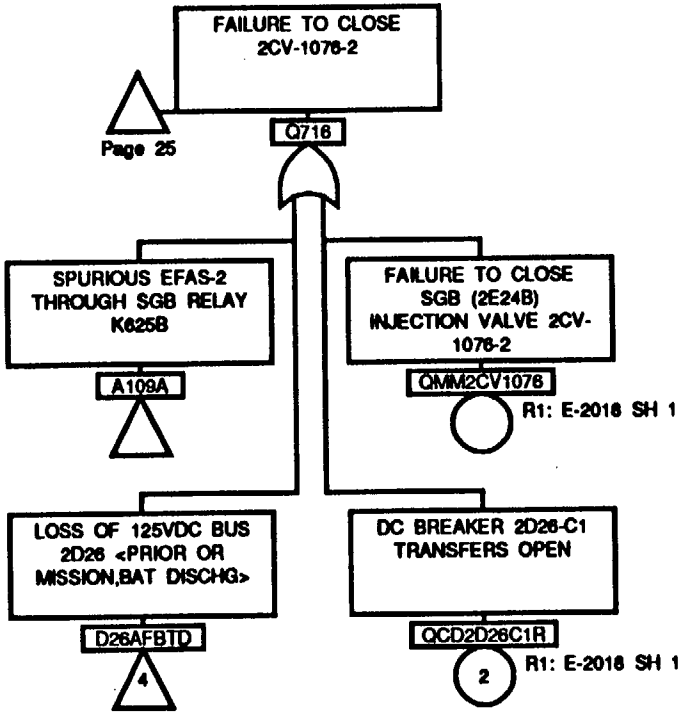

FAILURE TO CLOSE
2CV-1026-2
Page 20
Q712
SPURIOUS EFAS-1
THROUGH SGA RELAY
K624B
A107A
FAILURE TO CLOSE
SGA (2E24A)
INJECTION VALVE 2CV-
1026-2
QMM2CV1026
R1:
LOSS OF 125VDC BUS
2D26 <PRIOR OR
MISSION,BAT DISCHG>
D26AFBTD
4
DC BREAKER 2D26-A4
TRANSFERS OPEN
QCD2D26A4R
2
R1: E-2018

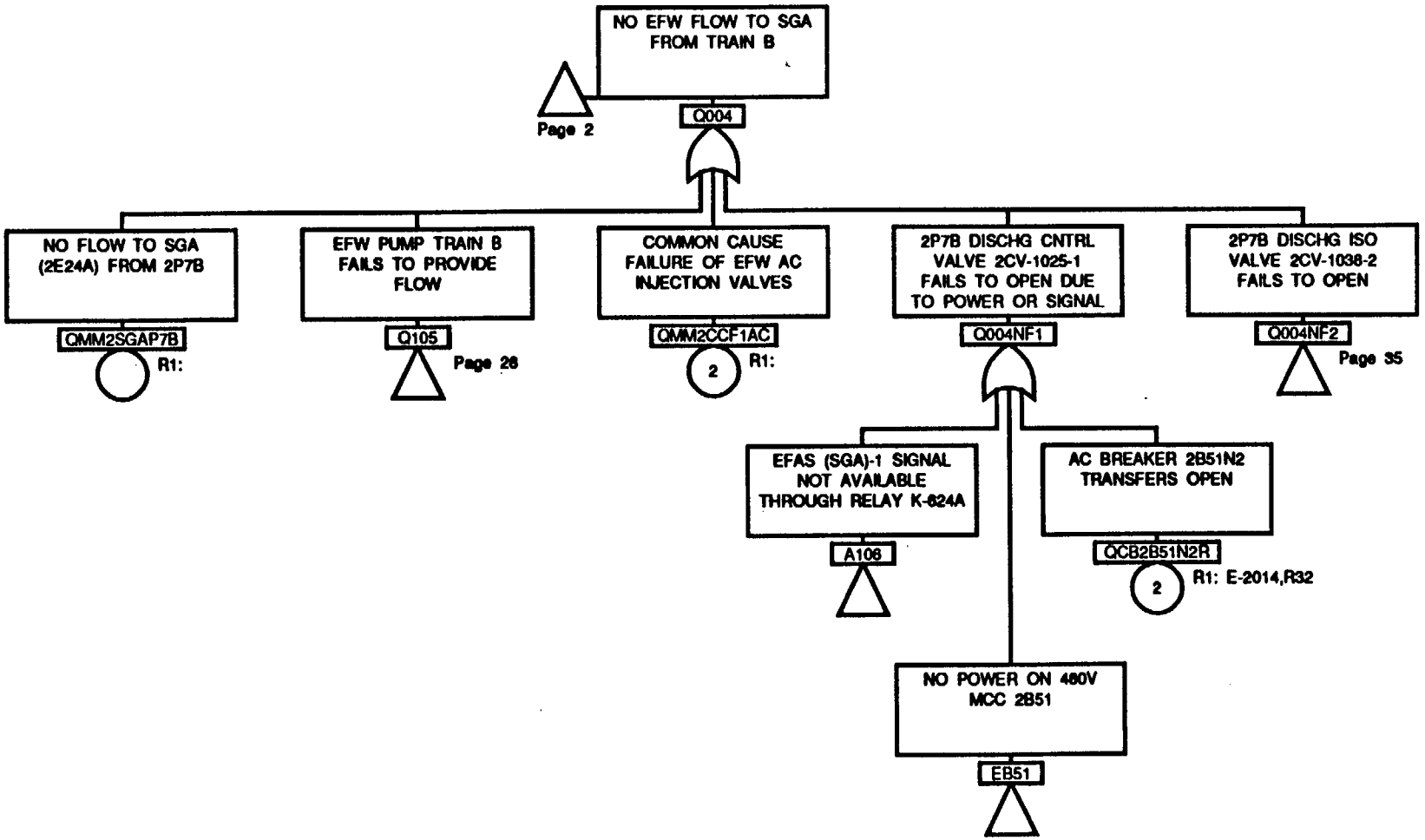

EXCESSIVE MFW OR EFW FLOW TO SG "B"
Page 16
Page 41
Q603
EXCESSIVE MFW FLOW TO SG "B"
F408TEST
EXCESSIVE EFW FLOW TO SG "B"
Q209
EXCESSIVE FLOW TO SG B FROM 2P7B
Q703TEST
EXCESSIVE FLOW TO SG "B" FROM 2P7A
Q704TEST
INJECTION VALVES 2CV-1036-2 AND 2CV-1075-1 FAIL TO CLOSE
Q703
Page 23
EXCESSIVE FLOW TO SG B FROM 2P7B FLAG
XSEFWBTOB
R1:
INJECTION VALVES 2CV-1039-1 AND 2CV-1076-2 FAIL TO CLOSE
Q704
Page 25
EXCESSIVE FLOW TO SG B FROM 2P7A FLAG
XSEFWATOB
R1:

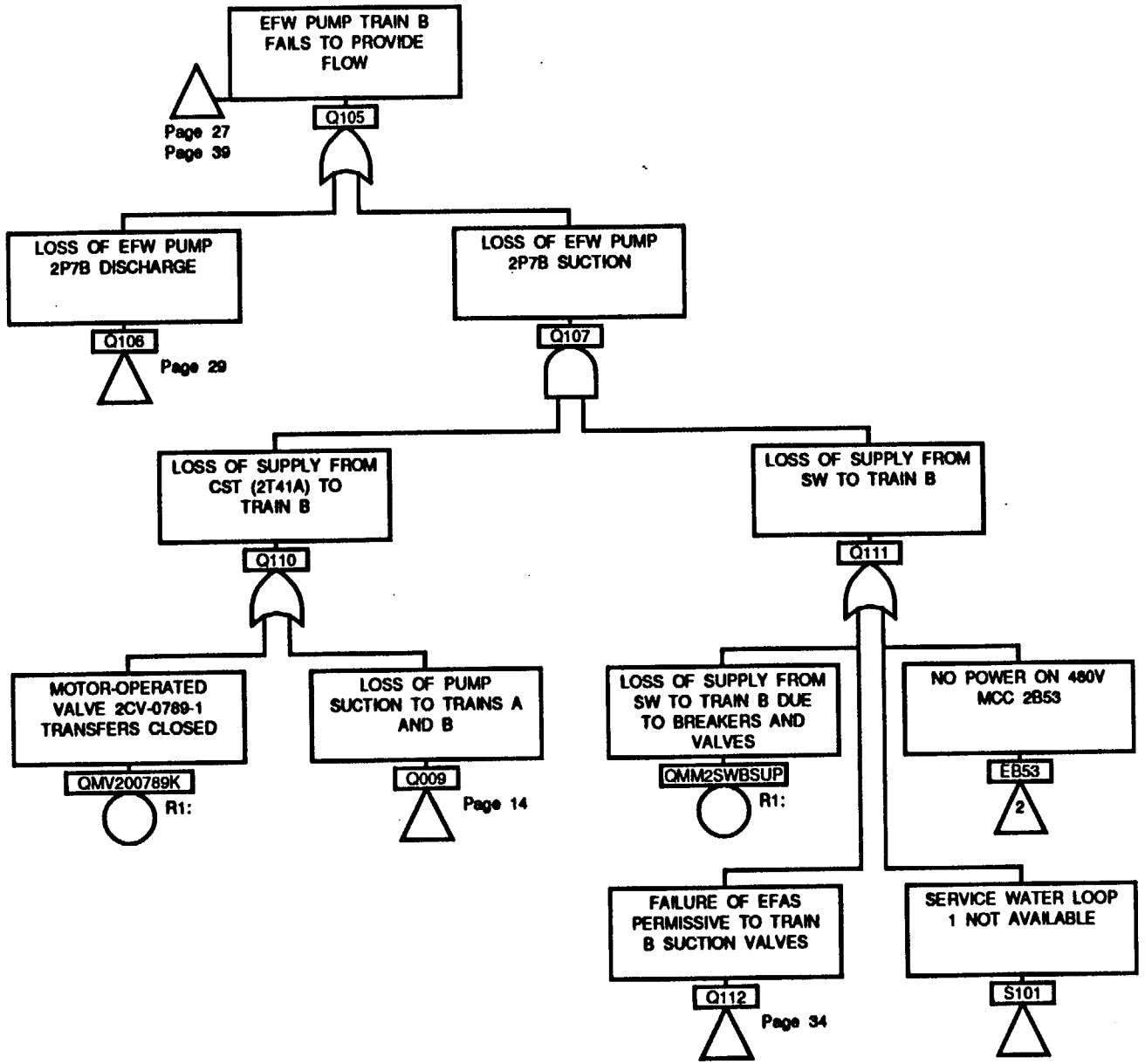

INJECTION VALVES 2CV-1036-2 AND 2CV-1075-1 FAIL TO CLOSE
Page 22
Q703
FAILURE TO CLOSE 2CV-1036-2
FAILURE TO CLOSE 2CV-1075-1
Q215
Q715
Page 24
SPURIOUS EFAS-2 SIGNAL THROUGH SGB RELAY K725B
AC BREAKER 2B63H1 TRANSFERS OPEN PRIOR TO MISSION
A113A
QCB263H1AR
R1:E-2015,SH 3
NO POWER ON 480V MCC 2B63
AC BREAKER 2B63H1 TRANSFERS OPEN DURING MISSION
EB63
2
QCB263H1FR
2
R1: E-2015 SH 3
FAILURE TO CLOSE SGB (2E24B) INJECTION VALVE 2CV-1036-2
QMM2CV1036
R1:

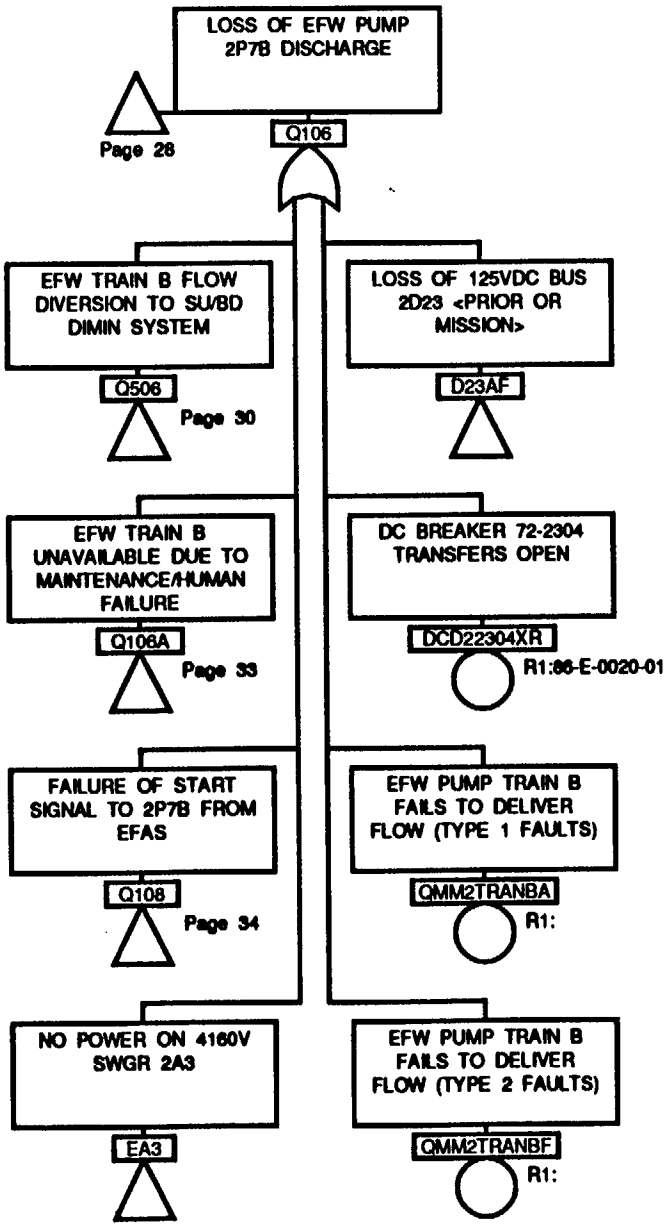

FAILURE TO CLOSE
2CV-1075-1
Page 23
Q715
SPURIOUS EFAS-2
THROUGH SGB RELAY
K625A
A108A
AC BREAKER 2B53J2
TRANSFERS OPEN
QCB2B53J2R
2
R1:E-2014,SH 3
FAILURE TO CLOSE
SGB (2E24B)
INJECTION VALVE 2CV-
1075-1
QMM2CV1075
R1:
480V MCC 2B53 FAULT
MODULE
EMM2B53XXX
R1: E-2014

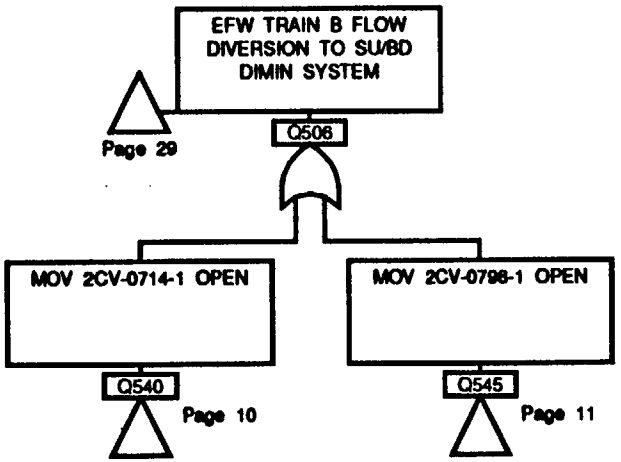

INJECTION VALVES 2CV-1039-1 AND 2CV-1076-2 FAIL TO CLOSE
Page 22
Q704
FAILURE TO CLOSE 2CV-1039-1
FAILURE TO CLOSE 2CV-1076-2
Q216
Q716
Page 26
SPURIOUS EFAS-2 SIGNAL THROUGH RELAY K725A
DC BREAKER 2D27-B2 TRANSFERS OPEN PRIOR TO MISSION
A112A
QCD227B2AR
R1: E-2018
LOSS OF 125VDC BUS 2D27 <PRIOR OR MISSION,BAT DISCHG>
DC BREAKER 2D27-B2 TRANSFERS OPEN DURING MISSION
D27AFBTD
2
QCD227B2FR
2
R1: E-2018
FAILURE TO CLOSE SGB (2E24B) INJECTION VALVE 2CV-1039-1
QMM2CV1039
R1:

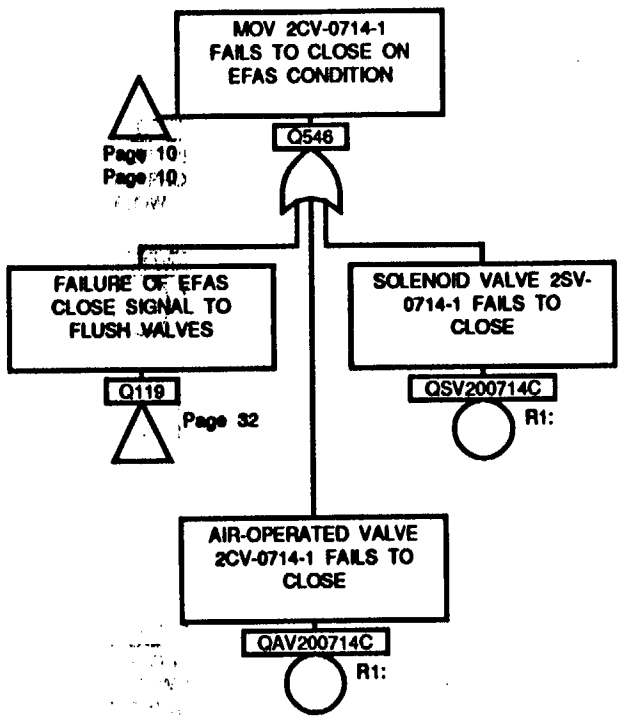

FAILURE TO CLOSE
2CV-1076-2
Page 25
Q716
SPURIOUS EFAS-2
THROUGH SGB RELAY
K625B
A109A
FAILURE TO CLOSE
SGB (2E24B)
INJECTION VALVE 2CV-
1076-2
QMM2CV1076
R1: E-2018 SH 1
LOSS OF 125VDC BUS
2D26 <PRIOR OR
MISSION,BAT DISCHG>
D26AFBTD
4
DC BREAKER 2D26-C1
TRANSFERS OPEN
QCD2D26C1R
2
R1: E-2018 SH 1

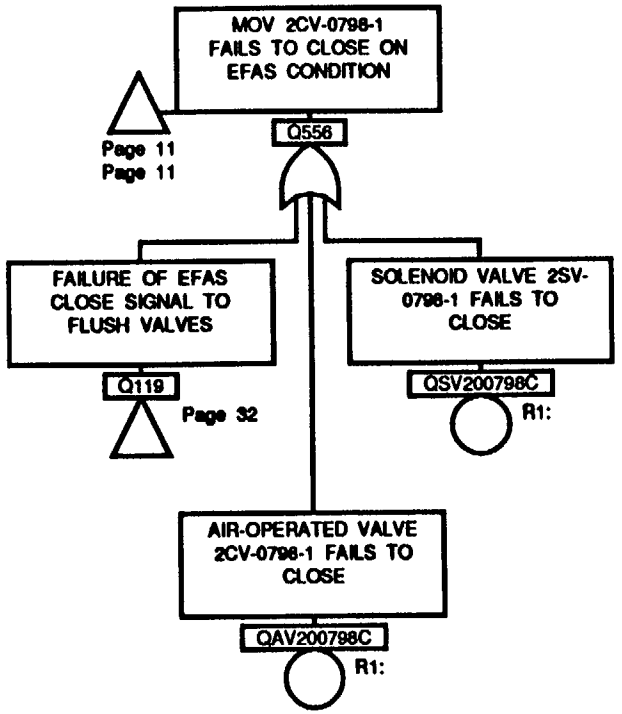

NO EFW FLOW TO SGA FROM TRAIN B
Page 2
Q004
NO FLOW TO SGA (2E24A) FROM 2P7B
QMM2SGAP7B
R1:
EFW PUMP TRAIN B FAILS TO PROVIDE FLOW
Q105
Page 28
COMMON CAUSE FAILURE OF EFW AC INJECTION VALVES
QMM2CCF1AC
2
R1:
2P7B DISCHG CNTRL VALVE 2CV-1025-1 FAILS TO OPEN DUE TO POWER OR SIGNAL
Q004NF1
2P7B DISCHG ISO VALVE 2CV-1038-2 FAILS TO OPEN
Q004NF2
Page 35
EFAS (SGA)-1 SIGNAL NOT AVAILABLE THROUGH RELAY K-624A
A106
AC BREAKER 2B51N2 TRANSFERS OPEN
QCB2B51N2R
2
R1: E-2014,R32
NO POWER ON 480V MCC 2B51
EB51

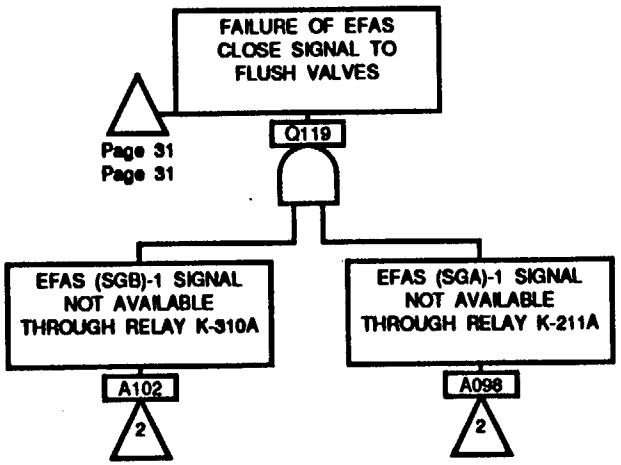

EFW PUMP TRAIN B FAILS TO PROVIDE FLOW
Q105
Page 27
Page 39
LOSS OF EFW PUMP 2P7B DISCHARGE
Q106
Page 29
LOSS OF EFW PUMP 2P7B SUCTION
Q107
LOSS OF SUPPLY FROM CST (2T41A) TO TRAIN B
Q110
MOTOR-OPERATED VALVE 2CV-0789-1 TRANSFERS CLOSED
QMV200789K
R1:
LOSS OF PUMP SUCTION TO TRAINS A AND B
Q009
Page 14
LOSS OF SUPPLY FROM SW TO TRAIN B
Q111
LOSS OF SUPPLY FROM SW TO TRAIN B DUE TO BREAKERS AND VALVES
QMM2SWBSUP
R1:
NO POWER ON 480V MCC 2B53
EB53
2
FAILURE OF EFAS PERMISSIVE TO TRAIN B SUCTION VALVES
Q112
Page 34
SERVICE WATER LOOP 1 NOT AVAILABLE
S101

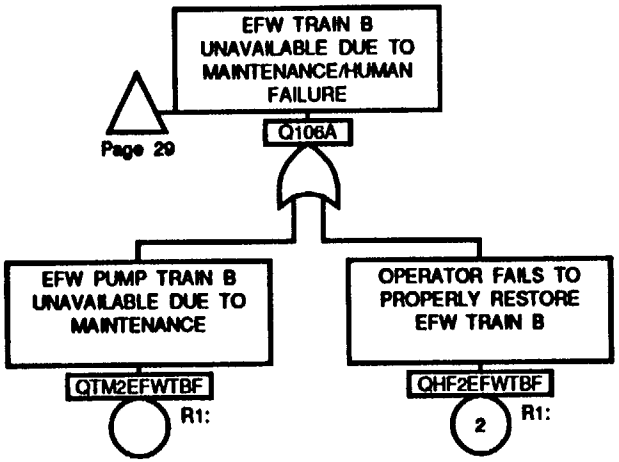

LOSS OF EFW PUMP 2P7B DISCHARGE
Page 28
Q106
EFW TRAIN B FLOW DIVERSION TO SU/BD DIMIN SYSTEM
Q506
Page 30
LOSS OF 125VDC BUS 2D23 <PRIOR OR MISSION>
D23AF
EFW TRAIN B UNAVAILABLE DUE TO MAINTENANCE/HUMAN FAILURE
Q106A
Page 33
DC BREAKER 72-2304 TRANSFERS OPEN
DCD22304XR
R1:86-E-0020-01
FAILURE OF START SIGNAL TO 2P7B FROM EFAS
Q108
Page 34
EFW PUMP TRAIN B FAILS TO DELIVER FLOW (TYPE 1 FAULTS)
QMM2TRANBA
R1:
NO POWER ON 4160V SWGR 2A3
EA3
EFW PUMP TRAIN B FAILS TO DELIVER FLOW (TYPE 2 FAULTS)
QMM2TRANBF
R1:

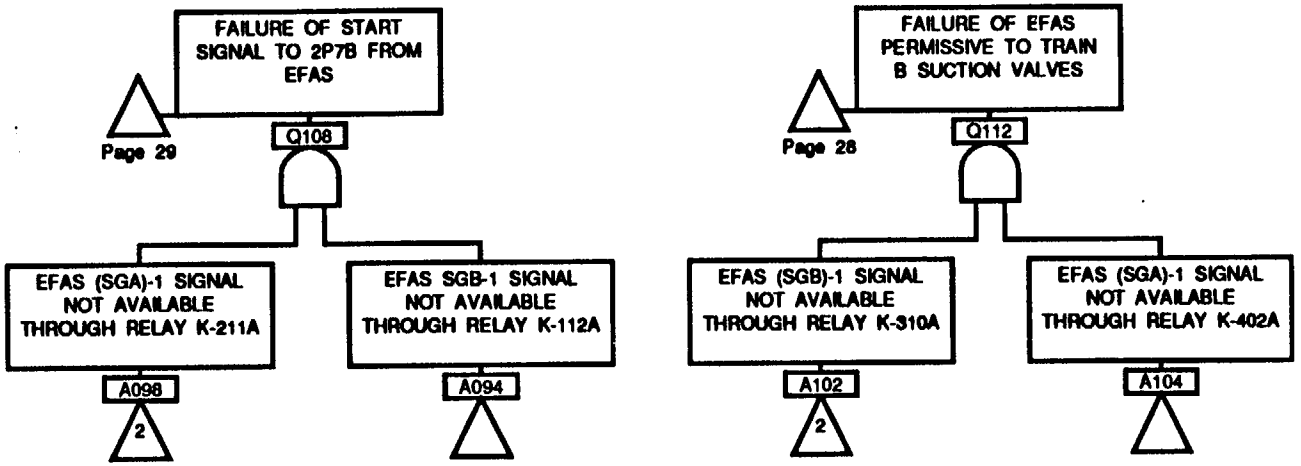

EFW TRAIN B FLOW
DIVERSION TO SU/BD
DIMIN SYSTEM
Page 29
Q506
MOV 2CV-0714-1 OPEN
MOV 2CV-0798-1 OPEN
Q540
Page 10
Q545
Page 11

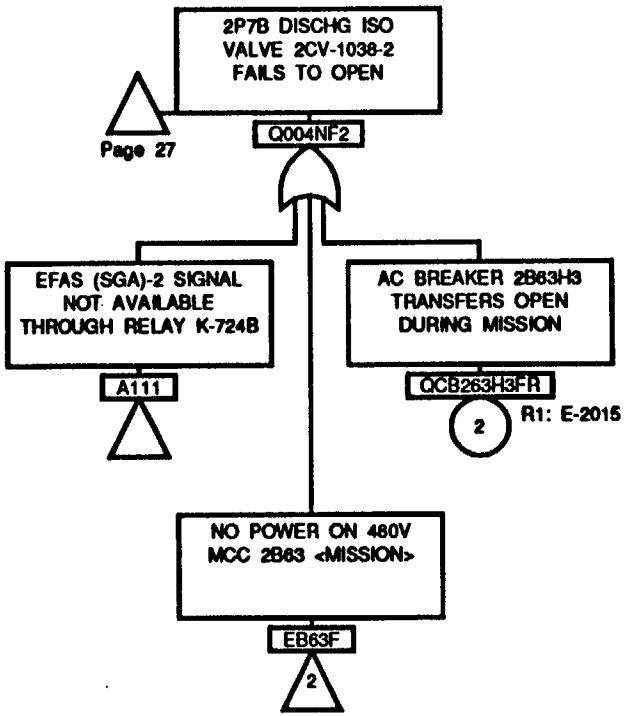

MOV 2CV-0714-1
FAILS TO CLOSE ON
EFAS CONDITION
Q546
Page 10
Page 10
FAILURE OF EFAS
CLOSE SIGNAL TO
FLUSH VALVES
Q119
Page 32
SOLENOID VALVE 2SV-
0714-1 FAILS TO
CLOSE
QSV200714C
R1:
AIR-OPERATED VALVE
2CV-0714-1 FAILS TO
CLOSE
QAV200714C
R1:

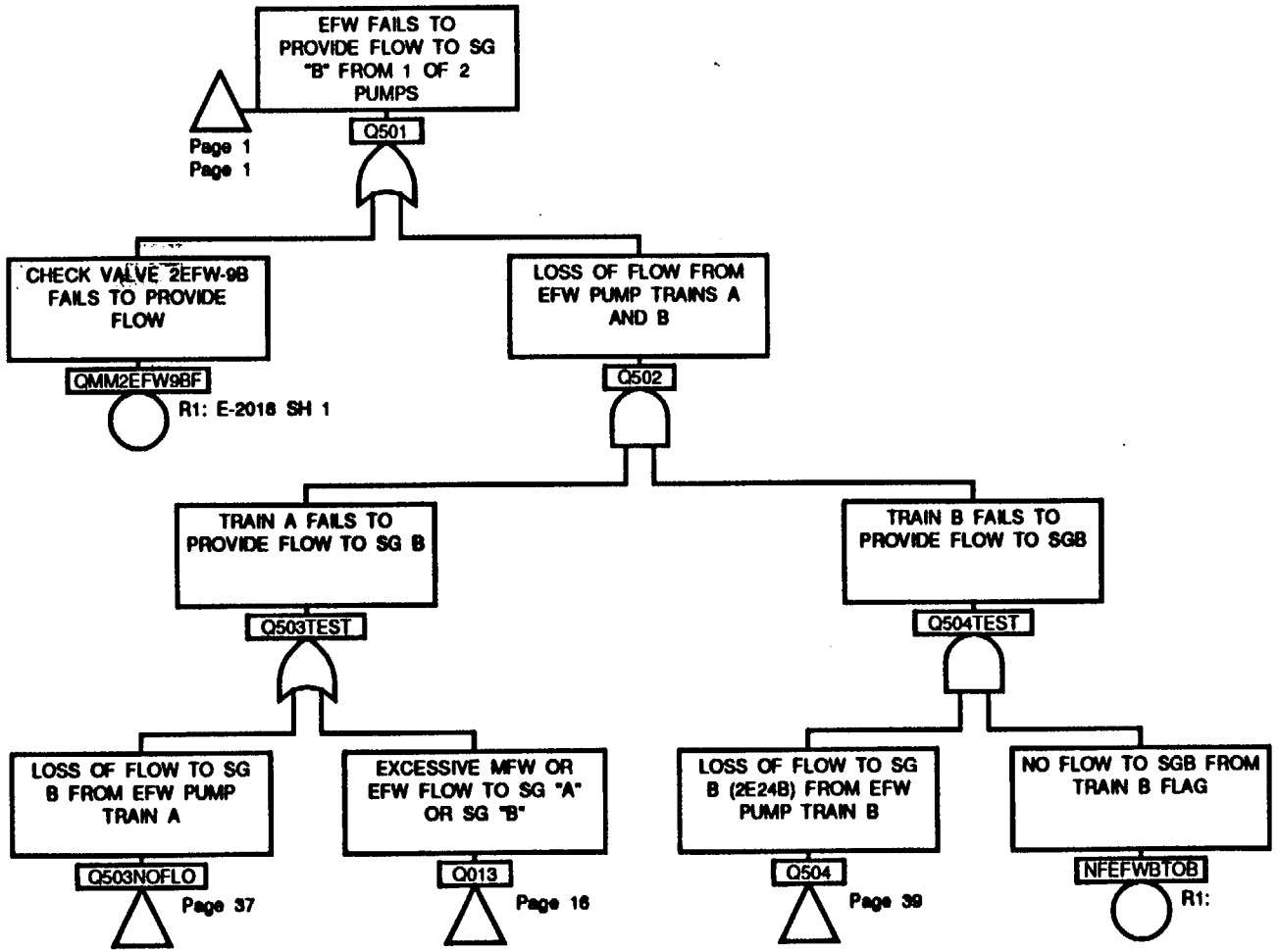

MOV 2CV-0798-1
FAILS TO CLOSE ON
EFAS CONDITION
Q556
Page 11
Page 11
FAILURE OF EFAS
CLOSE SIGNAL TO
FLUSH VALVES
Q119
Page 32
SOLENOID VALVE 2SV-
0798-1 FAILS TO
CLOSE
QSV200798C
R1:
AIR-OPERATED VALVE
2CV-0798-1 FAILS TO
CLOSE
QAV200798C
R1:

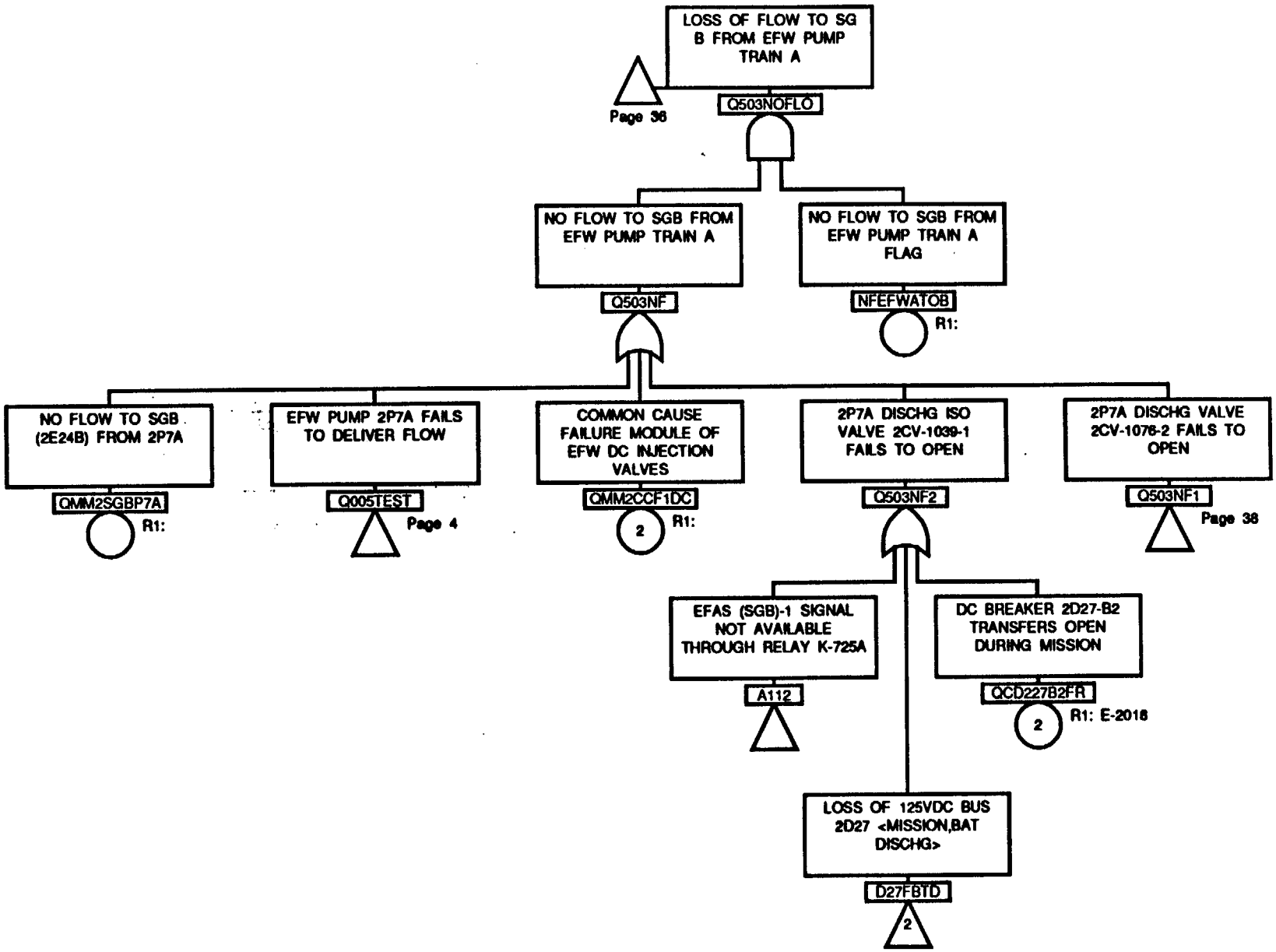

FAILURE OF EFAS CLOSE SIGNAL TO FLUSH VALVES
Page 31
Page 31
Q119
EFAS (SGB)-1 SIGNAL NOT AVAILABLE THROUGH RELAY K-310A
EFAS (SGA)-1 SIGNAL NOT AVAILABLE THROUGH RELAY K-211A
A102
A098
2
2

