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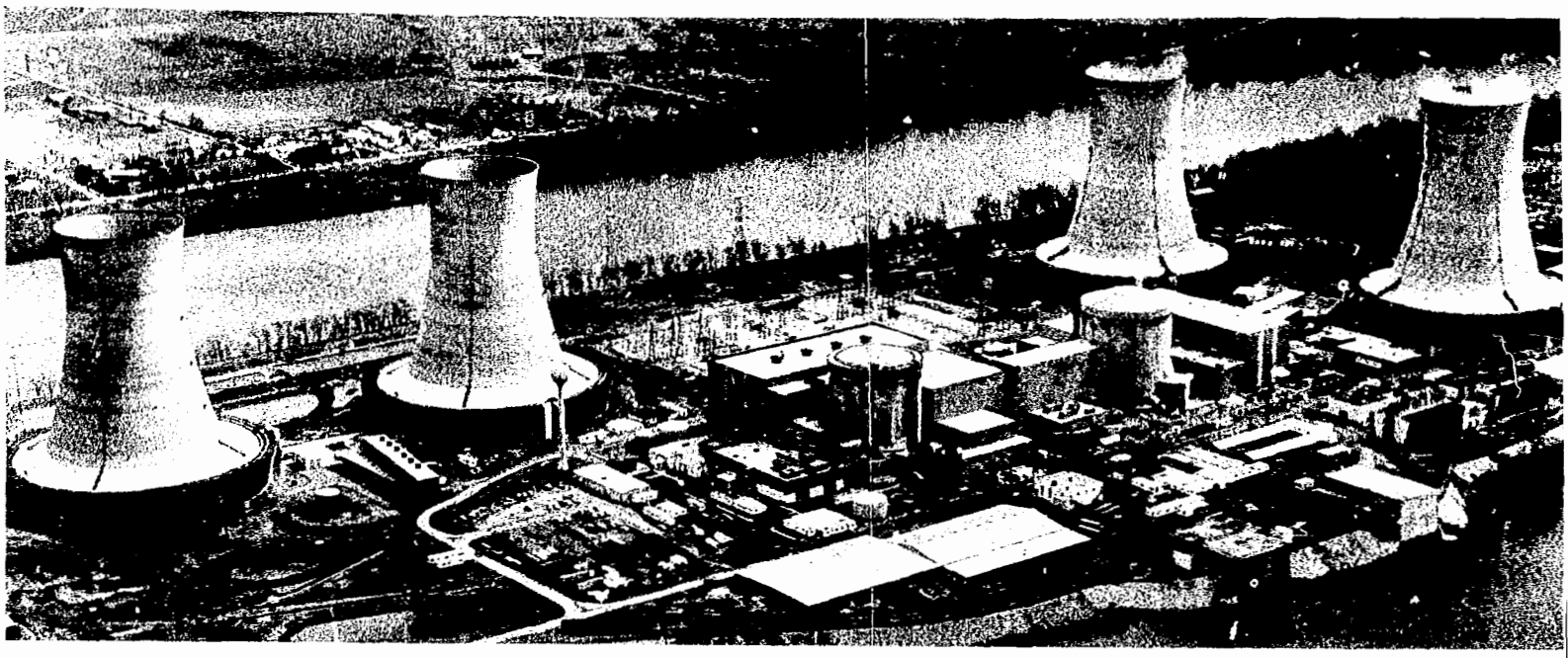

This is an informal report intended for use as a preliminary or working document

GEND

General Public Utilities • Electric Power Research Institute • U.S. Nuclear Regulatory Commission • U.S. Department of Energy

FIELD MEASUREMENTS AND INTERPRETATION OF TMI-2 INSTRUMENTATION: CF-1-PT3

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Prepared for the
U.S. Department of Energy
Three Mile Island Operations Office
Under DOE Contract No. DE-AC07-76IDO1570

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Section 1

INTRODUCTION

During and following the TMI-2 accident, a number of instruments failed or were suspected of providing erroneous readings. Because of this problem, industry concerns were focused upon the behavior of instrumentation under adverse conditions. To better understand failure mechanisms, the Technical Integration Office (TIO) contracted Technology for Energy Corporation (TEC) to perform field measurements on a set of selected TMI-2 instruments to determine in-situ operating characteristics. For some instruments, these measurements were to be performed prior to removal (and replacement with new instruments) in order to have a cross reference with post-removal observations. For other instruments, an indication of the condition of the instrument (i.e., fully operational or failed) was desired.

This report describes the measurements and results on the Core Flood Tank 1B pressure monitor CF-1-PT4. This instrument consists of a Foxboro Model E11GM-HSAE1 electronic absolute pressure transmitter connected to a readout module by approximately 600 feet of cable through a penetration and an instrument mounting terminal block. This instrument was one of the few primary loop pressure monitors that was believed not failed during the accident. As a result, measurements on this instrument were performed to determine if it was properly functioning or if it had suffered some degradation.

Section 2

INSTRUMENT LOCATION, CABLING, AND TERMINATIONS

A review of appropriate drawings from Foxboro and Burns & Roe (itemized in the Appendix in the measurement procedure, pages A-5 and A-6) resulted in the composite electrical diagram shown in Figure 2-1. From this information, a list of the appropriate termination points for performing measurements in Control Cabinet 156 was generated and is given in Table 2-1. Figure 2-1 also indicates the cable lengths pulled during instrument installation and lengths after trimming between each termination and/or junction point.

The pressure sensing assembly is a Foxboro Model E11GM-HSAE1 which is shown in a cross-sectional view in Figure 2-2. This instrument has a normal range of 0-750 psia producing a 10-50 ma current output. The electrical diagram of the detector circuit is also shown in Figure 2-2.

Since measurements were being made in Control Cabinet 156, the effect of the readout meter (attached to the signal line) was also present on the observed instrument response. However, since this readout was located outside containment, it did not experience severe operating environments, and thus was not considered to have failed.

