April 18, 1979

O'Connor EXHIBIT 3
FOR IDENTIFICATION
7/5/77 S. McCRYSTAL

FROM: J. C. Miller

TO: R. C. Arnold

SUBJECT: Preliminary Report on EMERGENCY FEED WATER SYSTEM

In accordance with your request, Ed O'Connor and I have undertaken to assess possible reasons why the emergency feed block valves (EF V-12A and 12B) may have been closed during the first few minutes of the incident at TMI-2 on March 28, 1979. Our assessment has not included any attempt to determine whether these valves were closed, but rather assuming that they were, why and for how long this condition may have existed.

Our assessment to date has focused on surveillance procedures which involve these valves and a review of the documentation of the surveillance during 1979.

The emergency feedwater system is subject to frequent surveillance of 1) valve alignment, 2) valve operation, and 3) pump test operation which requires operation and re-alignment of valves.

Surveillance requirements for in service inspection and testing must be performed in accordance with Section XI of ASME Boiler and Pressure Vessel Code and applicable addenda as required by 10CFR50.

Surveillance of the emergency feed system involving the EF V-12A and 12B valves has been accomplished twelve (12) times during 1979 prior to the date of the incident.

The surveillance test last performed prior to 0400 on March 28 which involved operation of EF V-12A and 12B valves was on March 26 from about 1000 to 1245. Like all routine surveillance tests, this was scheduled to be performed by the RELIEF SHIFT during the day between 0700 to 1500. The surveillance testing coordinator delivers computer print-outs to the Control Room outlining each test to be performed during the week. After reviewing the schedule, the foreman of the RELIEF SHIFT arranges for his crew to do the testing in conjunction with crew manning the Control Room and plant operation.

The test March 26 was on motor driven emergency feed water pumps in accordanc with procedure 2303-M27 A/B (see Attachment 1). On March 26 only M27B was performed on motor driven pumps. At the start of the test, copies of the sheets from the procedure giving the listing in sequence of steps to be performed were given to Auxiliary Operator and CRO. These serve both as step by step guide for testing and also as a check off list. Appendices A and B of the procedure, give valve alignments for testing the two pumps. It should be noted that only 6 of the 19 valves are unique to either the A or B pump systems; the other 13 valves are the same. The pumps are tested one at a time. Each test procedure requires closing both EF V-12A and EF V-12B which isolates both emergency feedlines to the steam generators. In the event of a reactor trip while the surveillance procedure is being executed, those lines would remain out of service until the CRO

opened EF V-12A and EF V 12-B from the Control Room.

In completing the test, the Auxiliary Operator brings his check off list back to Control Room and directs one of the CRO's to realign valves to normal operating alignment. This may be accomplished by the CRO assigned to RELIEF SHIFT or by CRO on the OPERATING SHIFT, or part by one and part by the other.

As is indicated by Attachment 2, this test is documented to have been successfully completed at 1245 on March 26. Neither this surveillance test nor any other test which involves operation of EF V-12A and V-12B was scheduled to be performed between completion of this test and 0400 on March 28.

As indicated above, the valve alignment required in step 6.2.2 in this procedure requires that both valves EF V-12A and 12B be closed during the time the pump tests are run. Attachment 3 is a simplified piping diagram of emergency feed system, and from this diagram you will note that EF V-12A and 12B are closed in order to produce pressure, when one pump is run, on the discharge side of non-return valves on the other two pumps not running. In this manner the tightness of the non-return valves can be checked as required in the procedure. The valve alignment in the procedure as originally prepared did not require V-12A and V-12B to be closed, because it was expected that EF V-11A and 11B, which are control valves and normally closed during normal plant operation, would be sufficiently tight to shut off flow to steam generators and thus provide for the pressure level required to test both the pumps and the non-return valves. However, valves V-11A and V-11B were not sufficiently tight, and Revision 4 was approved to include closing valves V-12A and V-12B in order to be able to accomplish the testing as structured in the procedure.

Our preliminary view at this time is that EF V-12A and 12B valves may have been closed for a period of up to forty-two (42) hours prior to the initiation of the incident, e.g., from about 1000 on March 26 when they were closed in accordance with valve alignment required in the surveillance procedure to 0400 on March 28. Based on existing documentation of the completion of the surveillance testing, valves EF V-12A and 12B were correctly repositioned open. On the assumption both that the valves were correctly positioned open at the completion of the surveillance test about 1200 on March 26, and were shut at 0400 on March 28, they had to have been operated to closed position either from the Control Room or from the control station in the Auxiliary Building for shutdown outside the Control Room. Our view is that either of the latter happenings is unlikely.

In addition to our assessment of TMI-2 emergency feed system surveillance requirements, we have reviewed as well Procedures 1300-3F and 1300-3G A/B for surveillance testing of emergency feed system on TMI-1. TMI-1 is a simpler system. Attachment 4 shows a simplified diagram of the emergency feedwater system. The procedure for pump tests requires closing of only valves 10A and 10B for motor driven pumps and valves 2A and 2B for turbine driven pump. Thus at no time during the surveillance tests for TMI-1 are both emergency feed trains out of service simultaneously. Non-return valves 11A, 11B, and 13 are tested only during cold shutdown condition. TMI In-Service Inspection (ISI) group are working on revision to TMI-1 procedures that will require someone not a part of the test group to verify valve alignment following each surveillance test.

J. G. Miller
Executive Consultant

cc: R. Long
E. O'Connor

Attachments (4)

THREE MILE ISLAND NUCLEAR STATION

UNIT #2 SURVEILLANCE PROCEDURE 2303-M27A/B

MOTOR DRIVEN EMERGENCY FEEDPUMP

FUNCTIONAL TEST AND VALVE OPERABILITY TEST

NOTE: 2303-M27A includes pump and valve testing, 2303-M27B includes pump testing only.

1.0 PURPOSE

1.1 To insure compliance with Technical Specification 4.0.5 which references ASME Section XI for testing of pumps. ASME Section XI specifies test quantities to be measured and acceptable ranges for those quantities.

1.2 To insure compliance with TMI Unit #2 Technical Specifications, Section 4.0.5.a, which states:

Inservice testing of ASME Code Class 1, 2, and 3 pumps and valves shall be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code and applicable addenda as required by 10 CFR50, Section 50.55a(g).

The above inservice testing will confirm the operation of the following ASME Code Class 3 valves:

EF-V1 A and B and EF-V27 A and B and EF-V2 (CLOSED)

2.0 APPLICABLE SURVEILLANCE FREQUENCY AND MODES

2.1 Surveillance Frequency --

31 days (M) for the pump tests (2303-M27B)

92 days (Q) for the valve tests (2303-M27A)

NOTE: Subsection 6.1 of this procedure includes both valve and pump testing; subsection 6.2 includes pump testing only. If 2303-M27A and 2303-M27B

are both scheduled on the Weekly Checklist Master Schedule, perform subsection 6.1 only. If only 2303-M27B is scheduled perform subsection 6.2 only. All of the steps in 6.2 are included in 6.1.

