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## Power Supplies and Failure Modes for Auxiliary Feedwater System Electrical Components

Pump	Device Number	Power	Control Power	Auto Start or Open/Close	SI (Safeguards Sequence)	Low-Low Level Signal Power	<u>Undervoltage</u> Signal Power	Low Suction Pressure Trip Circuit Power	Low Suction Pressure Transmitter Loop Pov
1P-29	1MS-2019	D-11	D-11	N/A		D-16	D-11	N/A	N/A
	NC - FAI	[D01]	[D01]			[D01]	[D01] D-27		
	B SG Supply	B SG	B SG			LL Level Only	D-27		
						[bistables fail safe]	[D02] UV Only		
-	1MS-2020	D-27	D-27	N/A	N/A	D-21	D-11	N/A	N/A
	NC – FAI	[D02]	[D02]	1		[D02]	[D01]		• • • •
	A SG Supply	A SG	A SG			LL Level Only	[D01] D-27		
						[bistables fail safe]	[D02]		
	IMS-2082	D-11	D-11	N/A	N/A	N/A	UV Only N/A	D-11	1Y-03
	NO-FAI	[D01] None	[D01]					[D01]	[D03]
	Trip Throttle	None	None			*		1P-29 Seismic Only	1P-29 Seismic Only
	1AF-4000 NT - FAI	D-27 [D02]	D-27	N/A	N/A	N/A	N/A	N/A	N/A
	B SG Feed	1P-29 with Faulted B	[D02] 1P-29 with Faulted B			ſ			
	1AF-4001	D-11	D-11	N/A	N/A	N/A	N/A	N/A	N/A
	NT – FAI	[D01]	[D01]				1971	IVIL	IWI
	A SG Feed	1P-29 with Faulted A	1P-29 with Faulted A			,			
	IAF-4002 NC-FC	N/A	D-11	1Y-06 (1DPIS-4002)	N/A	N/A	N/A	N/A	N/A
	Recirc		[D01] 1-P29	[1B03] 1P-29		1		,	
	IAF-4006	1B-42	1972) 1B-42	N/A	N/A	N/A	N/A	N/A	N/A
	NC – FAI	none	none			IVIX	NA	IVA	IVA
	SW Supply					1			
	1FI-4002 1P-29 Forward	N/A	IY-01 (IFQ-4002)	N/A	N/A	N/A	N/A	N/A	N/A
	Flow Indicator		[D01] Loss of Indication						
P-38A	P-38A	1B-03	D-11	D-17	D-16 U1	D-16 UI	N/A	D-17	1Y-103
		P-38A	[D01]	[D01]	[D01]	[D01]	IVA	ID-17	[D03]
			P-38A	P-38Å	Safeguards Only UI	LL Level Only U1		[D01] P-38A Seismic Only	P-38A Seismic Only
					_	[bistables fail safe]			
					D-22 U2				
					[D01] Safeguards Only U2	D-22 U2			
	,		-		Saleguarus Only 02	[D01] LL Level Only U2			
						[bistables fail safe]			
	AF-4007	N/A	D-11	1Y06 (DPIS-4007)	N/A	N/A	N/A	N/A	N/A
	NC-FC Recirc		[D01] P-38A	[1B03] P-38A		l			
	recent		I-JOA	P-38A					
	AF-4012	N/A	1Y-01	N/A	N/A	N/A	N/A	N/A	N/A
	NC-FO Flow Control		[D01]			1			• • • •
	AF-4022	2B-32	P-38A (runnout)						
	U2 A SG.Feed	- P-38A U2	2B-32 P-38A U2	D-17 [D01]	D-22 U2 [D91]	D-22 U2	N/A	N/A	N/A
	NC-FAI			P-38A U2	Safeguards Only U2	[D31] LL Level Only U2			
					Salegued S only Oz	[bistables fail safe]			
	AF-4023	1B-32	1B-32	D-17	D-16 U1	D-16 U1	N/A	N/A	N/A
	UIASGFeed NC-FAI	P-38A U1	P-38A UI	[D01]	[D01]	[D01]			
	NC-FAI			P-38A U1	Safeguards Only UI	LL Level Only UI			
	AF-4009	1B-32	1B-32	N/A	N/A	[bistables fail safe] N/A	N/A	N/A	N/A
	NC – FAI	none	none		1911	iva ,	N/A		IV/A
	SW Supply								
	FI-4007	N/A	1Y-02 (FQ-4007)	N/A	N/A	N/A	N/A	N/A	N/A
	P-38A Forward Flow Indicator		[D02] Loss of Indication	1					
	1FI-4036	N/A	IY-03 (IFQ-4036)	N/A	N/A		N//A	NA	
	UI A SG Total	• • • • •	[D03]	IVA	IVA	N/A	N/A	N/A.	N/A
	Flow Indicator		Loss of Indication						
T	2FI-4036	N/A	2Y-03 (2FQ-4036)	N/A	N/A	N/A (	N/A	N/A	N/A
	U2 A SG Total Flow Indicator		[D03] Loss of Indication			)			
	LION INDICATOR		Loss of Indication	1					