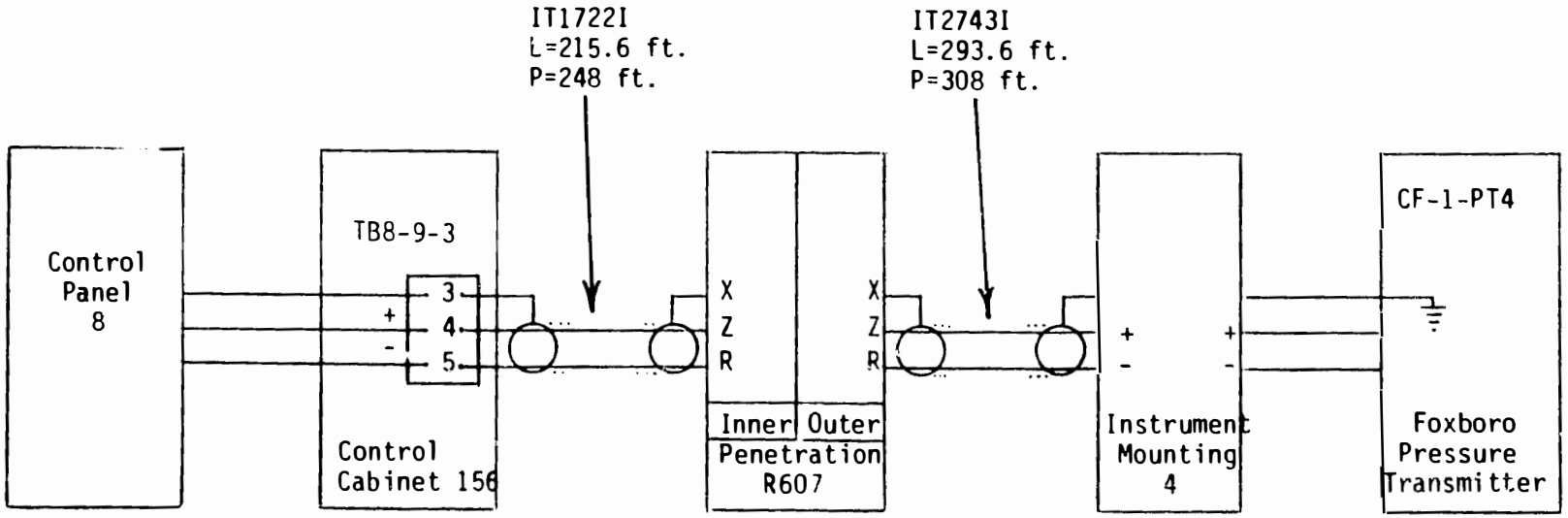


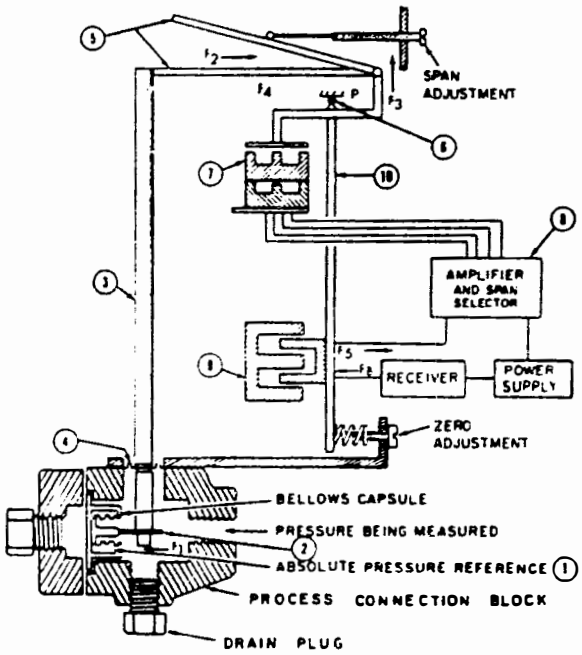
Figure 2-1. CF-1-PT4 Composite Electrical Diagram.

Table 2-1

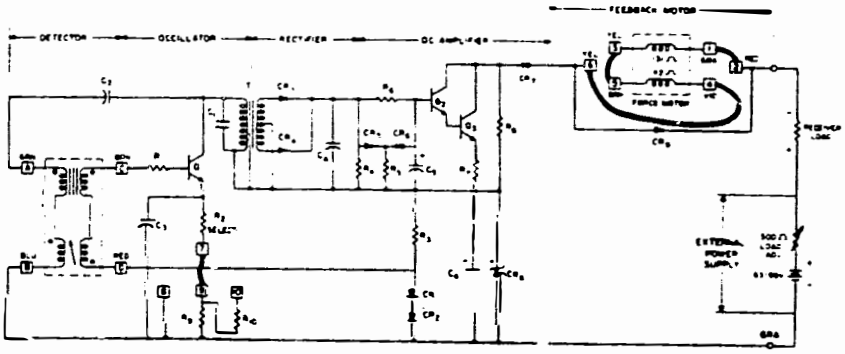
TERMINATION POINTS FOR CF-1-PT4 MEASUREMENTS

Signal	Cabinet 156 Identification*
+Signal	TBB-9-3/4
-Signal	TBB-9-3/5
Shield	TBB-9-3/3

*From cable IT1722I



a. Cross Sectional View.



b. Electrical Schematic.

Figure 2-2. Foxboro Model E11GM Design.

Section 3

MEASUREMENT PROCEDURES

As a result of generating the composite electrical diagram and from a review of the Foxboro EIA Series Electronic Absolute Pressure Transmitters technical information literature, measurements to be performed were identified as:

1. Determine as-found condition of pressure indication and record signal output.

2. Perform passive measurements (i.e., passively monitor signals) on each electrical connection consisting of time domain waveforms, very high frequency spectrum analysis (i.e., MHz region), and frequency spectra below 100 kHz.

3. Perform resistance, capacitance, impedance, and Time Domain Reflectometry (TDR) active measurements (i.e., actively introducing a test signal).

These measurements were designed to verify the operation of the Readout Module and the power supplies, but the focus of the measurement was on the pressure sensing assembly, cabling, and terminations/connections to the assembly. The Appendix contains the detailed procedure which was followed during the measurement program, and a summary of measurements is presented in the next section.