2.2 Modes: 1 thru 4 - Testing required per ASME Section XI.
5 and 6 - Testing optional per ASME Section XI.

3.0 LIMITS AND PRECAUTIONS

3.1 When a reference value or set of values may have been affected by repair or routine servicing of the pump, a new reference value or set of values shall be determined, or the previous value reconfirmed by an inservice test run prior to or within 96 hours after return of the pump to normal service. Deviations between the previous and new set of reference values shall be identified and verification that the new values represent acceptable pump operation shall be placed in the Technical Specifications surveillance file for that pump.

3.2 An inservice test shall be run on each pump nominally each month during normal plant operation. It is recommended that this test frequency be maintained during cold shutdown periods where this can reasonably be accomplished, although this is not mandatory.

3.3 Pumps that are operated more frequently than every month need not be run or stopped for a special test provided the quantities specified were measured, observed, and analyzed.

3.4 All test data must be analyzed within 96 hours after test completion.

3.5 Bearing temperatures are only required to be measured once every year. When measurement of bearing temperature is not required,

each pump shall be run for at least five minutes under conditions as stable as the system permits. At the end of this time at least one measurement of each of the quantities specified shall be made and recorded.

3.6 The vibration probe must be placed in the same position each test to insure repeatable measurements.

3.7 Record identification of the instruments used on the Data Sheet.

3.8 Instruments used for measuring quantities shall not have a scale range exceeding four times the reference value.

3.9 If a valve is in an out of service system, it need not be exercised until immediately prior to return of the system to service.

3.10 After a valve or its control system has either been replaced, repaired, or has undergone maintenance that could affect its performance, and prior to the time it is returned to service, it shall be tested as necessary to demonstrate that the performance parameters which could be affected are within acceptable limits. Adjustment of stem packing; removal of the bonnet, stem assembly, or actuator; or disconnection of hydraulic or electrical lines are examples of maintenance that could affect valve performance parameters.

4.0 LOCATION OF SYSTEM

4.1 Emergency feedwater pumps are located in the Control Building Area, elevation 280'6".

4.2 Controls for the emergency feedwater pumps are located in Control Room on Panel 4. Local controls are also available.

5.0 EQUIPMENT REQUIRED

5.1 IRD Vibration Analyzer, Model 306, or equivalent.

5.2 Eagle Eye Meter, Model 77C, ± 1.5% full scale, 0-50 inches of water or equivalent.

5.3 Stopwatch - required only if 2303-M27A is scheduled.

6.0 PROCEDURE

NOTE: The following procedure may be used for Motor Driven Emergency Feedpump 2A or 2B. Those components designations in (parenthesis) refer to the B system.

NOTE: Subsection 6.1 includes both valve and pump testing; subsection 6.2 includes pump testing only. If 2303-M27A and 2303-M27B are both scheduled on the Weekly Checklist Master Schedule, perform subsection 6.1 only. If only 2303-M27B is scheduled perform subsection 6.2 only. All of the steps in 6.2 are included in 6.1.

Initial Each Step After Satisfactory Completion.

6.1 Emergency Feed Pump (EF-P2A(B)) and valve test.

____6.1.1 INSTALL Eagle Eye Meter or equivalent at CO-FE-7616 (7617).

____6.1.2 PERFORM Appendix A (B) Valve Line up.

____6.1.3 RECORD on Data Sheet A (B) the pump idle inlet pressure from CO-PI-2025 (2026).

____6.1.4 INSURE Proper lube oil level on pump from bearing sight glasses and INITIAL Data Sheet.

____6.1.5 From its local control switch, OPEN EF-V-27A(B) and time from when the open button is pressed until only the red open light is illuminated on the panel. Record time on Data Sheet A(B).

____6.1.6 CLOSE EF-V27A(B).

_____6.1.7 START EF-P-2A (B) from Panel 4.

_____6.1.8 INSURE EF-V27A (B) automatically opens.

_____6.1.9 THROTTLE OPEN EF-V39 (EF-V40) until the flow rate as indicated by the differential pressure across CO-FE-7616 (7617) corresponds to the reference value. The reference value is designated on the Data Sheet. Calculate flow rate from the equation $Q = 66.05\ \sqrt{\Delta P}$ where ΔP is the differential pressure across CO-FE-7616 (7617) in inches of water, and Q is in gpm.

_____6.1.10 Cooling water flow to floor drain indicates that check valves EF-V1A(B) opened as required. Record on Data Sheet A(B) if valves EF-V1A(B) opened as required.

_____6.1.11 With pump EF-P-2A(B) operating as required, verify that pump EF-P-2B(A) is not windmilling due to fluid backflow through EF-V1B(A). Record on Data Sheet B(A) that valves EF-V1B(A) closed as required.

_____6.1.12 With pump EF-P-2A or EF-P-2B operating as required, verify that pump EF-P-1 (steam driven EF pump) is not windmilling due to fluid backflow through EF-V2. Record on Data Sheet A that valve EF-V2 closed as required.

_____6.1.13 LET pump run five minutes or longer until system stabilizes.

NOTE: Perform the following two steps only the first time this test in run during each calendar year, since bearing temperature measurement is only required once each year.

____6.1.14 ALLOW EF-P-2A (2B) to run until three successive bearing temperature measurements (as indicated by Computer Group 16, or Computer points 1653 and 1654 (1658 and 1659)) taken at 10 minute intervals, change by less than 3%.

____6.1.15 RECORD on Data Sheet A (B) the bearing temperatures, and times taken. RECORD the final temperatures in the table.

____6.1.16 RECORD the pump running inlet pressure from CO-PI-2025 (2026).

____6.1.17 RECORD the pump running discharge pressure from EF-PI-2002 (2001).

____6.1.18 CALCULATE and RECORD flow rate on Data Sheet A (B) using the equation $Q = 66.05 \sqrt{\Delta P}$ where ΔP is the D/P across CO-FE-7616 (7617) in inches of water, and Q is in gpm.

____6.1.19 MEASURE and RECORD the pump inboard bearing vibration in the horizontal and vertical plane perpendicular to the rotating shaft. INDICATE the higher of the two vibration amplitudes and designate whether in the horizonal (H) or vertical (V) plane. INSURE the probe is on the designated test points.

____6.1.20 STOP EF-P-2A (B).

____6.1.21 REMOVE Eagle Eye Meter.

____6.1.22 Insure EF-V8A(B) is open, EF-V12A(B) is open, EF-V7A(B) is closed, and close EF-V39(EF-V40.

6.2 Emergency Feed Pump (EF-P2A(B)) Test.

____6.2.1 INSTALL Eagle Eye Meter or equivalent at CO-FE-7616 (7617).

____6.2.2 PERFORM Appendix A (B) Valve Line up.

____6.2.3 RECORD on Data Sheet A (B) the pump idle inlet pressure from CO-PI-2025 (2026).

____6.2.4 INSURE Proper lube oil level on pump from bearing sight glasses and INITIAL Data Sheet.

____6.2.5 START EF-P-2A (B) from Panel 4.

____6.2.6 INSURE EF-V27A (B) automatically opens.

____6.2.7 THROTTLE EF-V39 (EF-V40) until the flow rate as indicated by the differential pressure across CO-FE-7616 (7617) corresponds to the reference value. The reference value is designated on the Data Sheet. Calculate flow rate from the equation $Q = 66.05 \sqrt{\Delta P}$ where ΔP is the differential pressure across CO-FE-7616 (7617) in inches of water, and Q is in gpm.