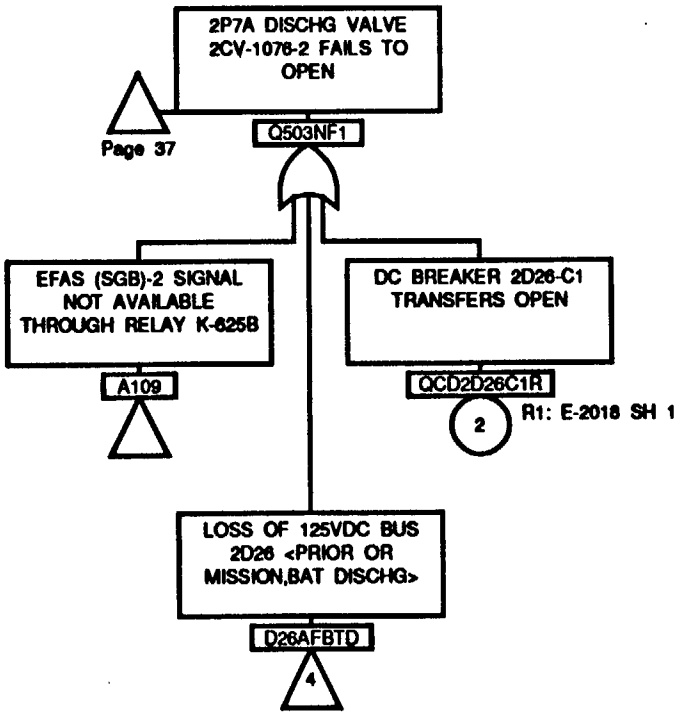

EFW TRAIN B
UNAVAILABLE DUE TO
MAINTENANCE/HUMAN
FAILURE
Q106A
Page 29
EFW PUMP TRAIN B
UNAVAILABLE DUE TO
MAINTENANCE
QTM2EFWTBF
R1:
OPERATOR FAILS TO
PROPERLY RESTORE
EFW TRAIN B
QHF2EFWTBF
2
R1:

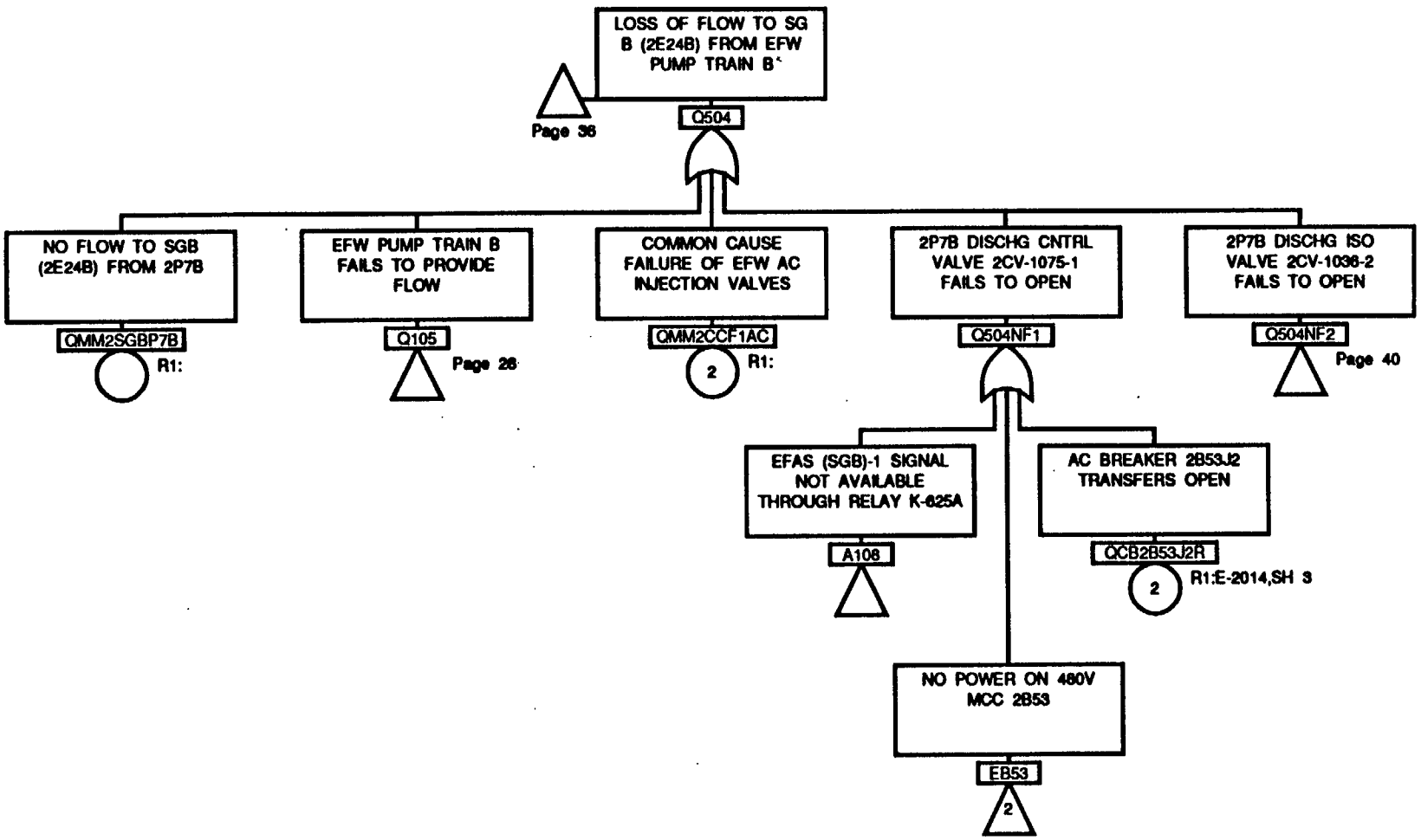

FAILURE OF START SIGNAL TO 2P7B FROM EFAS
Page 29
Q108
EFAS (SGA)-1 SIGNAL NOT AVAILABLE THROUGH RELAY K-211A
EFAS SGB-1 SIGNAL NOT AVAILABLE THROUGH RELAY K-112A
A096
A094
2
FAILURE OF EFAS PERMISSIVE TO TRAIN B SUCTION VALVES
Page 28
Q112
EFAS (SGB)-1 SIGNAL NOT AVAILABLE THROUGH RELAY K-310A
EFAS (SGA)-1 SIGNAL NOT AVAILABLE THROUGH RELAY K-402A
A102
A104
2

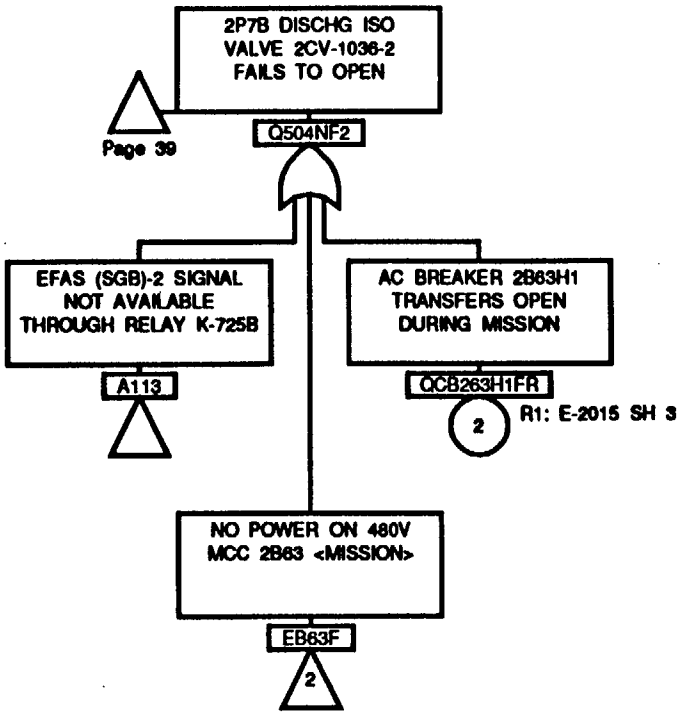

2P7B DISCHG ISO
VALVE 2CV-1038-2
FAILS TO OPEN
Q004NF2
Page 27
EFAS (SGA)-2 SIGNAL
NOT AVAILABLE
THROUGH RELAY K-724B
A111
AC BREAKER 2B63H3
TRANSFERS OPEN
DURING MISSION
QCB263H3FR
2
R1: E-2015
NO POWER ON 480V
MCC 2B63 <MISSION>
EB63F
2

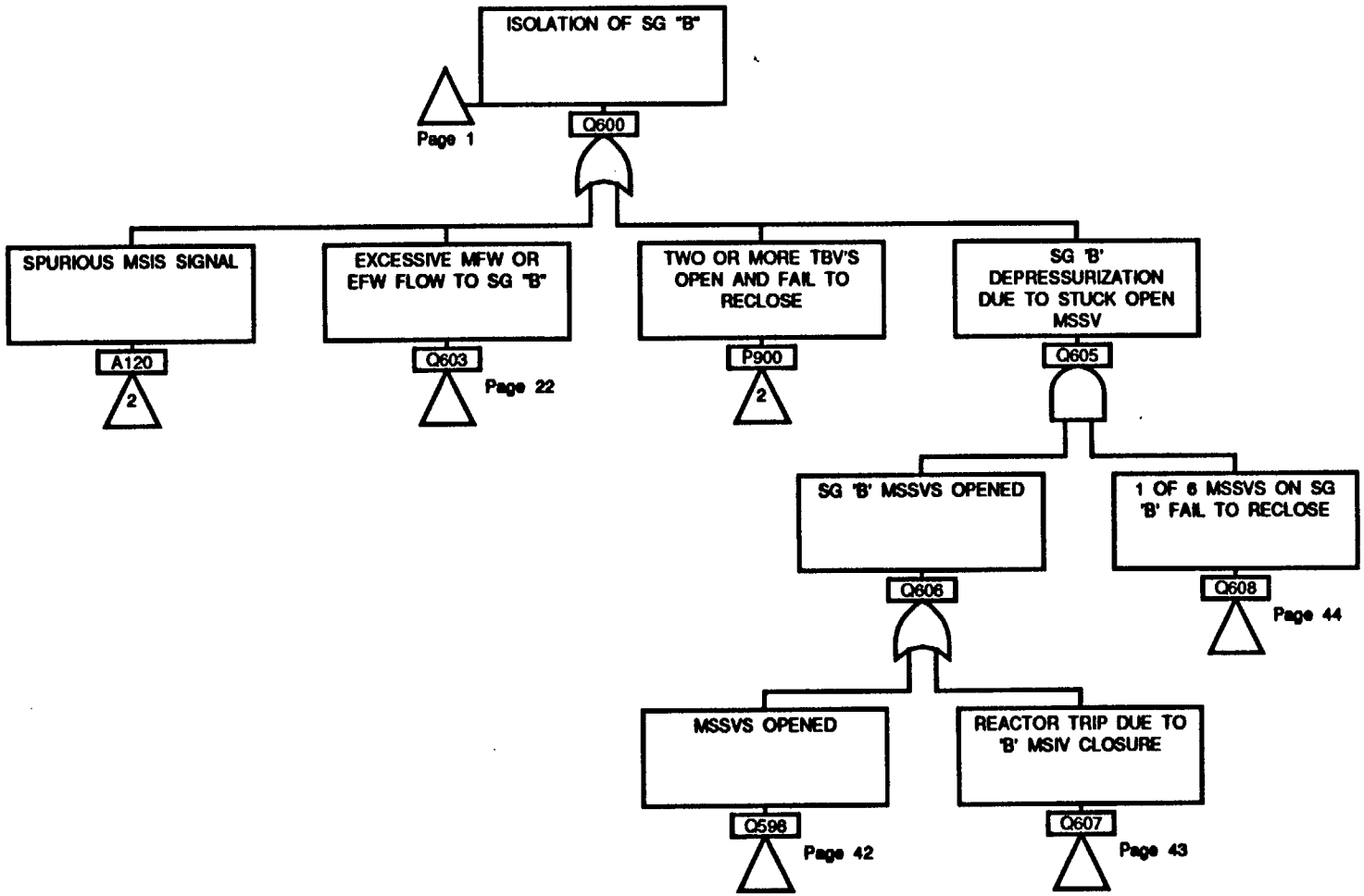

EFW FAILS TO PROVIDE FLOW TO SG "B" FROM 1 OF 2 PUMPS
Q501
Page 1
Page 1
CHECK VALVE 2EFW-9B FAILS TO PROVIDE FLOW
QMM2EFW9BF
R1: E-2018 SH 1
LOSS OF FLOW FROM EFW PUMP TRAINS A AND B
Q502
TRAIN A FAILS TO PROVIDE FLOW TO SG B
Q503TEST
TRAIN B FAILS TO PROVIDE FLOW TO SGB
Q504TEST
LOSS OF FLOW TO SG B FROM EFW PUMP TRAIN A
Q503NOFLO
Page 37
EXCESSIVE MFW OR EFW FLOW TO SG "A" OR SG "B"
Q013
Page 16
LOSS OF FLOW TO SG B (2E24B) FROM EFW PUMP TRAIN B
Q504
Page 39
NO FLOW TO SGB FROM TRAIN B FLAG
NFEFWBTOB
R1:

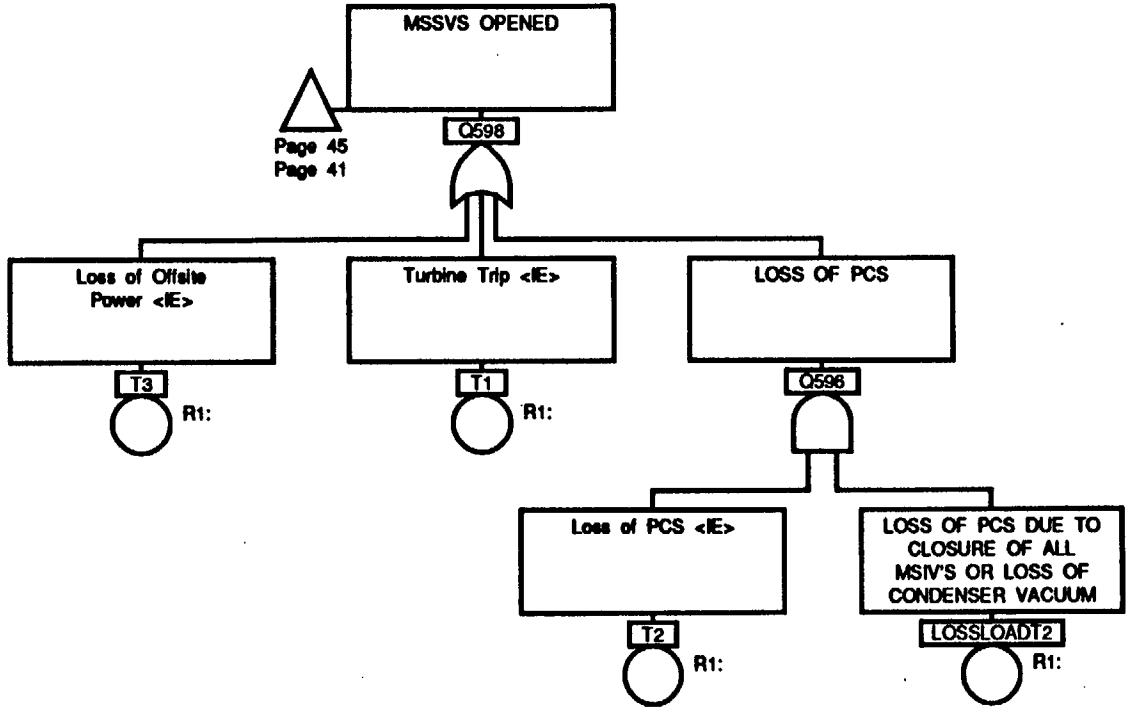

LOSS OF FLOW TO SG B FROM EFW PUMP TRAIN A
Page 36
Q503NOFLO
NO FLOW TO SGB FROM EFW PUMP TRAIN A
Q503NF
NO FLOW TO SGB FROM EFW PUMP TRAIN A FLAG
NFEFWATOB
R1:
NO FLOW TO SGB (2E24B) FROM 2P7A
QMM2SGBP7A
R1:
EFW PUMP 2P7A FAILS TO DELIVER FLOW
Q005TEST
Page 4
COMMON CAUSE FAILURE MODULE OF EFW DC INJECTION VALVES
QMM2CCF1DC
2
R1:
2P7A DISCHG ISO VALVE 2CV-1039-1 FAILS TO OPEN
Q503NF2
2P7A DISCHG VALVE 2CV-1076-2 FAILS TO OPEN
Q503NF1
Page 38
EFAS (SGB)-1 SIGNAL NOT AVAILABLE THROUGH RELAY K-725A
A112
DC BREAKER 2D27-B2 TRANSFERS OPEN DURING MISSION
QCD227B2FR
2
R1: E-2016
LOSS OF 125VDC BUS 2D27 <MISSION,BAT DISCHG>
D27FBTD
2

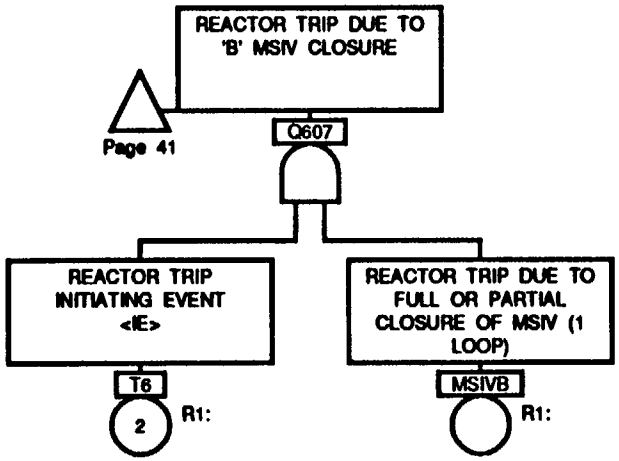

2P7A DISCHG VALVE 2CV-1076-2 FAILS TO OPEN
Q503NF1
Page 37
EFAS (SGB)-2 SIGNAL NOT AVAILABLE THROUGH RELAY K-625B
A109
DC BREAKER 2D26-C1 TRANSFERS OPEN
QCD2D26C1R
2
R1: E-2018 SH 1
LOSS OF 125VDC BUS 2D26 <PRIOR OR MISSION,BAT DISCHG>
D26AFBTD
4

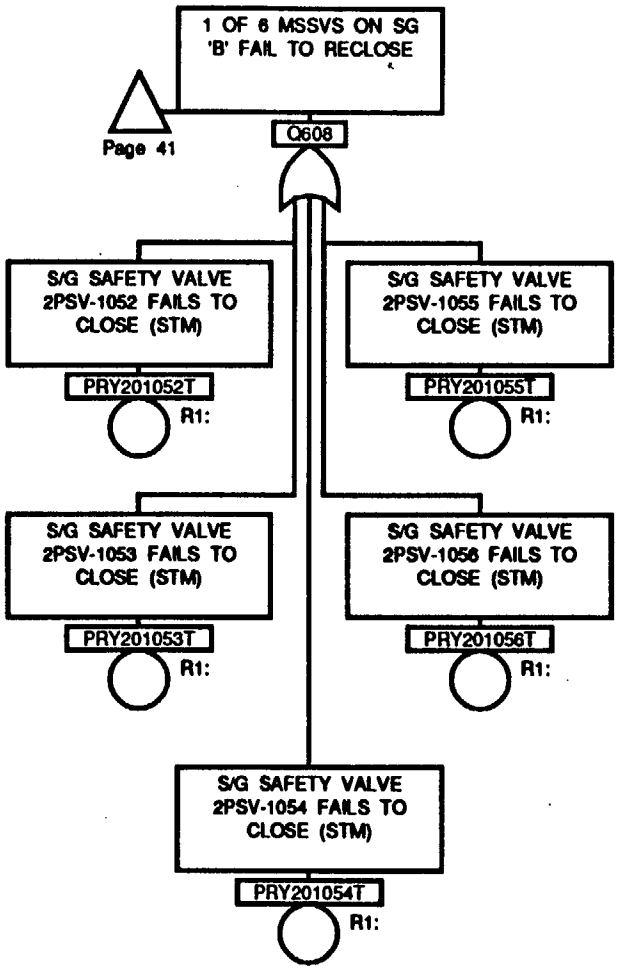

LOSS OF FLOW TO SG B (2E24B) FROM EFW PUMP TRAIN B
Page 36
Q504
NO FLOW TO SGB (2E24B) FROM 2P7B
QMM2SGBP7B
R1:
EFW PUMP TRAIN B FAILS TO PROVIDE FLOW
Q105
Page 26
COMMON CAUSE FAILURE OF EFW AC INJECTION VALVES
QMM2CCF1AC
2
R1:
2P7B DISCHG CNTRL VALVE 2CV-1075-1 FAILS TO OPEN
Q504NF1
2P7B DISCHG ISO VALVE 2CV-1036-2 FAILS TO OPEN
Q504NF2
Page 40
EFAS (SGB)-1 SIGNAL NOT AVAILABLE THROUGH RELAY K-625A
A108
AC BREAKER 2B53J2 TRANSFERS OPEN
QCB2B53J2R
2
R1:E-2014,SH 3
NO POWER ON 480V MCC 2B53
EB53
2

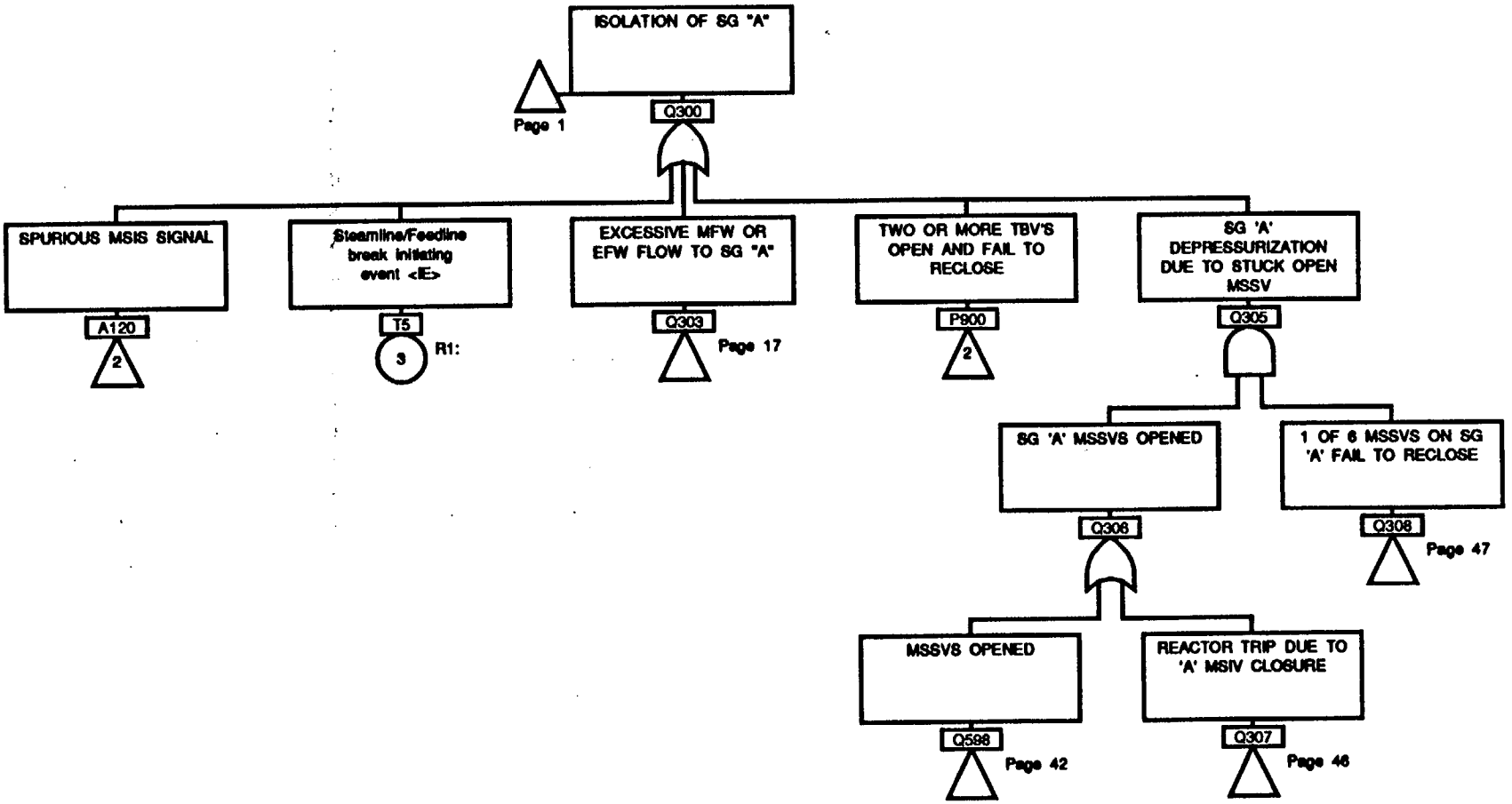

2P7B DISCHG ISO
VALVE 2CV-1036-2
FAILS TO OPEN
Page 39
Q504NF2
EFAS (SGB)-2 SIGNAL
NOT AVAILABLE
THROUGH RELAY K-725B
A113
AC BREAKER 2B63H1
TRANSFERS OPEN
DURING MISSION
QCB263H1FR
2
R1: E-2015 SH 3
NO POWER ON 480V
MCC 2B63 <MISSION>
EB63F
2