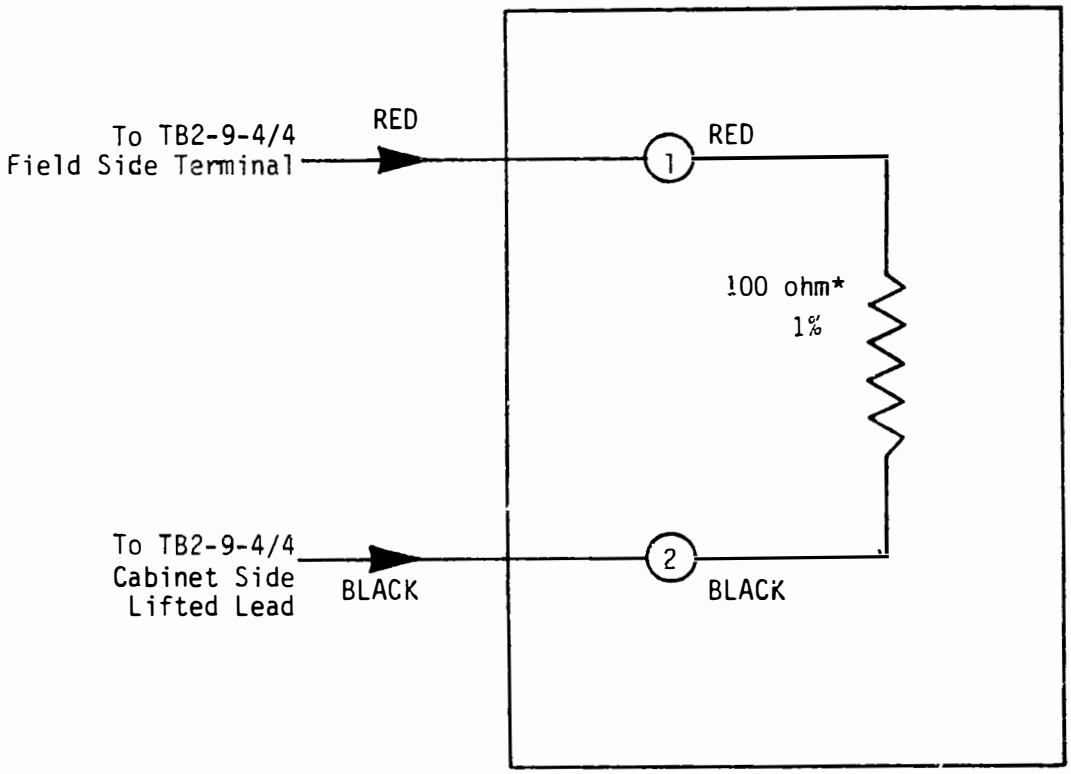
Section 4

MEASUREMENTS

Since the pressure signal from CF-1-PT4 was a 10-50 ma current loop, a test fixture was needed to convert this current to voltage for field measurements. A sketch of the test fixture used for this conversion is given in Figure 4-1. However, before insertion of the test fixture into the circuit, the readout of CF-1-PT4 was recorded as 170 psi to insure that the fixture did not affect the device. Following the test fixture insertion, the readout was 170 psi. Since there was no noticeable change in the readout, it was not believed that this load affected the instrument responses.

After the insertion of the test fixture and verification of CF-1-PT4 output reading, the 1-5 volt signal from the connections on the test fixture was recorded for approximately 10 minutes on a FM recorder. During this recording, the DC voltage was measured (with a Keithley Model 177 DVM) as 1.91 volts, or equivalently 19.1 ma current.

The next measurement consisted of photographing the output waveform from the screen of a storage oscilloscope. Figure 4-2 shows the results of these time trace measurements for two different time scales. Along with the time traces, both high and low frequency spectra (frequency domain) were taken of the signal. Figure 4-3 shows the measured spectrum over both a 6 MHz 400 kHz bandwidth, while Figure 4-4 shows spectra over both 100 kHz and 1 kHz ranges.



*Note: 100 ohm resistance converts 10-50 ma range to 1-5 volts for testing.

Figure 4-1. Current-to-Voltage Test Fixture.

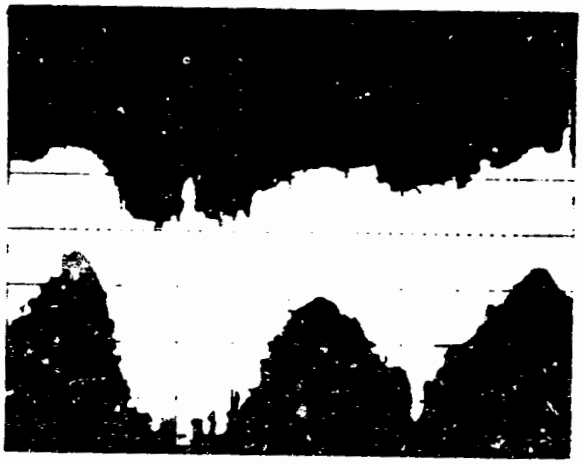


Photo 108-1

Time - 2msec/div

Gain - 50 mV/div

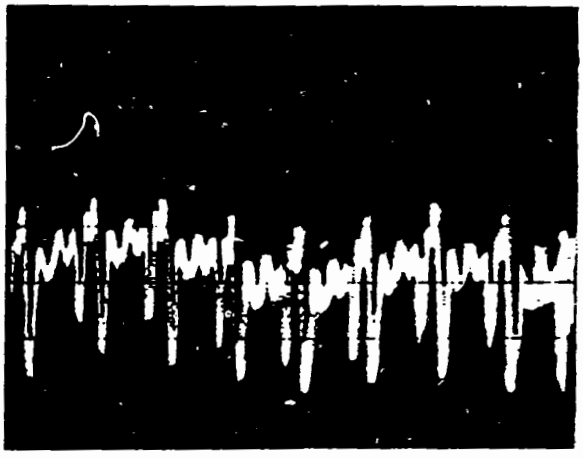


Photo 108-2

Time - 50μsec/div

Gain - 50 mV/div

Figure 4-2. Oscilloscope Traces of Pressure Signal.