_____6.2.8 LET pump run five minutes or longer until system stabilizes.

NOTE: Perform the following two steps only the first time this test in run during each calendar year, since bearing temperature measurement is only required once each year.

_____6.2.9 ALLOW EF-P-2A (2B) to run until three successive bearing temperature measurements (as indicated by Computer Group 16, or Computer points 1653 and 1654 (1658 and 1659)) taken at 10 minute intervals, change by less than 3%.

_____6.2.10 RECORD on Data Sheet A (B) the bearing temperatures, and times taken. RECORD the final temperatures in the table.

_____6.2.11 RECORD the pump running inlet pressure from CO-PI-2025 (2026).

_____6.2.12 RECORD the pump running discharge pressure from EF-PI-2002 (2001).

_____6.2.13 CALCULATE and RECORD flow rate on Data Sheet A (B) from the equation $Q = 66.05 \sqrt{\Delta P}$ where ΔP is the differential pressure across CO-FE-7616 (7617) in inches of water, and Q is in gpm.

_____6.2.14 MEASURE and RECORD the pump inboard bearing vibration in the horizonal and vertical plane perpendicular to the rotating shaft. INDICATE the higher of the two vibration amplitudes and designate whether in the horizonal (H) or vertical (V) plane. INSURE the probe is on the designated test points.

_____6.2.15 STOP EF-P-2A (B).

____6.2.16 REMOVE Eagle Eye Meter.

____6.2.17 Insure EF-V8A(B) is open, EF-V12A(B) is open, EF-V7A(B) is closed, and close EF-V39 (EF-V40).

7.0 ACCEPTANCE CRITERIA

7.1 If measured values fall within the Acceptable Range, Analysis portion of the data sheet shall be filled out and signed by the Shift Supervisor/Shift Foreman within 96 hours.

7.2 If deviations fall within the Alert Range, the frequency of testing shall be doubled until the cause of the deviation is determined and the condition corrected. Analysis portion of the data sheet shall be filled out and signed by the Lead Mechanical Engineer/ISI Coordinator within 96 hours.

7.3 If deviations fall within the Required Action Range, the pump shall be declared inoperative and not returned to service until the cause of the deviation has been determined and the condition corrected. Analysis portion of the data sheet shall be filled out and signed by the Lead Mechanical Engineer/ISI Coordinator.

NOTE: Correction can be replacement or repair or an analysis to demonstrate that the condition does not impair pump operability and that the pump will still fulfill its function. A new set of reference values shall be established after such analysis.

NOTE: Modes 1 thru 3 - Two motor driven emergency feedpumps OPERABLE per T.S. 3.7.1.2.

NOTE: If the acceptance criteria are not met, proceed with ACTION statement 3.7.1.2.

7.4 Each of the valves which has been tested to function, shall have been observed to function as required on the data sheet. If a valve fails to exhibit the required change of valve stem or disc position during the test, corrective action shall be initiated immediately. If the condition is not or can not be corrected within 24 hours, the valve shall be declared inoperative. When corrective action is required as a result of tests during cold shutdown, the condition shall be corrected before startup. A retest showing acceptable operation shall be run following any required corrective action before the valve is returned to service.

7.5 When valve testing has been performed, the Analysis portion of the data sheet shall be filled out by the Lead Mechanical Engineer/ISI Coordinator.

DATA SHEET A

Motor Driven Emergency Feedpump EF-P-2A Functional Test

1. Pump idle inlet pressure _____ psig
2. Pump running inlet pressure (6.1.16 or 6.2.11) _____ psig
3. Rump running discharge pressure (6.1.17 or 6.2.12) _____ psig
4. Calculate differential pressure (#3 - #2) _____ psig
5. Lube oil level (Initial if satisfactory) _____
6. Pump Inboard Bearing Vibration (mils) H _____
   V _____

QUANTITY	MEASURED VALUE	ACCEPTABLE RANGE	ALERT RANGE		REQUIRED ACTION RANGE		REFERENCE VALUE
			LOW	HIGH	LOW	HIGH	
PUMP IDLE INLET PRESS. (PSIG)		>7.8	NA	NA	≤7.8	NA	150
PUMP RUNNING INLET PRESS. (PSIG)		>7.8	NA	NA	≤7.8	NA	145
PUMP DIFF. PRESSURE (PSI)		1269 to 1392	1228 to 1269	1392 to 1405	<1228	>1405	1365
FLOW RATE (GPM)		117.5 to 127.5	112.5 to 117.5	127.5 to 128.75	<112.5	>128.75	125
PUMP INBOARD BEARING TEMP. (^{o}F)	*	<180	NA	NA	NA	≥180	91.3
PUMP OUTBOARD BEARING TEMP. (^{o}F)	*	<180	NA	NA	NA	≥180	109.9
MAX VIBRATION (MILS)		0.0 to 1.0	NA	>1.0 to 1.5	NA	>1.5	.15 V

*Measurements taken only during first test run each calendar year.

DATA SHEET A (Cont'd)

Bearing Temperatures

NOTE: To be measured yearly.

TIME	INBOARD BEARING TEMP.	OUTBOARD BEARING TEMP.

NOTE: Three consecutive measurements taken at 10 minute intervals must change by less then 3%.

DATA SHEET A (cont'd)

	CO-PI-2025	EF-PI-2002	CO-FE-7516	EAGLE EYE METER	VIBRATION INSTRUMENT
MANUFACTURE					
MODEL					
SERIAL NO.					
SCALE RANGE					

PERFORMED BY: _____ DATE: _____ TIME: _____

APPROVED BY: _____ DATE: _____

Valve No.	Stroke Time (sec)	Acceptance Criteria
EF-V27A	OPEN in _____	≤3 sec.