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ure Trip Power	Notes
	Opens on AMSAC, 1A01 and 1A02 undervoltage, or low-low level in both Unit 1 SGs. 1Y-06: Unit 1 AMSAC signal will not open valve. 1Y-06 is an acceptable power supply for the AMSAC signal since AMSAC is not a safety related trip function. Fails AS IS.
	Opens on AMSAC, 1A01 and 1A02 undervoltage, or low-low level in both Unit 1 SGs 1Y-06: Unit 1 AMSAC signal will not open valve. 1Y-06 is an acceptable power supply for the AMSAC signal since AMSAC is not a safety related trip function. Fails AS IS.
Only	
	Normally closed. Opens on IMS-2019 or 1MS-2020 opening. Closes via 1DPIS-4002 after flow has been established. Fails closed.
	Normally closed. Manually opened by operators to switch to SW after a low suction pressure trip. Fails AS IS.
Only	Normally not running. Starts on SI (safeguards sequence), AMSAC, or low-low level in one SG. 1Y-06 and 2Y-06: Unit 1 or Unit 2 AMSAC will not start pump. 1Y-06 and 2Y-06 are acceptable power supplies for the AMSAC signals since AMSAC is not a safety related start function.
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## Power Supplies and Failure Modes for Auxiliary Feedwater System Electrical Components

Pump	Device Number	Power	Control Power	Auto Start or Open/Close	SI (Safeguards Sequence)	Low-Low Level Signal Power	Undervoltage Signal Power	Low Suction Pressure Trip Circuit Power	Low Suction Pressure Tr Transmitter Loop Power
P-38B	P-38B	2B-04 P-38B	D-13 [D02] P-38B	D-19 [D02] P-38B	D-21 UI [D02] Safeguards Only UI D-18 U2 [D02] Safeguards Only U2	D-21 UI [D02] LL Level Only UI [bistables fail safe] D-18 U2 [D02] LL Level Only U2	N/A	D-19 [D02] P-38B Seismic Only	2Y-104 [D04] P-38B Seismic Only
	AF-4014 NC-FC Recirc	N/A	D-13 [D02] P-38B	2Y06 (DPIS-4014) [2B04] P-38B	N/A	[bistables fail safe] N/A	N/A	N/A	N/A
	AF-4019 NC-FO	N/A	2Y-02 [D02]	N/A	N/A	N/A	N/A	N/A	N/A
	Flow Control AF-4020 NC - FAI U2 B SG Feed	2B-42 P-38B U2	P-38B (runnout) 2B-42 P-38B U2	D-19 [D02] P-38B	D-18 U2 [D02] Safeguards Only U2	D-18 U2 [D02] LL Level Only U2 [bistables fail safe]	N/A	N/A	N/A
	AF-4021 NC - FA1 UI B SG Feed	1B-42 P-38B U1	1B-42 P-38B 01	D-19 [D02] P-38B	D-21 UI [D02] Safeguards Only U2	D-21 UI [D02] LL Level Only UI [bistables fail safe]	N/A	N/A	N/A
	AF-4016 NC- FAI SW Supply	2B-42 none	2B-42 none	N/A	N/A	N/A	N/A	N/A	N/A
	FI-4014 P-38B Forward Flow Indicator	N/A	2Y-02 (FQ-4014) [D02] ' Loss of Indication	N/A	N/A	N/A	N/A	N/A	N/A
	IFI-4037 UI B SG Total Flow Indicator	N/A	IY-04 (IFQ-4037) [D04] Loss of Indication	N/A	N/A	N/A	N/A	N/A	N/A
	2FI-4037 U2 B SG Total Flow Indicator	N/A	2Y-04 (2FQ-4037) [D04] Loss of Indication	N/A	N/A	N/A	N/A	N/A	N/A
2 <b>P-29</b>	2MS-2019 NC - FAI B SG Supply	D-12 [D01] B SG	D-12 [D01] B SG	N/A	N/A	D-22 [D01] LL Level Only [bistables fail safe]	D-12 [D01] D-13 [D02] UV Only	N/A	N/A
	2MS-2020 NC – FAI A SG Supply	D-13 [D02] A SG	D-13 [D02] A SG	N/A	N/A	D-18 [D02] LL Level Only [vistables fall safe] -	D-12 [D01] D-13 [D02] UV Only	N/A	N/A
	2MS-2082 NO - FAI	D-13 [D02]	D-13 [D02]	N/A	N/A	N/A	N/A	D-13 [D02] 2P-29 Seismic Only	2Y-04 [D04] 2P-29 Seismic Only
	Trip Throttle 2AF-4000 NT-FAI B SG Feed	D-13 [D02] 2P-29 with Faulted B	D-13 [D02] 2P-29 with Faulted B	N/A	N/A	N/A	N/A	N/A	N/A
	2AF-4001 NT-FAI A SG FEED	D-12 [D01] 2P-29 with Faulted A	D-12 [D01] 2P-29 with Faulted A	N/A	N/A	N/A	N/A .	N/A	N/A
	2AF-4002 NC - FC Recirc	N/A	D-12 [D01] 2P-29	2Y-06 (2DPIS-4002) [2B04] 2P-29	N/A	N/A	N/A	N/A L	N/A
	2AF-4006 NC – FAI SW Supply	2B-42 none	-2B-42 none	N/A	N/A	N/A	N/A	N/A	N/A
	2FI-4002 2P-29 Forward Flow Indicator	N/A	2Y-01 (2FQ-4002) [D01] Loss of Indication	N/A	N/A	N/A	N/A	N/A	N/A