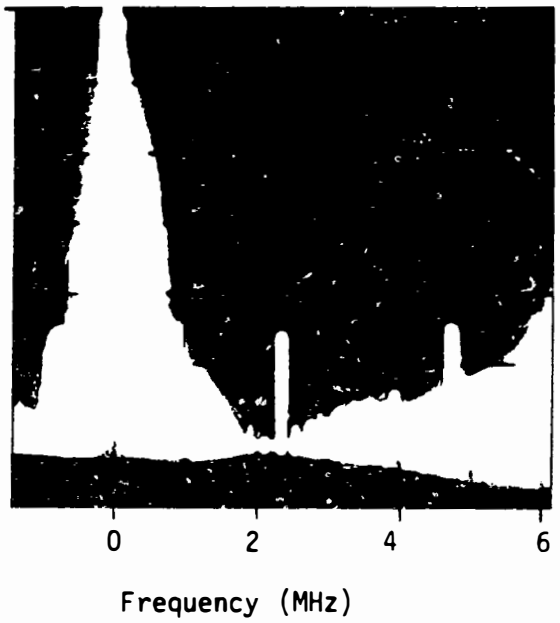


Photo 108-3

BW - 3 KHz

Scan width - 1 MHz/div

Scan time - 1 sec/div

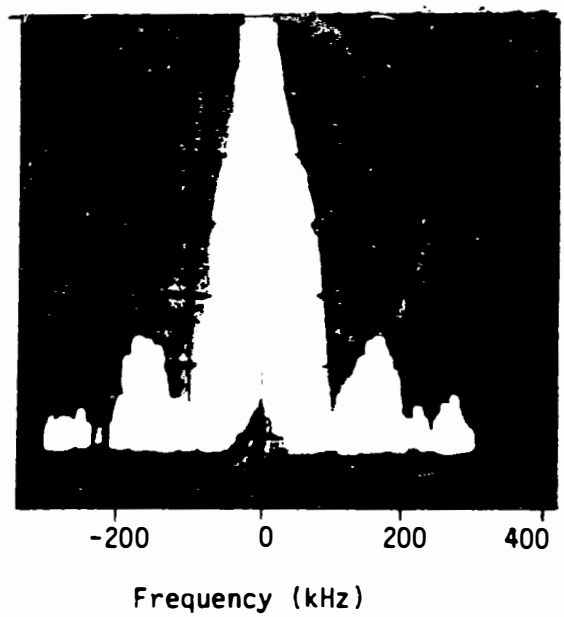


Photo 108-4

BW - 3KHz

Scan width - 100 KHz/div

Scan time - 0.1 sec/div

Figure 4-3. High Frequency Spectra of Pressure Signal.

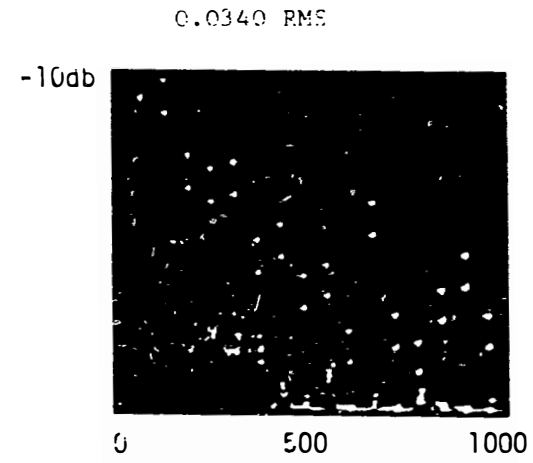


Photo 108-5

1 KHz Range

+10 db Reference

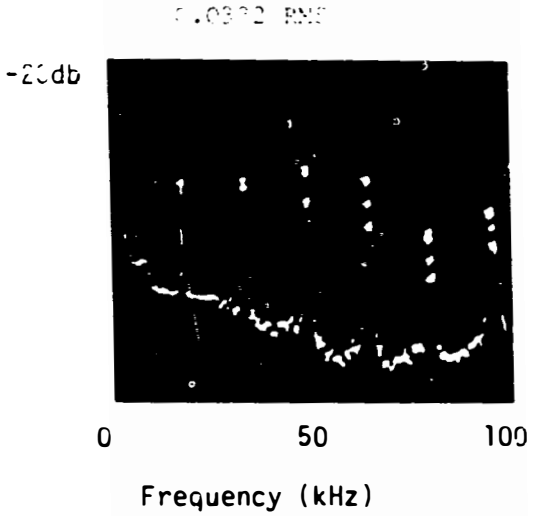


Photo 108-6

100 KHz Range

-20 db Reference

Figure 4-4. Low Frequency Spectra of Pressure Signal.

Following the frequency spectra measurements, electrical calibration was performed on the CF-1-PT4 readout module by a TMI technician. No significant adjustments were noted during this calibration. After electrical calibration, power was removed from CF-1-PT4. The test fixture was removed and all signal lines between cable IT1722I and cabinet 156 were disconnected.

A series of active measurements (i.e., actively introducing a test signal into the circuit) was then performed. Table 4-1 shows the results of capacitance, impedance, and DC resistance measurements on the field cable lines. A set of TDR measurements was taken on the signal lines to determine possible cable defects. The resulting TDR traces are shown in Figures 4-5 to 4-7.

Table 4-1

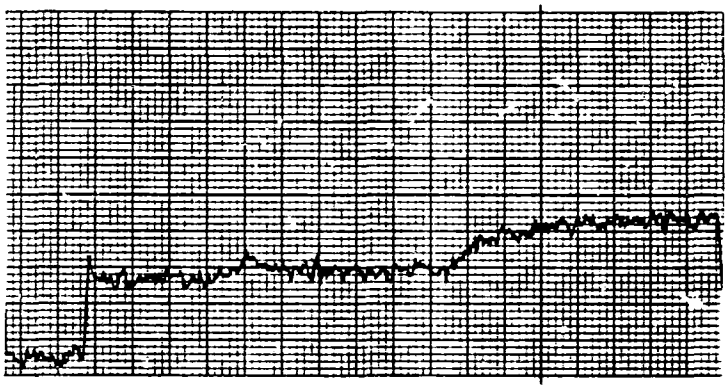
CAPACITANCE, IMPEDANCE, AND RESISTANCE MEASUREMENTS

	Capacitance (nF)			Impedance (ohms)			
Signal	100Hz	1kHz	100kHz	100Hz	1kHz	100kHz	Resistance
+Signal -Signal	4	3.4	35	OF	OF	48	OF†
+Signal Shield	--*	20	32	OF	OF	49	OF
-Signal Shield	--	18	34	--	6K	44	OF

*Indicates data was erratic.

†Indicates overflow, i.e., above 20×10^6 ohms.

STRIP CHART 108-1



Setting - 500μp/div

Range - 52.6 ft/div

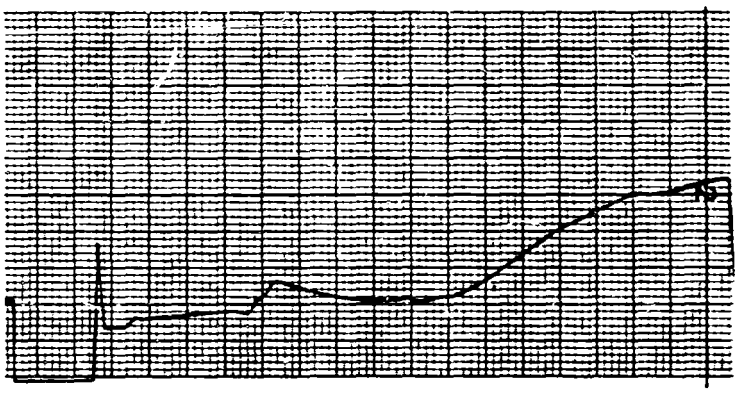
Sensitivity - 0.25

Filter - 5 Hz

Cable dielectric - other

Figure 4-5. TDR Trace of Pressure Signal Lines.