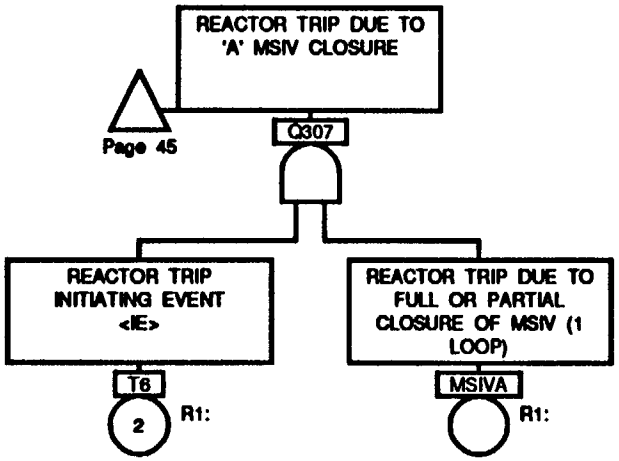

ISOLATION OF SG "B"
Page 1
Q600
SPURIOUS MSIS SIGNAL
A120
2
EXCESSIVE MFW OR EFW FLOW TO SG "B"
Q603
Page 22
TWO OR MORE TBV'S OPEN AND FAIL TO RECLOSE
P900
2
SG 'B' DEPRESSURIZATION DUE TO STUCK OPEN MSSV
Q605
SG 'B' MSSVS OPENED
Q606
1 OF 6 MSSVS ON SG 'B' FAIL TO RECLOSE
Q608
Page 44
MSSVS OPENED
Q598
Page 42
REACTOR TRIP DUE TO 'B' MSIV CLOSURE
Q607
Page 43

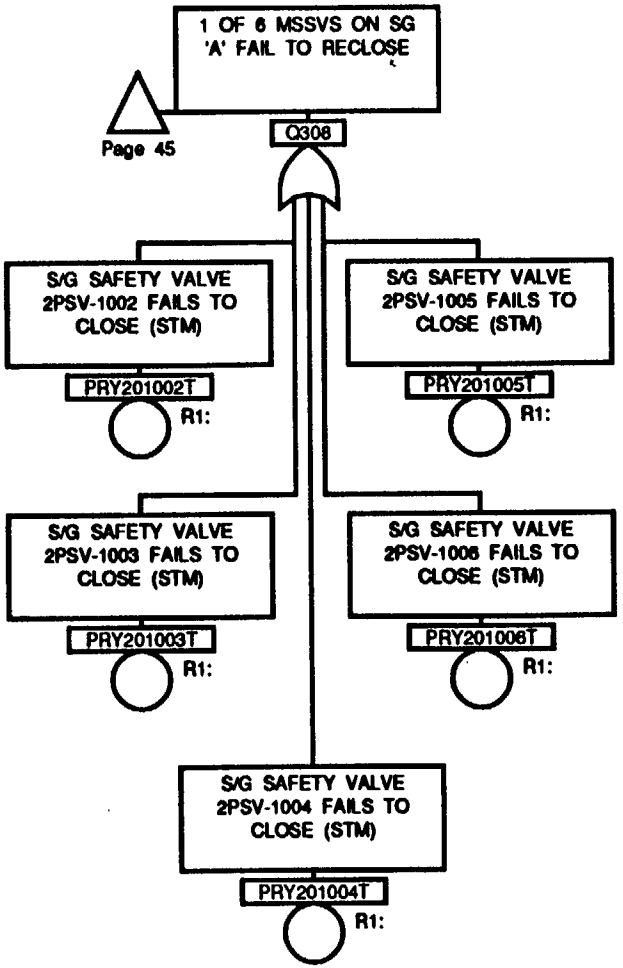

MSSVS OPENED
Q598
Page 45
Page 41
Loss of Offsite Power <IE>
T3
R1:
Turbine Trip <IE>
T1
R1:
LOSS OF PCS
Q598
Loss of PCS <IE>
T2
R1:
LOSS OF PCS DUE TO CLOSURE OF ALL MSIV'S OR LOSS OF CONDENSER VACUUM
LOSSLOADT2
R1:


REACTOR TRIP DUE TO 'B' MSIV CLOSURE
Page 41
Q607
REACTOR TRIP INITIATING EVENT <IE>
REACTOR TRIP DUE TO FULL OR PARTIAL CLOSURE OF MSIV (1 LOOP)
T6
2
R1:
MSIVB
R1:


1 OF 6 MSSVS ON SG 'B' FAIL TO RECLOSE
Page 41
Q608
S/G SAFETY VALVE 2PSV-1052 FAILS TO CLOSE (STM)
PRY201052T
R1:
S/G SAFETY VALVE 2PSV-1055 FAILS TO CLOSE (STM)
PRY201055T
R1:
S/G SAFETY VALVE 2PSV-1053 FAILS TO CLOSE (STM)
PRY201053T
R1:
S/G SAFETY VALVE 2PSV-1056 FAILS TO CLOSE (STM)
PRY201056T
R1:
S/G SAFETY VALVE 2PSV-1054 FAILS TO CLOSE (STM)
PRY201054T
R1:


ISOLATION OF SG "A"
Page 1
Q300
SPURIOUS MSIS SIGNAL
A120
2
Steamline/Feedline break initiating event <IE>
T5
3
R1:
EXCESSIVE MFW OR EFW FLOW TO SG "A"
Q303
Page 17
TWO OR MORE TBV'S OPEN AND FAIL TO RECLOSE
P800
2
SG 'A' DEPRESSURIZATION DUE TO STUCK OPEN MSSV
Q305
SG 'A' MSSVS OPENED
Q306
1 OF 6 MSSVS ON SG 'A' FAIL TO RECLOSE
Q308
Page 47
MSSVS OPENED
Q598
Page 42
REACTOR TRIP DUE TO 'A' MSIV CLOSURE
Q307
Page 46


REACTOR TRIP DUE TO 'A' MSIV CLOSURE
Page 45
Q307
REACTOR TRIP INITIATING EVENT <IE>
T6
2
R1:
REACTOR TRIP DUE TO FULL OR PARTIAL CLOSURE OF MSIV (1 LOOP)
MSIVA
R1:


1 OF 6 MSSVS ON SG 'A' FAIL TO RECLOSE
Page 45
Q308
S/G SAFETY VALVE 2PSV-1002 FAILS TO CLOSE (STM)
PRY201002T
R1:
S/G SAFETY VALVE 2PSV-1005 FAILS TO CLOSE (STM)
PRY201005T
R1:
S/G SAFETY VALVE 2PSV-1003 FAILS TO CLOSE (STM)
PRY201003T
R1:
S/G SAFETY VALVE 2PSV-1006 FAILS TO CLOSE (STM)
PRY201006T
R1:
S/G SAFETY VALVE 2PSV-1004 FAILS TO CLOSE (STM)
PRY201004T
R1:

Gate/Event Name	Page	Zone	Gate/Event Name	Page	Zone	Gate/Event Name	Page	Zone	Gate/Event Name	Page	Zone
A083	6	2	D27AFBTD	25	1	Q003NF1	3	5	Q106A	29	1
A084	6	3	D27FBTD	3	4	Q003NF1	15	2	Q106A	33	2
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	NFEFWATOA	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
A112A	25	1	PRY201002T	47	1	Q011	13	5	Q216	25	2
A113	40	1	PRY201003T	47	1	Q012	13	3	Q222	6	2
A113A	23	1	PRY201004T	47	2	Q013	2	2	Q300	1	5
A120	41	1	PRY201005T	47	2	Q013	16	2	Q300	45	3
A120	45	1	PRY201006T	47	2	Q013	36	2	Q303	16	1
D23AF	29	2	PRY201052T	44	1	Q101	1	1	Q303	17	2
D26AF	7	1	PRY201053T	44	1	Q101	1	3	Q303	45	3
D26AF	13	4	PRY201054T	44	2	Q101	2	2	Q305	45	5
D26AFBTD	15	2	PRY201055T	44	2	Q105	27	2	Q306	45	4
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
D27AFBTD	20	1	Q003NF	3	3	Q106	29	2	Q308	47	2

Gate/Event Name	Page	Zone	Gate/Event Name	Page	Zone	Gate/Event Name	Page	Zone	Gate/Event Name	Page	Zone
Q310	5	4	Q546	10	1	Q712	21	2	QMM2CCF003	13	6
Q310	6	2	Q546	10	3	Q715	23	3	QMM2CCF1AC	27	3
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
Q504NF1	39	4	Q603	22	2	QCB263H3AR	18	2	QMM2CV1076	26	2
Q504NF2	39	5	Q603	41	2	QCB263H3FR	18	2	QMM2EFW9AF	2	1
Q504NF2	40	2	Q605	41	4	QCB263H3FR	35	2	QMM2EFW9BF	36	1
Q504TEST	36	4	Q606	41	4	QCB2B51N2R	19	2	QMM2MSLIAF	6	1
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
Q515	8	4	Q700	18	2	QCD227B1FR	20	2	QMM2SGBP7B	39	1
Q530	8	1	Q700TEST	17	2	QCD227B2AR	25	2	QMM2STMADM	7	2
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

Gate/Event Name	Page	Zone	Gate/Event Name	Page	Zone	Gate/Event Name	Page	Zone	Gate/Event Name	Page	Zone
QSV200798C	31	4									
QSV200798R	11	6									
QTM2EFWTAF	4	5									
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									
XSEFWATOA	17	4									
XSEFWATOB	22	4									
XSEFWBTOA	17	2									
XSEFWBTOB	22	2									

ATTACHMENT H

LIST OF COMPUTER FILES

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	NFEFWATOA	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	QHF2EFWTAF	OPERATOR FAILS TO PROPERLY RESTORE EFW PUMP TRAIN A	4.20E-04
121	QHF2EFWTBF	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	QMM2COOLTB	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	QMM2MSLIAF	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	QMV2CCFBF$	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	XSEFWATOA	EXCESSIVE EFW FLOR FROM PUMP A TO SG A FLAG	1.00E+00 (Note 3)
234	XSEFWATOB	EXCESSIVE FLOW TO SG B FROM 2P7A FLAG	1.00E+00 (Note 3)
235	XSEFWBTOA	EXCESSIVE EFW FLOR FROM PUMP B TO SG A FLAG	1.00E+00 (Note 3)
236	XSEFWBTOB	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 XSEFWATOA, XSEFWATOB, XSEFWBTOA, and XSEFWBTOB are conditional flag events.

Attachment 1c

Recovery Events AFWFEEDREC and AFWFEEDRES

REV	DATE	BY	CHK
0	7/28/93		

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

		response
5.1 Type of behavior		no
5.2 Presence of burden		
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

AFWFEEDREC

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	DHH	GMM

App. B 19 of 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 AFWFEFDREC

Description of the activity

Operator fails to start and align the AFW pump after loss of both EFW trains

Standard items

1. *Who will perform the action?*
   RO
2. *What procedure will be used?*
   EOP
3. *How will the completion of the activity be recorded?*
   station log

Specific questions

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.

1. 55 min.

2. in control room

Comments

Date _____

REV	DATE	BY	CHK
0	7/9/92	BAH	JMM

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.