Valve No.	Valve Function Requirement	Date/Initial
EF-V1 A	(check valve) OPEN	_____
EF-V1B	(check valve) CLOSED	_____
EF-V2	(check valve) CLOSED	_____

PERFORMED BY: _____ DATE: _____

APPROVED BY: _____ DATE: _____

ANALYSIS:

Analysis by: _____ DATE: _____ TIME: _____

Analysis performed within 96 hours? Yes_____ No_____

DATA SHEET B

Motor Driven Emergency Feedpump EF-P-2B Functional Test

1. Pump idle inlet pressure _____ psig
2. Pump running inlet pressure (6.1.16 or 6.2.11) _____ psig
3. Pump running discharge pressure (6.1.17 or 6.2.12) _____ psig
4. Calculate differential pressure (#3 - #2) _____ psig
5. Lube oil level (Initial if satisfactory) _____
6. Pump Inboard Bearing Vibration (mils) H _____
   V _____

QUANTITY	MEASURED VALUE	ACCEPTABLE RANGE	ALERT RANGE LOW	ALERT RANGE HIGH	REQUIRED ACTION RANGE LOW	REQUIRED ACTION RANGE HIGH	REFERENCE VALUE
PUMP IDLE INLET PRESS. (PSIG)		>7.8	NA	NA	≤7.8	NA	148
PUMP RUNNING INLET PRESS. (PSIG)		>7.8	NA	NA	≤7.8	NA	144
PUMP DIFF. PRESSURE (PSI)		1279 to 1403	1238 to 1279	1403 to 1417	<1238	>1417	1375
FLOW RATE (GPM)		117.5 to 127.5	112.5 to 117.5	127.5 to 128.75	<112.5	>128.75	125.3
PUMP INBOARD BEARING TEMP. (°F)	*	<180	NA	NA	NA	≥180	114
PUMP OUTBOARD BEARING TEMP. (°F)	*	<180	NA	NA	NA	≥180	96.6
MAX VIBRATION (MILS)		0 to 1	NA	>1 to 1.5	NA	>1.5	.32V

*Measurements taken only during first test run each calendar year.

DATA SHEET B (Cont'd)

Bearing Temperatures

NOTE: To be measured yearly.

TIME	INBOARD BEARING TEMP.	OUTBOARD BEARING TEMP.

NOTE: Three consecutive measurements taken at 10 minute intervals must change by less then 3%.

DATA SHEET 8 (Cont'd)

	CO-PI-2026	EF-PI-2001	CO-FE-7617	EAGLE EYE METER	VIBRATION INSTRUMENT
MANUFACTURE					
MODEL					
SERIAL NO.					
SCALE RANGE					

PERFORMED BY: _____ DATE: _____ TIME: _____

APPROVED BY: _____ DATE: _____

Valve No.	Stroke Time (sec.)	Acceptance Criteria
EF-V27B	OPEN in _____	≤ 3 sec.

Valve No.	Valve Function Requirement	Date/Initial
EF-V1 B	(check valve) OPEN	_____
EF-V1A	(check valve) CLOSED	_____

PERFORMED BY: _____ DATE: _____

APPROVED BY: _____ DATE: _____

ANALYSIS:

Analysis by: _____ DATE: _____ TIME: _____

Analysis performed within 96 hours? Yes _____ No _____

APPENDIX A

Motor Driven Emergency Feedpump, EF-P-2A Recirculation Valve Line-Up

Valve	Description	Position	Initial
CO-V85	Iso Valve on Header from Cond. Pumps	OP	
CO-V82A	Iso Valve from Cond. Storage Tanks	OP	
CO-V83A	Suction to EF-P-2A	L.O.	
EF-V7A	EF-P-2A Recirc to Cond.	OP	
EF-V8A	EF-P-2A Recirc. to CO-T-1A	CL	
EF-V9	CO-T-1A isolation valve	OP	
CO-V88A	EF Suction from CO-T-1A	OP	
CO-V88B	EF Suction From CO-T-1B	OP	
CO-V87	EF Pumps Suct Hdr Block	OP	
EF-V11A	Emerg. F.W. to RC-H-1A	CL	
EF-V12A	Emerg. F.W. to RC-H-1A	CL	
EF-V32A	EF-V11A Bypass	CL	
EF-V33A	EF-V12A Bypass	CL	
EF-V29A	EF-P-2A Cooling Water Inlet	OP	
EF-V31A	Bearing cooling water outlet	OP	
EF-V11B	Emerg. F.W. to RC-H-1B	CL	
EF-V12B	Emerg. F.W. to RC-H-1B	CL	
EF-V32B	EF-V11B Bypass	CL	
EF-V33B	EF-V12B Bypass	CL	

APPENDIX B

Motor Driven Emergency Feedpump, EF-P-2B Recirculation Valve Line-Up

Valve	Description	Position	Initial
CO-V85	Iso Valve on Header from Cond. Pumps	OP	
CO-V82B	Iso Valve from Cond. Storage Tanks	~~OP~~	
CO-V83B	Suction to EF-P-2B	L.O.	
EF-V73	EF-P-2B Recirc to Cond.	OP	
EF-V83	EF-P-2B Recirc. to CO-T-1A	CL	
EF-V9	CO-T-1B isolation valve	~~OP~~	
CO-V98A	EF Suction from CO-T-1A	OP	
CO-V98B	EF Suction From CO-T-1B	~~OP~~	
CO-V87	EF Pumps Suct Hdr Block	OP	
EF-V11A	Emerg. F.W. to RC-H-1A	CL	
EF-V12A	Emerg. F.W. to RC-H-1A	CL	
EF-V32A	EF-V11A Bypass	CL	
EF-V33A	EF-V12A Bypass	CL	
EF-V29B	EF-P-2B Cooling Water Inlet	OP	
EF-V31B	Cooling water outlet	OP	
EF-V11B	Emerg. F.W. to RC-H-1B	CL	
EF-V12B	Emerg. F.W. to RC-H-1B	CL	
EF-V32B	EF-V11B Bypass	CL	
EF-V33B	EF-V12B Bypass	CL	

DATE PRINTED 03/14/79 — SURVEILLANCE PERFORMANCE FORM — MEI-ED I M I UNIT 2 — EARLY DATE 03-20-79 — **SCHED DATE 03-27-79** — LATE DATE 04-02-79

PROCEDURE NO 2303-M278 — TECH/SPEC REF 4.0.5 — ASME SECTION XI

DEPT RESP - OPERATIONS

TASK NO - 2303M278

EF-P2A/B PUMP TESTING

DEPENDENT TASK

ASSIST DEPT

WORK ORDER NO. - 016000326
ACCOUNT NO. - 520.1
GC CODE - 20
COMPONENT NO - T41-2303-M 27-A
COMPONENT DESC - STANDARD TECH SPEC ITEM
COMP LOCATION - BDG LVL GRID

SPECIAL COMMENT -

PLANT CONDITION 1-1-1-0-0-0-1

FREQUENCY M — QUALITY CONTROL 1

SPECIFIC DAY

CONTRACTOR 0 — INTERFERENCE 0

PRIORITY 1 — COMPONENT STATUS 1

** COMPLETE THIS SECTION **

(1) (5) (34)
401CT41 2303M 27H 036002TS2303M27H79AM00
+ COMP NO ++ CSU+ + TASK ++SCHD+

RESULTS(51) — (1) PERFORMED OK

CHECK ONE ONLY
( )2 EXCEPTIONS
( )3 DEFICIENCIES
( )4 BOTH E S AND O S
( )5 NOT PERFORMED

DATE PERFORMED(39) 10 31 (MONTH) 26 (DAY) 79 (YEAR)

ACTUAL MANHOURS(45) 0000061.0

ACTION TAKEN CODE(52)

REASON NOT PERFORMED(54)