STRIP CHART 108-2



Setting - 500μρ/div

Time - 52.6 ft/div

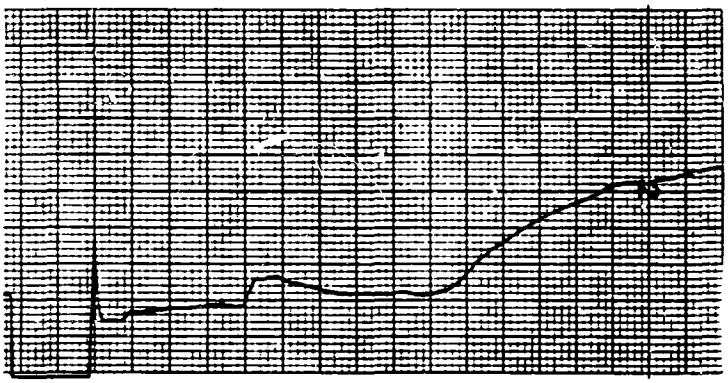
Sensitivity - 0.25

Filter - 5 Hz

Cable dielectric - other

Figure 4-6. TDR Trace of (+) Signal to Shield.

STRIP CHART 108-3



ctting - 500uρ/div

ange - 52.6 ft/div

sitivity - 0.25

Filter - 5 Hz

Cable dielectric - other

Figure 4-7. TDR Trace of (-) Signal to Shield.

Section 5

INTERPRETATION OF MEASUREMENTS

This section presents a summary of the interpretation of the measurements taken on CF-1-PT4. This interpretation is intended to indicate the condition of the device based on observed data.

Since this device varies from 10-40 ma for a 750 psi pressure range, the observation of 170 psi readout indicates that the current should be 19.07 ma. The measured current of 19.1 ma (1.91 volts across 100 ohms) matches within 1% of this expected value, which indicates the readout meter is correctly calibrated.

The time traces and frequency spectra do not indicate any serious contamination which would affect the DC readout. Table 5-1 lists the AC components present on the pressure signal. Note that even though up to 2.5 ma P-P fluctuations are present, readout devices normally respond at low frequencies. As a result, the worst-case effect of these AC variations is likely to be less than the 0.34 ma RMS value given for the 60 Hz components. Even with this relatively low value, this is an excessive noise level (approximately 1% of instrument range) and indicates a possible ground-loop problem.

The capacitance, impedance, and resistance data given in Table 4-1 is difficult to quantitatively interpret, but qualitative results are possible. The data indicates very low effective capacitance values, which would be expected from the amplifier section of the current loop driver. Other characteristics expected from the amplifier are extremely

Table 5-1

MAJOR AC COMPONENTS ON THE PRESSURE SIGNAL

Frequency	Amplitude
60 Hz and harmonics	34 mV RMS (0.34 ma RMS)
16 kHz	150 mV P-P (1.5 ma P-P)
16 kHz and harmonics	33 mV RMS (0.33 ma RMS)
160 kHz (broadband)	<1 mV RMS (<0.01 ma RMS)
Total Spectrum	250 mV P-P (2.5 ma P-P)

high DC resistance values and decreasing impedance at higher frequencies. Since all expected phenomena are present, there is no obvious indication of instrumentation degradation from these measurements.

The results of TDR measurements performed on the cable (shown in Figures 4-5 to 4-7) are summarized in Table 5-2. Note that the lengths identified in the table are only approximate since no calibration of the cable resistance or insulation type was performed on the TDR instrument. As in other measurements, no indication of cabling problems is present in this data.

Table 5-2

SUMMARY OF TDR MEASUREMENTS

Signal Lines	Distance* (ft)	Description**	Probable Cause
+Signal -Signal	189	Point R increase	Penetration R607
	505	Large R increase	Electronics
+Signal	37	Small continuous R increase	(?)
Shield	200	Point R increase	Penetration R607
	411-474	Point R small increase	(?)
	510	Large R increase	Electronics
	32	Small continuous R increase	(?)
-Signal	200	Point R increase	Penetration R607
Shield	411-474	Point R small increase	(?)
	511	Large R increase	Electronics

Note: Distances are not calibrated due to lack of prior information on the cable type which prevented calibration tests.

*TDR to terminal block test cable (15 ft) not included in distance.

**R is the abbreviation for resistance.

†Interpretation is difficult due to noisy signal.

Section 6

CONCLUSIONS

Based on the measurements, data reduction, and circuit analysis of CF-1-PT4, there is no indication of degradation of the instrument. The only abnormal contamination present in the pressure signal was the 16 kHz component. However, the amplitude of this signal was relatively low and, from other measurements performed at TMI, such a low-level 16 kHz component appears to be present on several unrelated instrument lines. Thus, this component is probably due to some common cause throughout the plant and is not a problem as long as the readout device properly discriminates against such high frequencies. In addition, the readout of another pressure monitor (CF-1-PT3) was noted to agree with the reading taken from CF-1-PT4. Checking the transmitter current output also produced the same current indication. Therefore, it appears that CF-1-PT3 is operational and probably calibrated since an independent monitor is producing the same output. However, there is a significant amount of 60 Hz ground loop noise present on the pressure signal which should be investigated.

APPENDIX

ORIGINAL FIELD PROCEDURES AND DATA SHEETS FOR CF-1-PT4

ASTON, PENNSYLVANIA 19014 · PHONE: (215) 358-3900

208-12

GENERATION CORRECTIVE MAINTENANCE SYSTEM
JOB TICKET FORM (Page A-1 **EE MILE ISLAND** **UNIT 2**

RECOMMENDED PRIORITY 2

COMPONENT DESIGNATION SYS	COMP TYPE	COMP ID	LOOP	LOCATION / UNIT	JOB TYPE	JOB TICKET NUMBER	REQUEST DATE MO	DAY	YR
CF	I	APT4		0360	02	CM [redacted] C5714	09	22	80

DESCRIBE MALFUNCTION OR MODIFICATION DESIRED: perform attached procedure.