CALC NO. 89-F-0018-22 REV

REV	DATE	BY	CHK
0	7/6/92	[illegible]	[illegible]

App. B 22 of 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 AFWFEEDRES

Description of the activity

Same as AFWFEDREC

Standard items

1. *Who will perform the action?*
2. *What procedure will be used?*
3. *How will the completion of the activity be recorded?*

Specific questions

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.

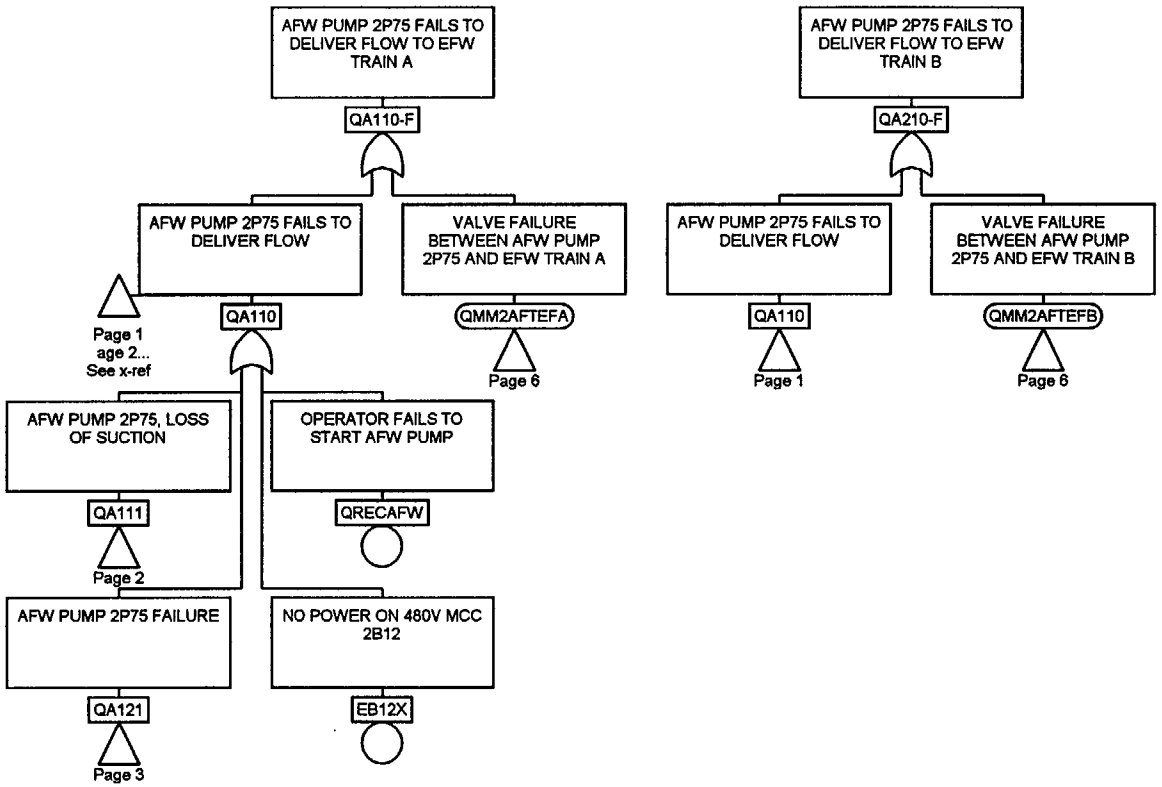
1.30 min.