ABNORMAL OCC REPT(56)

PERFORMED BY EMPLOYEE NUMBER(60) 10610 SIGNATURE J.K. Lining

APPROVED BY EMPLOYEE NUMBER(65) 05195 SIGNATURE C Guthrie

WITNESSED BY EMPLOY' NUMBER(70) SIGNATURE-

CORRECTIVE MAINTENANCE JOB TICKET NUMBER(75)

403A (1) DUPLICATE AS ABOVE (S-38)

402A (1) DUPLICATE AS ABOVE (S-38)

RESULTS DESCRIPTION (39)

(61)

ASSISTING DEPARTMENTS

CODE(39)

HOURS(44)

404A (1) DUPLICATE AS ABOVE (S-38)

CODE(50)

(39)

HOURS(55)

(61)

POOR ORIGINAL

DATE PRINTED 02/24/79

SURVEILLANCE PERFORMANCE FORM
MET-ED T M I UNIT 2

EARLY DATE 03-07-79
SCHED DATE 03-29-79
LATE DATE 04-20-79

PROCEDURE NO: 2303-M27A

TECH/SPEC REF: 4.0.5

ASME SECTION XI

DEPT RESP - OPERATIONS

TASK NO - 2303-M27A
EF-P2A/B PUMP & VALVE TESTING

DEPENDENT TASK

WORK ORDER NO. - 036000326
ACCOUNT NO. - 520.1
GC CODE - 20
COMPONENT NO - TMI-2303-M 27-A
COMPONENT DESC - STANDARD TECH SPEC ITEM
COMP LOCATION - BDG. LVL GRID

SPECIAL COMMENT -

PLANT CONDITION 1-1-1-0-0-0-1

ASSIST DEPT

FREQUENCY 0 QUALITY CONTROL 1

SPECIFIC DAY

CONTRACTOR 0 INTERFERENCE 0

PRIORITY 1 COMPONENT STATUS 1

** ** ** ** ** ** ** ** ** COMPLETE THIS SECTION ** ** ** ** ** ** ** ** **

(1) (5) (38)
401CTMI2303M 27A036002IS2303M27A790880
+ COMP NO ++ CSU+ + TASK ++SCHD+

RESULTS(51)

CHECK ONE ONLY
( )1 PERFORMED OK
( )2 EXCEPTIONS
( )3 DEFICIENCIES
( )4 BOTH E S AND D S
( )5 NOT PERFORMED

DATE PERFORMED(39) 03I 26I 79I (MONTH DAY YEAR)

ACTUAL MANHOURS(45) 000061:01

ACTION TAKEN CODE(52) LLI

REASON NOT PERFORMED(54) LLI

ABNORMAL OCC REPT(56) LLLLI

PERFORMED BY EMPLOYEE NUMBER(60) 06621 6I SIGNATURE- J.K. Livingood

APPROVED BY EMPLOYEE NUMBER(65) 05595 5I SIGNATURE- C. Gerlach

WITNESSED BY EMPLOYEE NUMBER(70) LLLLLI SIGNATURE-

CORRECTIVE MAINTENANCE JOB TICKET NUMBER(75) LLLLLI

403A (1) DUPLICATE AS ABOVE (5-38)

RESULTS DESCRIPTION

L0L1L L L L L L L L L L L L L L L L L I(39)
L L L L L L L L L L L L L L L L L L L I(61)

404A (1) DUPLICATE AS ABOVE (5-38)

L0L1L L L L L L L L L L L L L L L L L I(39)
L L L L L L L L L L L L L L L L L L L I(61)

402A (1) DUPLICATE AS ABOVE (5-38)

ASSISTING DEPARTMENTS

CODE(39) LLLLLI
HOURS(44) LLLLL I.L

CODE(50) LLLLLI
HOURS(55) LLLLL I.L

THREE MILE ISLAND NUCLEAR STATION

UNIT #2 SURVEILLANCE PROCEDURE 2303-M27A/S
MOTOR DRIVEN EMERGENCY FEEDPUMP
FUNCTIONAL TEST AND VALVE OPERABILITY TEST
Table of Effective Pages

Page	Date	Revision	Page	Date	Revision	Page	Date	Rev
1.0	12/01/77	1	26.0			51.0		
2.0	12/01/77	1	27.0			52.0		
3.0	05/04/78	3	28.0			53.0		
4.0	05/04/78	3	29.0			54.0		
5.0	05/04/78	3	30.0			55.0		
6.0	05/04/78	3	31.0			56.0		
7.0	08/30/78	4	32.0			57.0		
8.0	05/04/78	3	33.0			58.0		
9.0	08/30/78	4	34.0			59.0		
10.0	05/04/78	3	35.0			60.0		
11.0	08/30/78	4	36.0			61.0		
12.0	12/01/77	1	37.0			62.0		
13.0	05/04/78	3	38.0			63.0		
14.0	08/30/78	4	39.0			64.0		
15.0	12/01/77	1	40.0			65.0		
16.0	05/04/78	3	41.0			66.0		
17.0	08/30/78	4	42.0			67.0		
18.0	08/30/78	4	43.0			68.0		
19.0			44.0			69.0		
20.0			45.0			70.0		
21.0			46.0			71.0		
22.0			47.0			72.0		
23.0			48.0			73.0		
24.0			49.0			74.0		
25.0			50.0			75.0		

Unit 1 Staff Recommends Approval

Approval N/A Date —

Cognizant Dept. Head

Unit 2 Staff Recommends Approval

Approval N/A Date —

Cognizant Dept. Head

Unit 1 PORC Recommends Approval

N/A Date —

Chairman of PORC

Unit 2 PORC Recommends Approval

R P Warren Date 8/30

V-Chairman of PORC

Unit 1 Superintendent Approval

N/A Date —

Unit 2 Superintendent Approval

Date

Manager Generation Quality Assurance Approval N/A Date

DATA SHEET A

Motor Driven Emergency Feedpump EF-P-2A Functional Test

1. Pump idle inlet pressure 80 psig
2. Pump running inlet pressure (6.1.16 or 6.2.11) 80 psig
3. Pump running discharge pressure (6.1.17 or 6.2.12) 1470 psig
4. Calculated differential pressure (#3 - #2) 1390 psig
5. Lube oil level (Initial if satisfactory) J.L.
6. Pump Inboard Bearing Vibration (mils) H .22
   V .26

QUANTITY	MEASURED VALUE	ACCEPTABLE RANGE	ALERT RANGE LOW	ALERT RANGE HIGH	REQUIRED ACTION RANGE LOW	REQUIRED ACTION RANGE HIGH	REFERENCE VALUE
PUMP IDLE INLET PRESS. (PSIG)	80	>7.8	NA	NA	≤7.8	NA	150
PUMP RUNNING INLET PRESS. (PSIG)	80	>7.8	NA	NA	≤7.8	NA	145
PUMP DIFF. PRESSURE (PSI)	1390	1269 to 1392	1228 to 1269	1392 to 1405	<1228	>1405	1355
FLOW RATE (GPM)	123.5	117.5 to 127.5	112.5 to 117.5	127.5 to 128.75	<112.5	>128.75	125
PUMP INBOARD BEARING TEMP. (°F)	*	<180	NA	NA	NA	≥180	91.3
PUMP OUTBOARD BEARING TEMP. (°F)	*	<180	NA	NA	NA	≥180	109.9
MAX VIBRATION (MILS)	.26 V	0.0 to 1.0	NA	>1.0 to 1.5	NA	>1.5	.15 V

*Measurements taken only during first test run each calendar year.