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rip	
er	Notes
	Normally not running. Starts on SI (safeguards sequence), AMSAC, or low-low level in one SG1Y-06 and 2Y-06: Unit 1 or Unit 2 AMSAC will not start pump. 1Y-06 and 2Y-06 are acceptable power supplies for the AMSAC signals since AMSAC is not a safety related start function. 2Y-104: Pump will not trip on low suction pressure.
	NEED TO VERIFY THAT SEISMIC DOES NOT REQUIRE CONTROL ROOM OPERATION
	,
	Normally closed. Opens on AMSAC, 2A01 and 2A02 undervoltage, or low-low level in both Unit 2 SGs 2Y-06: Unit 2 AMSAC signal will not open valve. 2Y-06 is an acceptable power supply for the AMSAC signal since AMSAC is not a safety related trip function. Fails AS IS.
200 M 1	Normally closed. Opens on AMSAC, 2A01 and 2A02 undervoltage, or low-low level in both Unit 2 SGs. 2Y-06: Unit 2 AMSAC signal will not open valve. 2Y-06 is an acceptable power supply for the AMSAC signal since AMSAC is not a safety related trip function.
	Fails AS IS.
y	
	Normally closed. Opens on 2MS-2019 or 2MS-2020 opening. Closes via 2DPIS-4002 after flow has been established. Fails closed.
	Normally closed. Manually opened (remotely or locally) by operators to switch to SW after a low suction pressure trip Fails AS IS

The following is a summary of equipment lost during various single failures and the consequences of that equipment being lost:

-	· · · · · · · · · · · · · · · · · · ·								
		<u>D-01</u>	<u>D-02</u>	<u>D-03</u>	<u>D-04</u>	1B-03 AND 2B-03	1B-04 AND 2B-04	NNSR (1Y-06/2Y-06)	NOTES
f	1MS-2019	В	Р						D-01: Loss of valve power and all auto open signals.
									D-02: Loss of UV open signal only.
.	1MS-2020	Р	A						D-01: Loss of UV open signal only.
H	1MS-2082	XS		- VC					D-02: Loss of valve power and all auto open signals.
	IW3-2002	72		XS					D-01: Loss of valve power and low suction pressure trip.
F	1AF-4000		1XB						D-03: Loss of low suction pressure trip.
	1AF-4001	1XA							D-02: Loss of valve power. Valve normally throttled open but cannot b
	1AF-4002	X						x	D-01: Loss of valve power. Valve normally throttled open but cannot b D-01: Loss of valve power.
L								~	1Y-06: Loss of auto open/close signal from 1DPIS-4002.
	1AF-4006						XS	· · · · · · · · · · · · · · · · · · ·	1B-04 (and 2B-04): Loss of valve power.
	1FI-4002	<u> </u>							
		State Assist	12106355		的考虑作教	の名が表現する。	HERE	PATHON	D-01: Loss of indication. Flow indication still available from FI-4007,
	P-38A	х		XS		Х			1B03 (and 2B03): Loss of motor power.
									D-01: Loss of breaker control power, all auto start functions and low su
┢	AF-4007	x							D-03: Loss of low suction pressure trip.
		^						x	D-01: Loss of valve power.
F	AF-4012	x							1Y-06: Loss of auto open/close signal from DPIS-4007.
	AF-4022	2X				2X			D-01: Loss of valve power.
L						27			2B-03 (and 1B-03): Loss of valve power. D-01: Loss of all auto open/close signals.
- [-	AF-4023	IX				1X			1B-03 (and 2B-03): Loss of valve power.
L								l l	D-01: Loss of all auto open/close signals.
	AF-4009					⊃ XS	_		1B-03 (and 2B-03): Loss of valve power.
	FI-4007		I						D-02: Loss of indication. Flow indication still available from 1FI-4002,
	1FI-4036 2F1-4036			<u>     I                               </u>	l				D-03: Loss of indication. Flow indication still available from 1FI-4002
		and a support of the state of	and the second second	I		THE REPORT OF THE PARTY OF THE PARTY OF THE		1	D-03: Loss of indication. Flow indication still available from 2FI-4002
	P-38B		X	SKEW CKI	ALCOLOR W		ne el altra da presenta da	なななななななななななななななななななななななななななななななななななななな	D-03: Loss of indication. Flow indication still available from 2FI-4002
1	-500		^		XS		х	1	2B03 (and 1B03): Loss of motor power.
			1						D-02: Loss of breaker control power, all auto start functions and low suc
	AF-4014		X					X	D-04: Loss of low suction pressure trip. D-02: Loss of valve power.
								~	2Y-06: Loss of auto open/close signal from DPIS-4014.
	\F-4019		X						D-02: Loss of valve power.
1	AF-4020		2X				2X		2B-04 (and 1B-04): Loss of valve power.
							1	3	D-02: Loss of all auto open/close signals.
	\F-4021		1X				1X	i.	1B-04 (and 2B-04): Loss of valve power.
	VF-4016								D-02: Loss of all auto open/close signals.
	I-4014						XS	• 51 - •••	2B-04 (and 1B-04): Loss of vaive power.
	1-4014		I		····			Ę	D-02: Loss of indication. Flow indication still available from 1FI-4002,
					1 1		1		D At I are of indication. Flow indication still qualitable from 151 4002
1	FI-4037								D-04: Loss of indication. Flow indication still available from 1FI-4002
1	FI-4037 FI-4037	25-27-27-25-25-73-	01-3-2-1 10-5-1		I	The second second second			
1 2 要	FI-4037 FI-4037	R	nti zatronica in D		I ISSE STREET				D-04: Loss of indication. Flow indication still available from 2FI-4002
1 2 8	FI-4037 FI-4037	B	P	NEW C	I				D-04: Loss of indication. Flow indication still available from 2FI-4002 D-01: Loss of valve power and all auto open signals.
1 2 2 2	FI-4037 FI-4037	B	r		I BARANARAN				D-04: Loss of indication. Flow indication still available from 2FI-4002 D-01: Loss of valve power and all auto open signals. D-02: Loss of UV open signal only.
1 2 2 2	FI-4037 FI-4037 MS-2019		P A						D-04: Loss of indication. Flow indication still available from 2FI-4002 D-01: Loss of valve power and all auto open signals. D-02: Loss of UV open signal only. D-01: Loss of UV open signal only.
1 2 2 2	FI-4037 FI-4037 MS-2019		r						D-04: Loss of indication. Flow indication still available from 2FI-4002 D-01: Loss of valve power and all auto open signals. D-02: Loss of UV open signal only. D-01: Loss of UV open signal only. D-02: Loss of valve power and all auto open signals.
1 2 2 2 2	FI-4037 FI-4037 MS-2019 MS-2020 MS-2082		A		I ECLASSIC				D-04: Loss of indication. Flow indication still available from 2FI-4002 D-01: Loss of valve power and all auto open signals. D-02: Loss of UV open signal only. D-01: Loss of UV open signal only. D-02: Loss of valve power and all auto open signals. D-02: Loss of valve power and all auto open signals. D-02: Loss of valve power and low suction pressure trip.
1 2 2 2 2 2	FI-4037 FI-4037 MS-2019 MS-2020 MS-2082 AF-4000	P	A					1 1 1	<ul> <li>D-04: Loss of indication. Flow indication still available from 2FI-4002</li> <li>D-01: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of UV open signal only.</li> <li>D-01: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of valve power and all auto open signals.</li> <li>D-04: Loss of low suction pressure trip.</li> </ul>
1 2 2 2 2 2 2	FI-4037 FI-4037 MS-2019 MS-2020 MS-2082 AF-4000 AF-4001	P 2XA	A XS						<ul> <li>D-04: Loss of indication. Flow indication still available from 2FI-4002</li> <li>D-01: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of UV open signal only.</li> <li>D-01: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of valve power and low suction pressure trip.</li> <li>D-04: Loss of low suction pressure trip.</li> <li>D-02: Loss of valve power. Valve normally throttled open but cannot be</li> </ul>
1 2 2 2 2 2 2	FI-4037 FI-4037 MS-2019 MS-2020 MS-2082 AF-4000	P	A XS						<ul> <li>D-04: Loss of indication. Flow indication still available from 2FI-4002</li> <li>D-01: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of UV open signal only.</li> <li>D-01: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of valve power and all auto open signals.</li> <li>D-04: Loss of low suction pressure trip.</li> </ul>
1 2 2 2 2 2 2 2	FI-4037 FI-4037 MS-2019 MS-2020 MS-2082 AF-4000 AF-4001 AF-4002	P 2XA	A XS					X	<ul> <li>D-04: Loss of indication. Flow indication still available from 2FI-4002</li> <li>D-01: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of UV open signal only.</li> <li>D-01: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of valve power and low suction pressure trip.</li> <li>D-04: Loss of low suction pressure trip.</li> <li>D-02: Loss of valve power. Valve normally throttled open but cannot be</li> <li>D-01: Loss of valve power.</li> <li>Valve normally throttled open but cannot be</li> <li>D-01: Loss of valve power.</li> <li>2Y-06: Loss of auto open/close signal from 2DPIS-4002.</li> </ul>
1 2 2 2 2 2 2 2 2 2	FI-4037 FI-4037 MS-2019 MS-2020 MS-2082 AF-4000 AF-4001	P 2XA	A XS				XS	X	<ul> <li>D-04: Loss of indication. Flow indication still available from 2FI-4002</li> <li>D-01: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of UV open signal only.</li> <li>D-01: Loss of Valve power and all auto open signals.</li> <li>D-02: Loss of valve power and all auto open signals.</li> <li>D-02: Loss of valve power and low suction pressure trip.</li> <li>D-04: Loss of low suction pressure trip.</li> <li>D-02: Loss of valve power. Valve normally throttled open but cannot be D-01: Loss of valve power.</li> </ul>