Comments

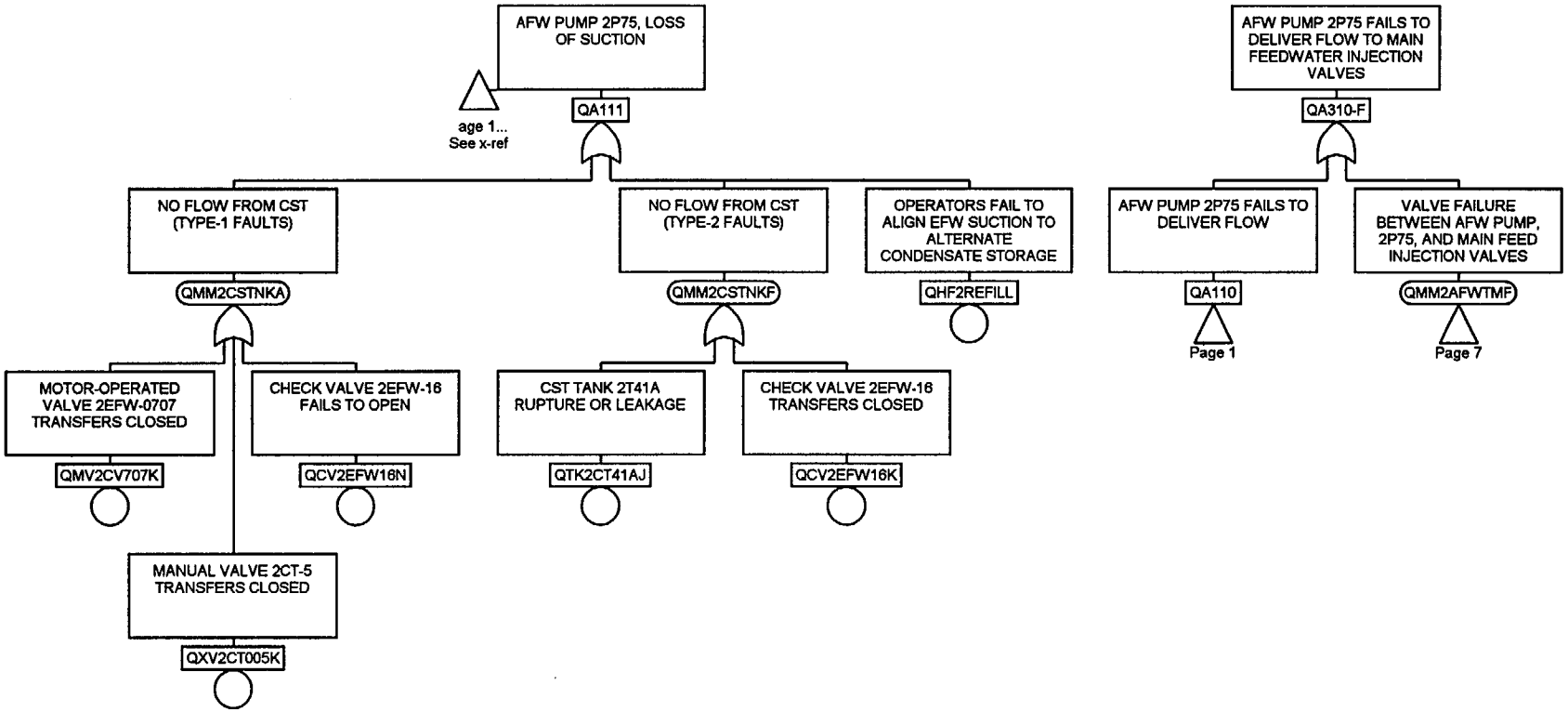
Date _____

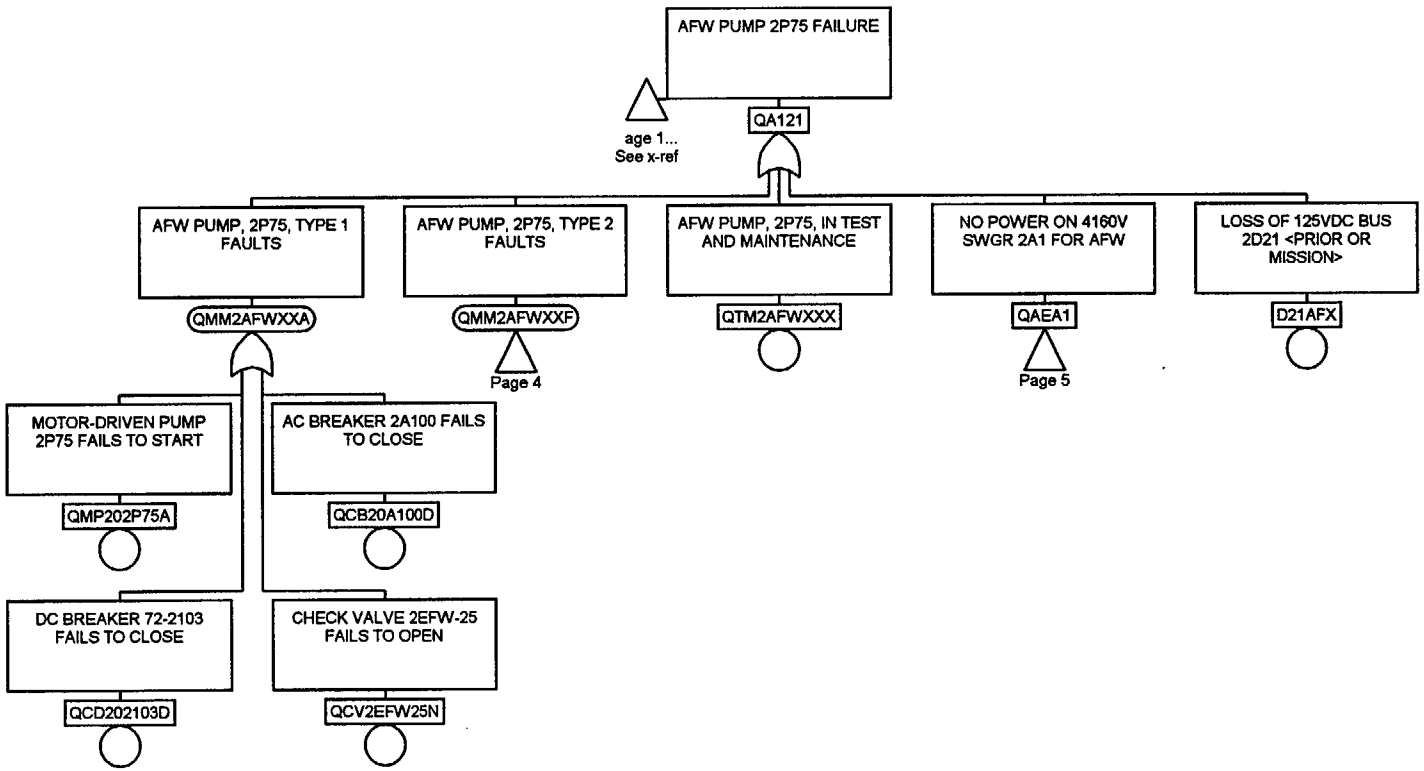
Attachment 1d

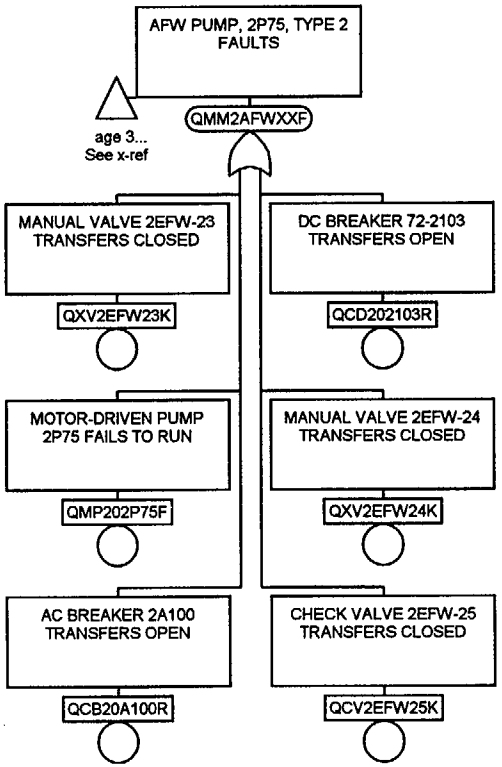
ANO-2 AFW System Fault Tree

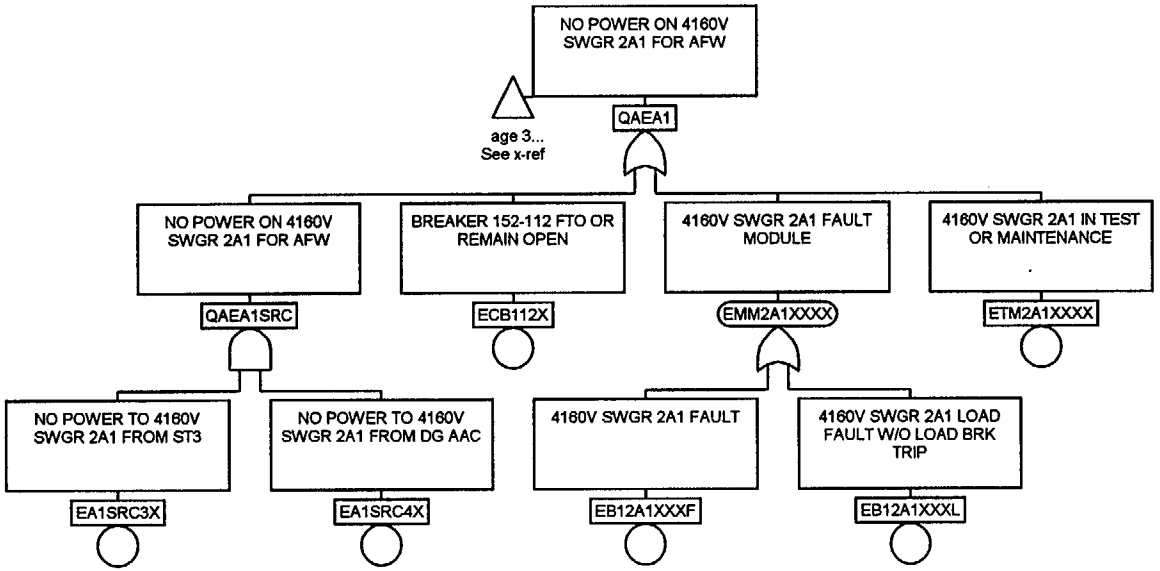


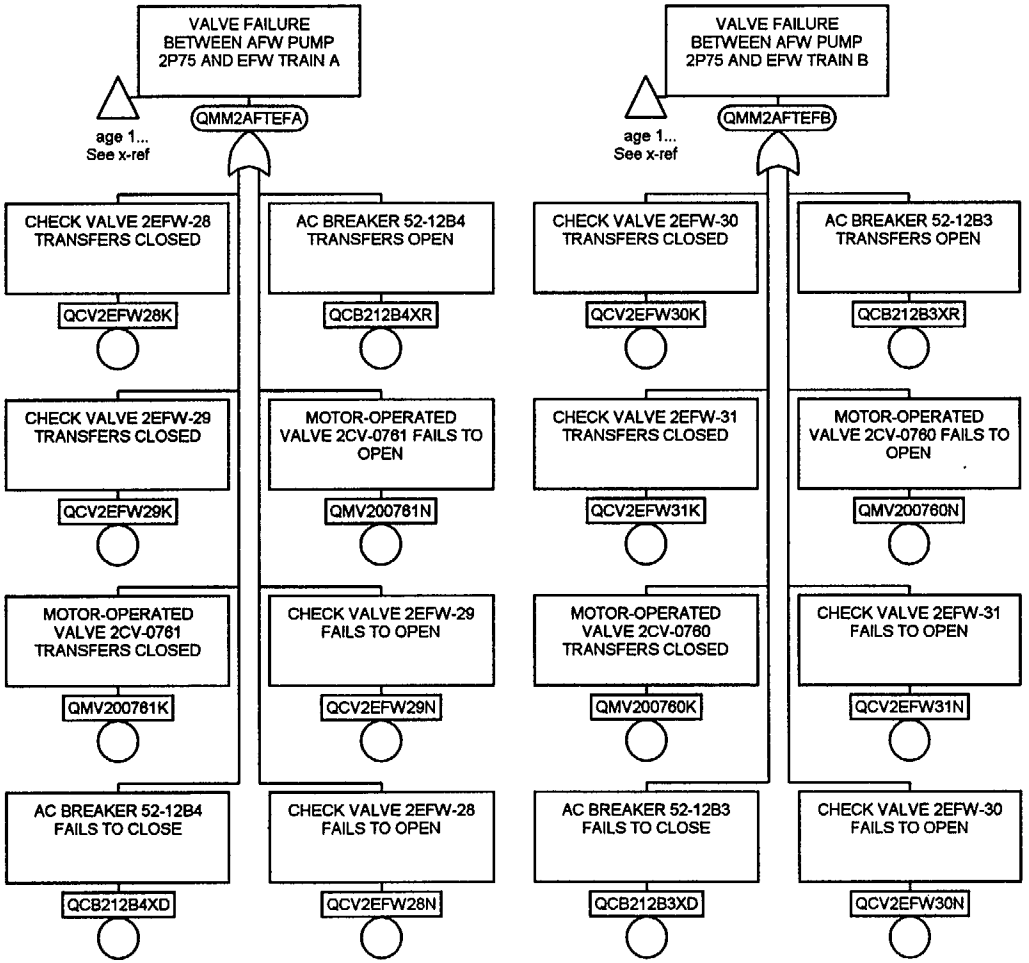
1	2	3	4
ANO-2 MASTER EOOS FAULT TREE	ANO-2 AFW	4/21/1900	Page 1

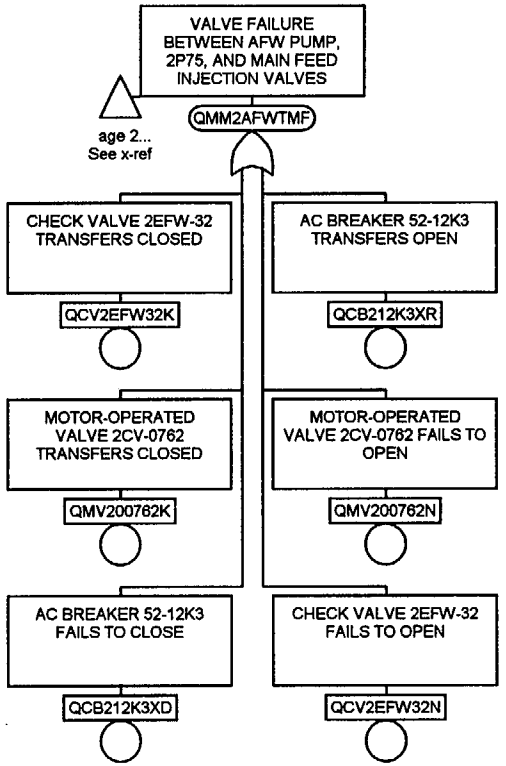

AFW PUMP 2P75, LOSS OF SUCTION
age 1...
See x-ref
QA111
NO FLOW FROM CST (TYPE-1 FAULTS)
QMM2CSTNKA
MOTOR-OPERATED VALVE 2EFW-0707 TRANSFERS CLOSED
QMV2CV707K
CHECK VALVE 2EFW-16 FAILS TO OPEN
QCV2EFW16N
MANUAL VALVE 2CT-5 TRANSFERS CLOSED
QXV2CT005K
NO FLOW FROM CST (TYPE-2 FAULTS)
QMM2CSTNKF
CST TANK 2T41A RUPTURE OR LEAKAGE
QTK2CT41AJ
CHECK VALVE 2EFW-16 TRANSFERS CLOSED
QCV2EFW16K
OPERATORS FAIL TO ALIGN EFW SUCTION TO ALTERNATE CONDENSATE STORAGE
QHF2REFILL
AFW PUMP 2P75 FAILS TO DELIVER FLOW TO MAIN FEEDWATER INJECTION VALVES
QA310-F
AFW PUMP 2P75 FAILS TO DELIVER FLOW
QA110
Page 1
VALVE FAILURE BETWEEN AFW PUMP, 2P75, AND MAIN FEED INJECTION VALVES
QMM2AFWTMF
Page 7


AFW PUMP 2P75 FAILURE
age 1...
See x-ref
QA121
AFW PUMP, 2P75, TYPE 1 FAULTS
AFW PUMP, 2P75, TYPE 2 FAULTS
AFW PUMP, 2P75, IN TEST AND MAINTENANCE
NO POWER ON 4160V SWGR 2A1 FOR AFW
LOSS OF 125VDC BUS 2D21 <PRIOR OR MISSION>
QMM2AFWXXA
QMM2AFWXXF
QTM2AFWXXX
QAEA1
D21AFX
Page 4
Page 5
MOTOR-DRIVEN PUMP 2P75 FAILS TO START
AC BREAKER 2A100 FAILS TO CLOSE
QMP202P75A
QCB20A100D
DC BREAKER 72-2103 FAILS TO CLOSE
CHECK VALVE 2EFW-25 FAILS TO OPEN
QCD202103D
QCV2EFW25N


AFW PUMP, 2P75, TYPE 2 FAULTS
QMM2AFWXXF
age 3...
See x-ref
MANUAL VALVE 2EFW-23 TRANSFERS CLOSED
QXV2EFW23K
DC BREAKER 72-2103 TRANSFERS OPEN
QCD202103R
MOTOR-DRIVEN PUMP 2P75 FAILS TO RUN
QMP202P75F
MANUAL VALVE 2EFW-24 TRANSFERS CLOSED
QXV2EFW24K
AC BREAKER 2A100 TRANSFERS OPEN
QCB20A100R
CHECK VALVE 2EFW-25 TRANSFERS CLOSED
QCV2EFW25K


NO POWER ON 4160V SWGR 2A1 FOR AFW
QAEA1
age 3...
See x-ref
NO POWER ON 4160V SWGR 2A1 FOR AFW
BREAKER 152-112 FTO OR REMAIN OPEN
4160V SWGR 2A1 FAULT MODULE
4160V SWGR 2A1 IN TEST OR MAINTENANCE
QAEA1SRC
ECB112X
EMM2A1XXXX
ETM2A1XXXX
NO POWER TO 4160V SWGR 2A1 FROM ST3
NO POWER TO 4160V SWGR 2A1 FROM DG AAC
4160V SWGR 2A1 FAULT
4160V SWGR 2A1 LOAD FAULT W/O LOAD BRK TRIP
EA1SRC3X
EA1SRC4X
EB12A1XXXF
EB12A1XXXL


VALVE FAILURE BETWEEN AFW PUMP 2P75 AND EFW TRAIN A
QMM2AFTEFA
age 1...
See x-ref
CHECK VALVE 2EFW-28 TRANSFERS CLOSED
QCV2EFW28K
AC BREAKER 52-12B4 TRANSFERS OPEN
QCB212B4XR
CHECK VALVE 2EFW-29 TRANSFERS CLOSED
QCV2EFW29K
MOTOR-OPERATED VALVE 2CV-0761 FAILS TO OPEN
QMV200761N
MOTOR-OPERATED VALVE 2CV-0761 TRANSFERS CLOSED
QMV200761K
CHECK VALVE 2EFW-29 FAILS TO OPEN
QCV2EFW29N
AC BREAKER 52-12B4 FAILS TO CLOSE
QCB212B4XD
CHECK VALVE 2EFW-28 FAILS TO OPEN
QCV2EFW28N
VALVE FAILURE BETWEEN AFW PUMP 2P75 AND EFW TRAIN B
QMM2AFTEFB
age 1...
See x-ref
CHECK VALVE 2EFW-30 TRANSFERS CLOSED
QCV2EFW30K
AC BREAKER 52-12B3 TRANSFERS OPEN
QCB212B3XR
CHECK VALVE 2EFW-31 TRANSFERS CLOSED
QCV2EFW31K
MOTOR-OPERATED VALVE 2CV-0760 FAILS TO OPEN
QMV200760N
MOTOR-OPERATED VALVE 2CV-0760 TRANSFERS CLOSED
QMV200760K
CHECK VALVE 2EFW-31 FAILS TO OPEN
QCV2EFW31N
AC BREAKER 52-12B3 FAILS TO CLOSE
QCB212B3XD
CHECK VALVE 2EFW-30 FAILS TO OPEN
QCV2EFW30N


VALVE FAILURE BETWEEN AFW PUMP, 2P75, AND MAIN FEED INJECTION VALVES
QMM2AFWTMF
age 2...
See x-ref
CHECK VALVE 2EFW-32 TRANSFERS CLOSED
QCV2EFW32K
AC BREAKER 52-12K3 TRANSFERS OPEN
QCB212K3XR
MOTOR-OPERATED VALVE 2CV-0762 TRANSFERS CLOSED
QMV200762K
MOTOR-OPERATED VALVE 2CV-0762 FAILS TO OPEN
QMV200762N
AC BREAKER 52-12K3 FAILS TO CLOSE
QCB212K3XD
CHECK VALVE 2EFW-32 FAILS TO OPEN
QCV2EFW32N

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			
EB12A1XXXF	5	3	QMM2AFWXXA	3	2			
EB12A1XXXL	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	94
126	83	109	SAI	45	0.3	01H	+0.77	0.53		

	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".