DATA SHEET A (cont'd)

	CO-PI-2025	EF-PI-2002	CO-FE-7616	EAGLE EYE METER	VIBRATION INSTRUMENT
MANUFACTURE	Barksdale	Barksdale		ITT Barton	IRD
MODEL	AISI 316	AISI 316			308
SERIAL NO.	-	-			C5144111449
SCALE RANGE	0-300	0-2000		0-100"	.1-100

PERFORMED BY: J. K. Travis DATE: 3/26/79 TIME: 10:00

APPROVED BY: C. Guthrie DATE: 3/26/79

Valve No.	Stroke Time (sec)	Acceptance Criteria
EF-V27A	OPEN in 1 sec	<3 sec.

Valve No.	Valve Function Requirement	Date/Initial
EF-V1 A	(check valve) OPEN	3/26/ JKL
EF-V1B	(check valve) CLOSED	3/26 JKL
EF-V2	(check valve) CLOSED	3/26 JKL

PERFORMED BY: J. K. Travis DATE: 3/26/79

APPROVED BY: C Guthrie DATE: 3/26/79

ANALYSIS: MEETS ACCEPTANCE CRITERIA

Analysis by: C Guthrie DATE: 3/26/79 TIME: 1245

Analysis performed within 96 hours? Yes ✓ No

DATA SHEET B

Motor Driven Emergency Feedpump EF-P-2B Functional Test

1. Pump idle inlet pressure 75 psig
2. Pump running inlet pressure (6.1.16 or 6.2.11) 74 psig
3. Pump running discharge pressure (6.1.17 or 6.2.12) 1460 psig
4. Calculated differential pressure (#3 - #2) 1386 psig
5. Lube oil level (Initial if satisfactory) E.T.
6. Pump Inboard Bearing Vibration (mils) H .5
   V .2

QUANTITY	MEASURED VALUE	ACCEPTABLE RANGE	ALERT RANGE LOW	ALERT RANGE HIGH	REQUIRED ACTION RANGE LOW	REQUIRED ACTION RANGE HIGH	REFERENCE VALUE
PUMP IDLE INLET PRESS. (PSIG)	75	>7.8	NA	NA	≤7.8	NA	148
PUMP RUNNING INLET PRESS. (PSIG)	74	>7.8	NA	NA	≤7.8	NA	144
PUMP DIFF. PRESSURE (PSI)	1386	1279 to 1403	1238 to 1279	1403 to 1417	<1238	>1417	1376
FLOW RATE (GPM)	118.1	117.5 to 127.5	112.5 to 117.5	127.5 to 128.75	<112.5	>128.75	125.3
PUMP INBOARD BEARING TEMP. (°F)	*	<180	NA	NA	NA	≥180	114
PUMP OUTBOARD BEARING TEMP. (°F)	*	<180	NA	NA	NA	≥180	96.6
MAX VIBRATION (MILS)	.5H	0 to 1	NA	>1 to 1.5	NA	>1.5	.32V

*Measurements taken only during first test run each calendar year.

DATA SHEET 8 (Cont'd)

	CO-PI-2026	EF-PI-2001	CO-FE-7617	EAGLE EYE METER	VIBRATION INSTRUMENT
MANUFACTURE	Dresser	ASHcroft		ITT Hoffman	IRD
MODEL	2151 311	Duragage			306
SERIAL NO.		—			5145 1144
SCALE RANGE	0-300#	0-2000		0-10"	.1-100

PERFORMED BY: J. K. Lemon DATE: 3/26/79 TIME: 10:00

APPROVED BY: C Guthrie DATE: 3/26/79

Valve No.	Stroke Time (sec.)	Acceptance Criteria
EF-V27B	OPEN in 1 sec	≤ 3 sec.

Valve No.	Valve Function Requirement	Date/Initial
EF-V1 B	(check valve) OPEN	3/26/79
EF-V1A	(check valve) CLOSED	3/26/79

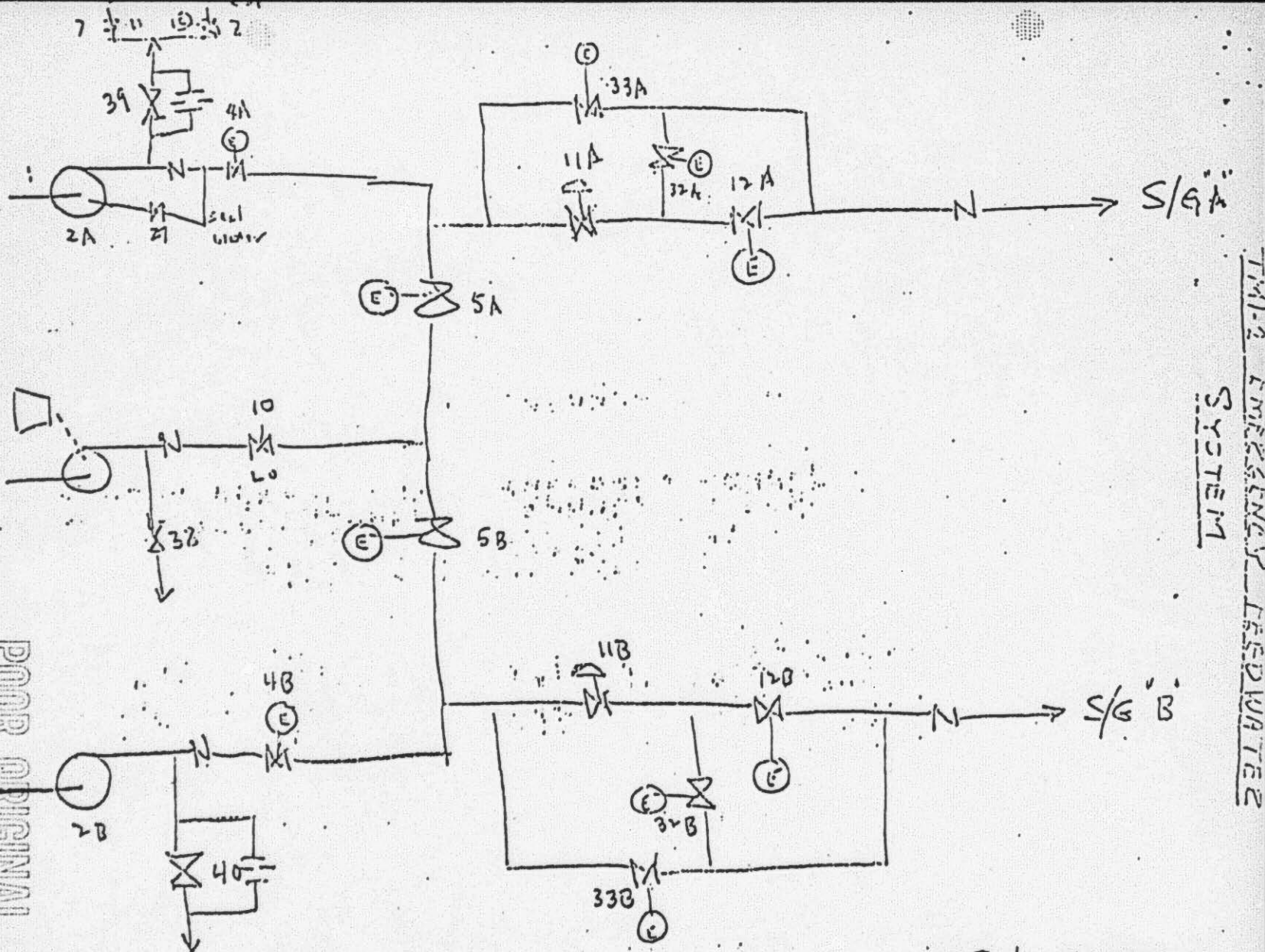
PERFORMED BY: K. Lemon G. Terre DATE: 3/26/79