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制的系统性学家自己的复数形式和自己和自己的主义。在中国人们

## suction pressure trip.

02, 2FI-4002, 1FI-4036 and 2FI-4036. 02 and FI-4007. 02 and FI-4007.

部署書きたは国家になった。こので、「ない」では、「ない」、」、

suction pressure trip.

02, 2FI-4002, 1FI-4037 and 2FI-4037.

02 and FI-4014. 02 and FI-4014.

如下中国的时代,他们的时候,这些这些是一些是一些是一些是一些是一些是一些是一些。

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t be remotely isolated. t be remotely isolated.

7, FI-4014, 2FI-4036 and 2FI-4037.

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X	Pump lost.
XS	Pump lost for seismic event only.
1XA	Pump lost with faulted Unit 1 "A" steam generator.
1XB	Pump lost with faulted Unit 1 "B" steam generator.
2XA	Pump lost with faulted Unit 2 "A" steam generator.
2XB	Pump lost with faulted Unit 2 "B" steam generator.
1X	Pump lost to Unit 1 only.
2X	Pump lost to Unit 2 only.
P	Only partial loss of pump function (see notes).
A	Loss of A-train steam supply to pump. Pump still operable from B-train steam supply.
В	Loss of B-train steam supply to pump. Pump still operable from A-train steam supply
I	Partial loss of flow indication (see notes).

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