CAUSE OF MALFUNCTION (IF KNOWN):

ORIGINATOR'S EMP NO.	ORIGINATOR'S SIGNATURE	DATE	SUPERVISOR'S EMP. NO.	SUPERVISOR'S SIGNATURE	DATE
06175	J K Brunner	9/22/80	04175	J K Brunner	9/22/80

Doc Ezzo Project

WORK ORDER NUMBER LOCATION	SERIAL	GC CODE	ACCOUNT NUMBER	PLANT CONDITION SU	OP	HD	CD	RF	HS	LR	NPRD FAILURE YR	MO	DAY	START HR	MIN
0360	001878	BD	X0001 78716019	1	1	1	1	1	1	1					

CHANGE MOD REQ	EWR	NUC SAFETY	NRC RPT	REG AGENCY CODE	CHG/MOD NUMBER	ENV CODE	OUTAGE CAUSE CODE	STATUS HOLD CODE
0	0	0	0			X		

S M APPROVAL COMMENCE WORK: MO 09 DAY 23 YR 80

PRIORITY RESP LOCATION OR CONTRACTOR: 2 0360M

Location Cable Room, 305' elevation Control Building

Limits and Precautions:
a) Personnel — Comply with the Provisions set forth in AP 1002 and Met Ed Safety Manual

b) Equipment

c) Environment

d) Nuclear

Post Maintenance Testing required and Acceptance Criteria:

ENSURE WORK AREA CLEANED UP AT COMPLETION OF JOB

JOB TICKET (WORK REQUEST)
REVIEW – CLASSII NG CONTROL FORM

JOB TICKET NUMBER C5714

1. Does work represent a change or modification to an existing system or component? If yes, an approved change modification is required per AP 1021.
   C/M No. NA — Yes ____ No ✓

2a. Does work requires an RWP? — Yes ____ No ✓

2b. Is an approved procedure required to minimize personnel exposure? — Yes ____ No ✓

3a. Is work on a QC component as defined in GP 1008? — Yes ____ No ✓

3b. If 3a is yes does work have an effect on Nuclear Safety? If 3b is yes, PORC reviewed Superintendent approved procedure must be used. — Yes ____ No ✓

4. Agreement that a PORC reviewed, Superintendent approved procedure is not required for this work because it has no effect on nuclear safety. (Applies only if 3a is Yes and 3b is No).

NA
UNIT SUPERINTENDENT ____ DATE

5a. Is the system on the Environmental Impact list in AP 1026? — Yes ____ No ✓

5b. If 5a is YES, is an approved procedure required to limit environmental impact? — Yes ____ No ✓

6. Agreement that 5b is No. (Required only if 5a is Yes).

NA
UNIT SUPT /SUPV OF OPERATIONS ____ DATE

7. Plant status or prerequisite conditions required for work. (Operating and/or shutdown)

8. QC Dept. review, if required in item No. 3.

NA
QC SUPERVISOR ____ DATE

9. Does work require code inspector to be notified? — Yes ____ No ✓

10. Supervisor of Maintenance approval to commence work.
    [signature] Date 9/23/80

11. Maintenance Foreman Assigned J. R Gilbert

12. Code Inspector Notified. Name ____ Date ____

13. Shift Foreman's approval to commence work. [signature] Date [illegible]

____ Initial if Shift Foreman signature is not required

WORK REQUEST PROCEDURE

TMI Nuclear Station

Maintenance Page A-3 **and Approval**

Unit No. 2

This form outlines the format and acts as a cover sheet for a maintenance procedure. Due to the limited size of the form, additional pages may be attached as required. Work Request procedure AP 1016 Section 6 should be used as a guide in preparing the maintenance procedure.

1. Procedure Title & No.:

   Sensor / Cable measurements for CF-1-PT4
   Core Flood Tank B Pressure.

2. Purpose: To determine signal characteristics of sensor/cable as it exists in Reactor Building.

3. Description of system or component to be worked on.

   CF-1-PT4

4. References:

   See attached

5. Special Tools, and Materials required.

   See attached.

6. Detailed Procedure (attach additional pages as required)

   See attached

Supervisor of Maintenance recommends approval _____ Date 9/23/80

Engineering Review _____ Date 9/22/80

- PORC RECOMMENDS APPROVAL

Unit No. 1 Chairman _____ Date _____ Unit No. 2 Chairman _____ Date _____

- UNIT SUPERINTENDENT APPROVAL

Unit No. 1 _____ Date _____ Unit No. 2 _____ Date _____

- Standing Procedure _____ Supervisor of QC _____ Date

*Note: These approvals required only on Nuclear Safety Related/Radiation work permit jobs.

TMI-84 2-78

Technology for Energy Corporation	TITLE IN-SITU MEASUREMENTS OF CABLES AND SIGNALS FROM CORE FLOOD TANK B PRESSURE CF-1-PT4	NO. TP-108
		REV. 0
	Page A-4	
	APPROVED	DATE
PROCEDURE	M.V. Mathis, Director, Tech. Serv. Div.	9-16-80

PURPOSE: The purpose of these measurements is to gather baseline data and information in preparation for removal of the Force Balance Transmitter CF-1-PT4 from the Reactor Building TMI Unit 2. The tests specified in this procedure are designed to assess the condition of the in-containment transmitter associated cabling, and readout devices. This assessment will require the use of Time Domain Reflectometry (TDR), Impedance (Z), Spectral Analysis (frequency domain), and general oscilloscope observations (with recording) of waveforms from/to the unit under test (UUT).

PROCEDURE (ADMINISTRATIVE):

A. Limitations and Precautions

1. Nuclear Safety. The unit is not part of the engineered reactor safeguards system and is nulcear safety-related.

2. Environmental Safety. Force Balance Transmitter CF-1-PT4 can be taken out-of and restored to services without producing a hazard to the environment.

3. Personnel Safety. The test described herein produces no additional personnel safety hazards other than normally associated with performing instrument testing.

4. Equipment Protection. In the performance of each test described herein, care will be taken to insure adequate equipment protection as follows:

   a. In all cases actual test hookups to the Unit-2 instrumentation shall be made and verified by Instrumentation Personnel.

   b. All passive measurements (Spectral Analysis and Oscilloscope observations) of waveforms and signals from powered instruments shall be performed using high input impedance probes or inputs ($Z = \geq 1$ Meg ohm) to prevent loading of signals.

   c. In all Time Domain Reflectometry and Impedance measurements, power will be removed from the unit under test and low level test signals prescribed in Table 4-1 shall be utilized to perform cable integretary measurements on the appropriate instrumentation cables by inserting test signals on appropriate conductors of Cable IT1722I. Terminations shall be removed and replaced on TB 8-9-3 of Cabinet 156.