APPROVED BY: C Guthrie DATE: 3/26/79

ANALYSIS: Meets Acceptance Criteria

Analysis by: C Guthrie DATE: 3/26/79 TIME:

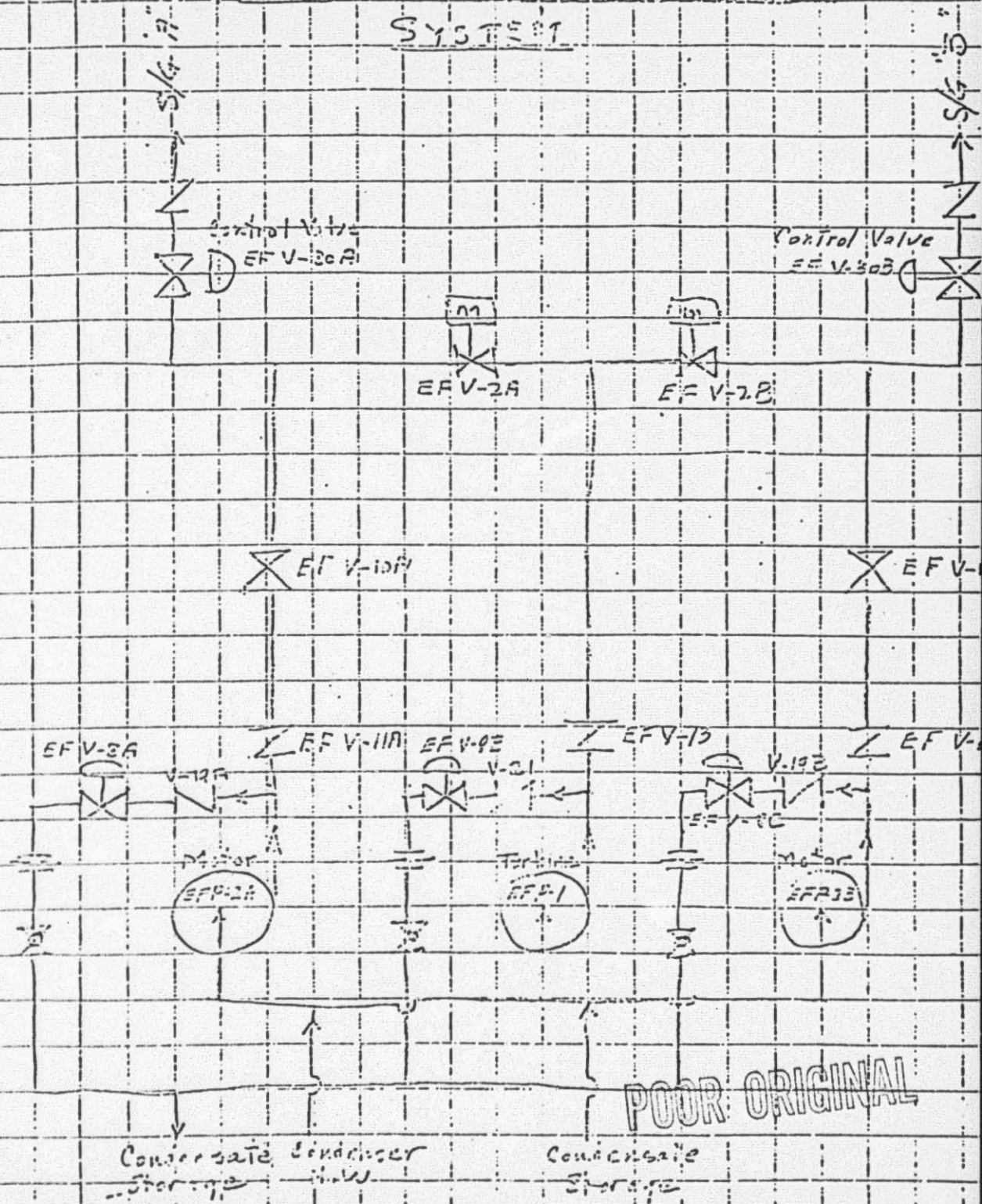
Analysis performed within 96 hours? Yes_____ No_____



TMI-2 EMERGENCY FEEDWATER SYSTEM

SIMPLIFIED DIAGRAM

TMI-1 EMERGENCY FEEDWATER SYSTEM



O'Connell EXHIBIT 4
FOR IDENTIFICATION
7/3/27 S.M.

(1) Time the last surveillance test was run on the EFW system?

ANS — 10^00 - 1245 3/26/79

(2) Do the EFV-12's have position indication on the rear panels?

ANS Yes - ~~No!~~ there is open/shut indication on the front panels (Panel 4) and rear panel #5, and near the local control switch located in the Control Bldg. [Note the local switch is not a key locked switch]

(3) Are tags used when valves are repositioned for surveillance tests?

ANS - No! tags are primarily for personnel & equipment protection. The step-by-step procedure is considered satisfactory for testing

(4) Obtain a recall of the 4/2/79 surveillance test?

ANS — attached are the cover sheets of all surveillance tests performed on the EFW thus far.

(5) Can the EF-V-12's be locally operated?

ANS — yes.

(6) What was the purpose of the Caution tag which was obstructing the view of the EF-V-12 (A or B) position indication lights?

ANS - The yellow tag dated 3/1 was attached to the EF V-16 recirc Control on the MFP [illegible] states "Flow [illegible] signal to Controller is bad".

(7) Is procedure 2303-M27A/B run twice once for each motor driven pump.

ANS. NO: The valve line up per appendix A & B of the procedure is established at one time. It should be noted that only 6 of the 19 valves are unique to either the A or B system, while the remainder are the same valves. The pumps are then run, one at a time and data taken prior to shutting it down and starting the next one.

It should be noted that the valve line up appears to be too extensive. It places both EFW trains to the S/G's out of service [which is probably a tech spec violation. It appears as though each pump could be tested without disabling the other 2 pumps or affecting their ability to feed either S/G.]

2. Valve line up of non-safety

(8) What changes were incorporated into Rev of 2303 M 27 A/B

ANS - See attached procedure change request. It should be noted that prior to the revision EFV-12A did not have to be shut to perform the test. The procedure was revised 8/ because EFV-11 A&B valves, which are control valves, not sufficiently tight to permit the pump testing.

(9) How are surveillance tasks assigned to operating staff.

ANS. - The extra shift on days the routine surveillance tests. The Surveillance test coordinator brings the computer print out sheets for that week to the control room. The extra (relief shift) shift foreman reviews the weekly schedule on a daily basis and arranges for his crew to do the testing in conjunction with the crew manning the control room.

Observations

(1) The 2 men who signed the surveillance test form (computer printout) for the test conducted on 3/26/79 stated that they felt their signature only pertained to the test form and its attached data sheets, and does not imply that the ~~test~~ systems valves were properly realigned.

(2) An aux operator stated that if he found a valve in an improper position while conducting ~~the~~ a valve line up verification, it would most probably be corrected (after discussing it with the control room) but not noted on the data sheet.

(3) The work sheets (check off lists) which are used to conduct a surveillance test are not retained. The Aux Operator most probably turns them over to the CRO who ~~go~~ discards

them. The shift foreman does not review them. (although this may not be typ[ical] of all shift crews, it is for the crew that did the 3/26 surveillance on the EFW system.)]

(4) There was no maintenance performed on the EFW system between 3/26 + 3/28 which would have require the EFV-12's to be shut.

(5) [At 0400 on 3/28/79 the operating crew was not setting up to do a EFW surveillance test.] All surveillance tests are performed on days by the relief shift.

~~(6) The main flow recirc valves are locked shut. [illegible] [illegible] [illegible] the pump is deadheaded after [illegible] LO [illegible]~~

Possible explanations for Cause of EF-V-12A&B Being shut on 3/28/79 at 0400.

The investigation of this subject conducted by JG Miller & E70 Comm on April 12 & 13, 1979 did not uncover why the valves were shut on 3/28/79 at 0400. There are however three possible explanations.

a) The valves were not reopened at the conclusion of the 3/21/79 test. The Aux Operator who conducted the test remembers speaking to 2 CRO's at the EFW panel as the system was being realigned to normal. He does not remember viewing the position indicators for the EF V-12's. Most probably one CRO thought the other had realigned the valves, while neither actually did.

b) In the excitement of the first minute of the incident on 3/28/79, the CRO may have mistakenly shut the EFV-12

c) The Valves could have been shut mistakenly from the local control

Observations (Cont'd)

Ref. a) pp 7; (3) pp 5

The CRO assigned in Relief shift duty surveillance test 3/26/74 on EFW system stated that he remembers Aux Ops reading off values to be realigned at the completion of the test, but he does not remember whether he performed the operation to obtain EF-U-12 values or whether the CRO on shift performs the operation. He stated they were both standing at the board and both responding alternately, apparently although he was not positive on the point. The confirms the report given by the Aux. Ops

The CRO also stated that the Aux. Ops gave him the check-off sheets when the test was completed and that he threw them into waste basket. He stated that until a few months past, the work sheets were kept on file but the large number made it impractical to keep them since the record on the was not considered necessary or important.

Conf. - Joe R. Bashista (Dave Good Trai
T. E Morck Tech Eng. 295 in 346-Ph

Freq. - ASME Sect. 11 (10 CFR 5
1974 Edition thru Summer '75

Sched EFP's - Monthly tests during normal Ops.
Valves - 1/4 'ly

Method - Basis - ASME Sect. 11 / St. Pumps referred to Tech. Spec.
Tech. Spec. refer to sect. 11

Consistency with Tech Specs. PORC Kunder
Engrg - Div.

Eval - Depended on V11's & system alignment
Auto since those valves normally closed
- Rev. 4 - Incl. V12's because V11's not t

Violation of Tech. Specs :-
Enter action statement for Surv. Testing (NRC
Both V12's out questionable

b If not acceptable :-
To Lead ME or 951 coordinator
for analysis within 96 hrs.
(Practically if failed pump would
receive immediate attention)

EF Pump Surveillance Procedure

Basis for schedule:

10 CFR 50 include requirements?

ASME Sect. 11 (1970 edition thru Summer

Pumps - Monthly test during norm
operation

Valves - Quarterly

Basis for Method:

Tech. Spec refers to ASME Sect 11 (Gener
Special requirements for EFP-1 (steam turb.

Consistency with Tech. Spec.

Original written to depend on EFV-11 Valv
to serve as shut-off valves because they are NC.
With this arrangement system would be
on auto including EFV-11 valves and th
would comply with Tech. Specs.

EFV-11 valves not sufficiently tight for
test and rev. 4 included closing
EFV-12 valves so tests could be prope
accomplished.

The thinking was that by entering a
statement for surveillance testing this w
meet Tech. Specs but this is questionab

Step by step execution in field:

Copy of step by step procedure sheets go to Aux Opr and CRO and this is the control for conducting the test. Aux Opr checks off each step as it is accomplished.

After test is completed the sheets are given to CRO and he discards.

History of Preparation of Orig. Procedure:

see above "Consistency with Tech Specs"

Review and Approval of Surveillance Results:

Aux. Opr signs "performed"

Shift Foreman signs "Approval" if results within allowable limits or states condition or not

Head M.E. or SSI combination analyzes made within 96 hrs for action if necessary. Actually unsat. conditions would normally receive immediate attention.

Results of Interviews:

see attached.

Sect 11 requires Testing per mo

approx 30

3 ESF, 3 Nuclear.

3 Nu Service, 2 Decay heat rem

2 decay heat Cl risers,

2 decay heat removal pump

2 " " interm. Cl cooling W

3 make up

2 recirc Bldg E. cooling Wate

2 screen wash.

2 screen house vent, cooling pu

Approx 300 values per 1/4 ly

When system designed Sect 11 not a known requirement

Mark Bezilla

Initial

Emergency F.W. Sys.
EF-V12A & EF-V12B closed
Rx power 97 %
P.R. spray htrs on manual
2 cond., 2 booster, 2 FW pumps
B make up pump ÷ 45 gpm letdown flow
1 demin tanks on, 1 regenerating

A - Cond. pump tripped
Valves on polishers closed to reduce flow
" - " closed 100 %
F.W.P. tripped
T-G tripped on loss of F.W.
+ ΔP reactor vessel
2255 psi electromatic rel. V. left

Caution tag blocks view of O-C lights on board ??

Loss of F.W. most severe transient
Instantaneous - full pwr on reactor
± Minute heat removal is