Table 4-1 Active Measurements

Active Signal Parameter	Time Domain Reflectometry	Impedance
Voltage	225 mV nominal (into 50 ohm base)	$\leq$ 5V rms
Frequency	---	100Hz, 1kHz, 10kHz, 100kHz
Current	$\leq$ 10mA	$\leq$ 100mA
Other	225mV, 110 picosecond pulses	---

d. In the calibration verification measurements section, baseline data on the as-found condition will be recorded prior to the performance of any adjustments or electronic calibrations.

B. Prerequisites

1. The Shift Supervisor/Shift Foreman shall be notified for concurrence prior to the performance of those measurements.

2. Instrumentation personnel shall be assigned to assist in the performance of these measurements.

3. All measurements and test instrumentation shall be in current calibration (traceable to NBS).

4. The Shift Supervisor/Shift Foreman shall be notified prior to starting and upon completion of the measurements.

C. Procedure for Performing Measurements

References:

1. Burns & Roe Dwg. 3024, Sh. 20.

2. Service Manual for Foxboro Series E10 Force-Balance Transmitter.

3. Burns & Roe Dwg. 3304, Sh. 24.

4. Burns & Roe Dwg. I.C. 3343, Sh. 4.

5. Burns & Roe Dwg. 3343, Sh. 4.
6. Burns & Roe Dwg. 3304, Sh. 26.
7. Burns & Roe Dwg. 3304, Sh. 23.
8. Burns & Roe Dwg. 3024, Sh. 20.
9. Instruction Manual, Tektronix Model 1502 Time Domain Reflectometer.
10. Instruction Manual, Hewlett Packard Model 4274 Multifrequency LCR Meter.
11. Instruction Manual, Hewlett Packard Spectrum Analyzer (Model 141T, 8553B, 8552B Modules).
12. Instruction Manual, Nicolet Model 444A-26 Spectrum Analyzer.
13. Instruction Manual, Tektronix Model 335 Oscilloscope.
14. Instruction Manual, Lockheed Store-4 Recorder.
15. Instruction Manual, Tektronix SC502 Oscilloscope.
16. TEC Composite Electrical Connection Diagram, CF-1-PT4 (see attachment).

SIGNAL	CABLE	CABINET 156
+ Sig	IT1722I	TB 8X9-3/4
- Sig	IT1722I	TB 8X9-3/5
SHLD	IT1722I	TB 8X9-3/3

STEPS

1. Notify Shift Supervisor/Shift Foreman of start of test on CF-1-PT4.
2. Verify power is applied to CF-1-PT4.
3. Record present reading from CF-1-PT4 Readout Module.

SIGNAL	READING IN PSI
CF-1-PT4 Readout	170

4. Remove all power from CF-1-PT4.

TS [illegible] 9/25/80
Signature/Date

5. Locate ~~Open link~~ TB ~~8~~ 9-3/4 in Cabinet 156.

TS [illegible] 9/25/80
Signature/Date

6. Insert TEC test fixture (100 ohm, 1.0% resistor) across terminals ~~across open link~~ TB ~~8~~ 9-3/4 per Figure 6-1 to convert 10-50 mA signal to voltage.

Cabinet 156

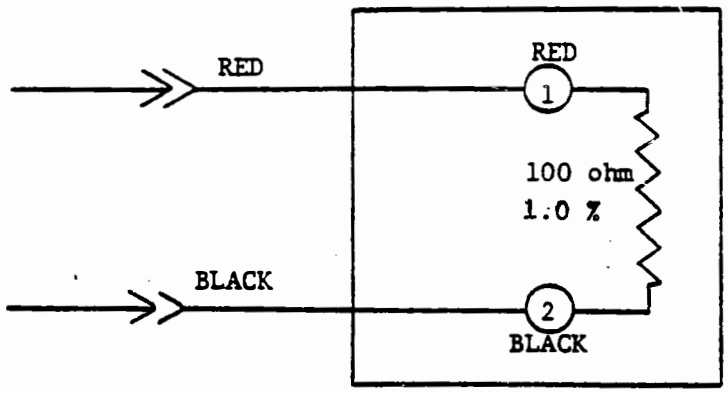
To TB~~8~~ 9-3/4 5

~~Cabine~~t Side
Fig. 6-1

To TB~~8~~ 9-3/4 5

~~B~~d Side
CABINET

FIGURE 6-1.



NOTE: This circuit converts the 10-50 ma signal to 1-5 V for testing.

7. Apply power to CF-1-PT4 and wait 10 minutes for instrument warm-up.

8. Record present reading from CF-1-PT4 Reaout Module.

SIGNAL	READING IN PSI
CF-1-PT4 Readout	170 PSI

9. Connect* differential Conditioning Amplifier (TEC Model 901) to the Force Balance Transmitter (TB ~~8~~9-3/4; in Cabinet 156). Connect Model 901 output to FM Recorder and record Signal for 30 minutes. Remove recorder when completed.

   *NOTE: Connection across banana jacks 1&2 of current-to-voltage text fixture (see Step 6).

10. Using a Keithley Model 177 DMM (or equivalent, Range 0-2000 V, Precision ± 1%) measure the DC Voltage or current at the following test point.

SIGNAL	CABINET 156	TEST LEAD	READING
*a.	TB ~~8~~9-3/4 TB ~~8~~9-3/4	(+) (-)	Signal 1.905 VDC

*Across text fixture banana jacks 1&2 (see Step 6).

[signature] 9/25/90
Signature/Date

11. Using a Tektronix Model SC502 (or equivalent) oscilloscope observe the waveform at the following test point:

SIGNAL	CABINET 156	PARAMETER			
*a.	TB ~~8~~9-3/4 TB ~~8~~9-3/4	SIG	Photo 108-1 Time Base 20MS Vert Gain 50MV	Photo 108-2 Time Base 50MS Vert Gain 50MV	Photo _____ Time Base ____ Vert Gain ____

*Across test fixture banana jacks 1&2 (see Step 6).

Sync the oscilloscope and photograph the waveform using up to three time base and vertical gain settings. Mark the back of the photographs with the instrument tag number and parameter measured.

Signature/Date

12. Using a Hewlett-Packard Spectrum Analyzer (Models 141T, 8553B and 8552 or equivalent) perform an analysis of the following signal for spectral content:

SIGNAL	CABINET 156	PARAMETER	PHOTO #
*a.	TB ~~8~~9-3/4 TB ~~8~~9-3/4	SIGNAL	108-3 108-4

*Across test fixture banana jacks 1&2 (see Step 6).

Before photographing each scope display adjust analyzer for best spectral resolution. Record critical analyzer parameters e.g., RF bandwidth, RF bandwidth and sweep speed on rear of photograph as well as parameter analyzed.

SPECTRUM IDENT	FREQUENCY	AMPLITUDE	REMARKS

BANDWIDTH SCAN WIDTH INPUT ATTEN SCAN TIME LOG REF SEN PNL

3KHz 1 MEGHz/DIV 0 1 SEC -20db 0 108-3

3KN2 0.1 MEGHz/DIV 0 0.1 SEC -20db 0 108-4

Signature/Date 9/25/80

13. Using the Nicolet Model 444 FFT Analyzer (or equivalent) perform FFT analysis of signals for the following test point:

SIGNAL	CABINET 156	PARAMETER	PHOTO #
*a.	TB 8-9-3/4 TB 8-9-3/4	SIGNAL	108-5 106-6

*Across test fixture banana jacks 1&2 (see Step 6).

Signature/Date 9/25/80

14. Inside Cabinet 156 perform usual electronic calibrations using applicable instrument shop procedures. Attach instrument shop calibration data sheet and record any significant adjustments or problems in the space below.

Procedure Step	Remarks
See attached instrument shop procedure data sheet.	

Instrument Shop Procedure No. _____

Signature/Date

15. Remove all power from CF-1-PT4.

Signature/Date 9/25/80

16. Open links for field wires from Cable IT1722I at TB 8-9-3/3, 4, and 5 (Cabinet 156) and remove test fixture (installed in Step 6).

TERMINAL	SIGNAL IDENT.
TB 8-9-3/4	(+) SIGNAL
TB 8-9-3/5	(-) SIGNAL
TB 8-9-3/3	SHIELD

Signature/Date

17. Using the Hewlett-Packard Model 4274 (or equivalent) Impedance Bridge, measure the capacitance and impedance at the following test points:

TEST POINT	FROM	TO
a.	TB 8-9-3/4 (+SIG)	TB 9-3/5 (- Sig)
b.	TB-8-9-3/4 (+SIG)	TB 9-3/3 (SHLD)
c.	TB-8-9-3/5 (-SIG)	TB 9-3/3 (SHLD)

Record the data required below:

Test Point	Capacitance			Impedance		
Frequency	100 Hz	1 kHz	100 kHz	100 Hz	1 kHz	100 kHz
a. TB 9-3/4:5	4 NF	3.4 NF	35 NF	OF	OF	48Ω/-10°
b. TB 9-3/4:3	~	22 NF	35 NF	OF	OF	45Ω/-83.0
c. TB 9-3/5:3	~	20 NF	32 NF	OF	OF	49Ω/-86°

9/25/8[illegible]
Signature/Date

18. Using the Tektronix Model 1502 (or equivalent) TDR unit peform TDR measurements on three test points and record the data below.

Test Point	Instrument Settings Ampl Range Mult	Strip Chart Number
a. TB ~~8~~9-3/4:5 (+ Sig: - Sig)		~~TP~~-108-1
b. TB ~~8~~9-3/4:3 (+ Sig: SHLD)		108-2
c. TB ~~8~~9-3/5:3 (- Sig: SHLD)		108-3

Signature/Date 9/25/92

19. Using the Keithley Model 144 (or equivalent DMM) perform resistance measurements on the test points specified and record values in the space provided.

			POLARITY From = +; To = -	POLARITY From = -; To = +
TEST POINT	FROM LINK	TO LINK	RESISTANCE	RESISTANCE
a.	TB-8-4-3/4	TB ~~8~~9-3/5	OPEN	OPEN
b.	8-9-3/4	TB ~~8~~9-3/3	OPEN	OPEN
c.	8-9-3/5	TB ~~8~~9-3/3	OPEN	OPEN

Signature/Date 9/25/92

20. Close links for field wires from Cable IT1722I at TB 8-9-3, 4, and 5 (Cabinet 156) and restore power.

21. Notify the Shift Supervisor/Shift Foreman of the conclusion of testing NI-AMP-2.

I hereby certify that this Test Procedure has been completed as written and that all data has been correctly entered and filed as requested.

TEC Representative _____ 9/25/80
Signature/Date

Instrumentation J. R. Gilbert
Signature/Date

GENERATION CORRECTIVE MAINTENANCE SYSTEM

CM STATUS ACTIVITY FORM

COMPONENT DESIGNATOR				LOCATION UNIT	JOB TYPE	WORK AUTHORIZATION NUMBER	REQUEST DATE		
SYS	COMP TYPE	COMP ID	LOOP				MO	DAY	YR
5	8	12	16	17 — 22	23 — 24	28 — 32	33		38
CF	1	OPT4		036002	CM	C5714	09	28	0

TXN CD	ACT
804	A

ECM NUMBER: (47 — 51)

TXN CD	ACT
805	A

PRTY	RESP LOCATION OR CONTRACTOR	PRTY	ASSISTING CONTRACTOR	PRTY	ASSISTING CONTRACTOR
66	67 — 71				
	2036N				

TXN CD	ACT
807	A

PURCHASE REQUISITION NUMBER	PURCHASE ORDER NUMBER
59 — 66	67 — 73

TXN	ACT
810	A

STATUS HOLD			% COMPL	S/M APPROVAL TO COMMENCE WORK			FIELD WORK COMPLETION DATE		
CODE	START DATE	RELEASE DATE		MO	DAY	YR	MO	DAY	YR
39 40	41 — 45	47 — 52	53 — 55	56		61	62		67

01	OUTAGE HOLD
02	PART HOLD
03	QUALITY CONTROL PART HOLD
04	QUALITY CONTROL PROCEDURE HOLD
05	OPERATIONS HOLD
06	CHANGE MODIFICATION HOLD
07	ENGINEERING HOLD
08	PLANNING HOLD
50	MANPOWER NOT AVAILABLE
51	AT PORC
52	AT QUALITY CONTROL
53	AT UNIT SUPERINTENDENT
54	AT READING
55	POST MAINTENANCE TEST HOLD
56	AT ALARA

TMI 199 5 R0