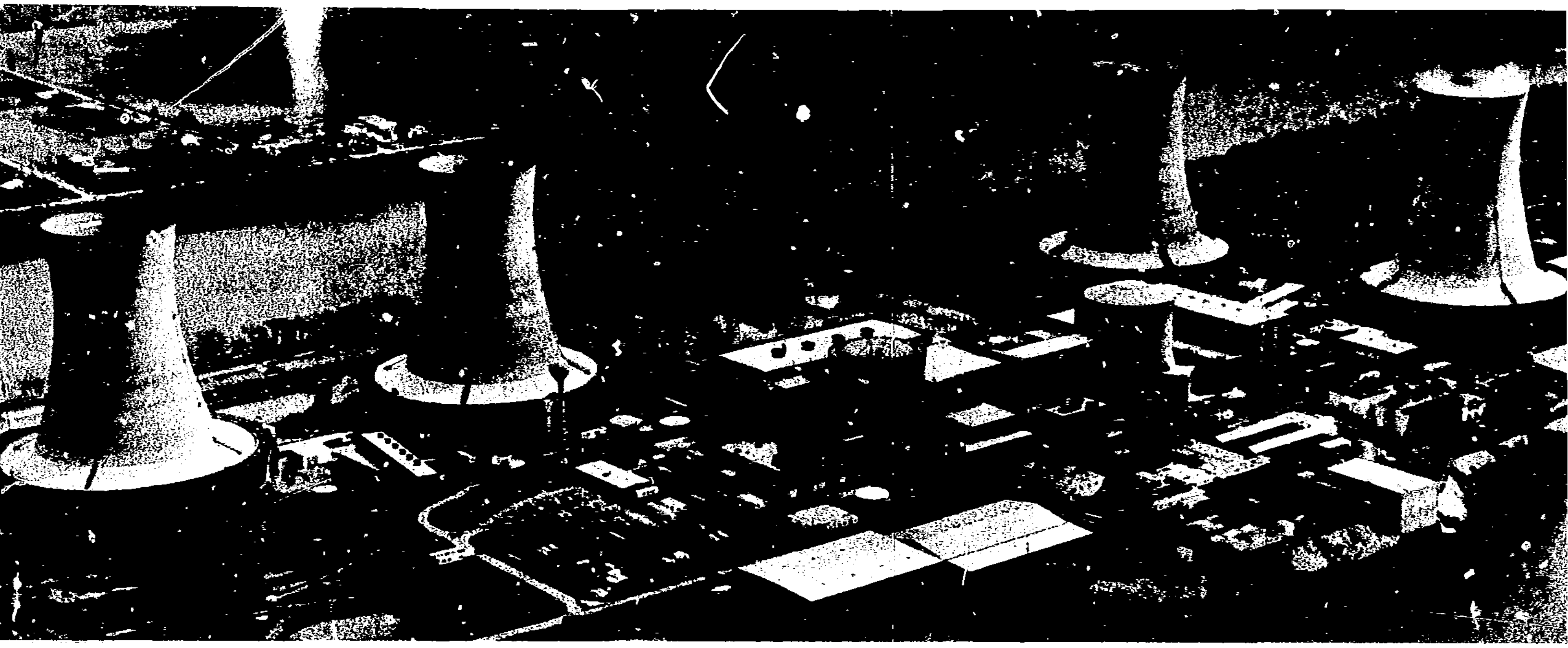
GEND-INF-017
Volume V
MASTER January 1982



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-2-LT2

J. E. Jones
J. T. Smith
M. V. Mathis

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

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

GEND-INF--017 Vol. 5

DE82 010492

GEND-INF-017
Volume V

FIELD MEASUREMENTS AND INTERPRETATION OF TMI-2 INSTRUMENTATION: CF-2-LT2

J. E. Jones
J. T. Smith
M. V. Mathis

Technology for Energy Corporation

January 1982

Published on Behalf of the GEND Group
by
EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

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

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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 of the Core Flood Tank 1A level monitor CF-2-LT2. This instrument consists of a Bailey Type BY Process Computer Transmitter connected to a readout module by approximately 500 feet of cable through a penetration junction and an instrument mounting junction. The status of this instrument is uncertain, but it was producing a reasonable output reading which implied it had not failed. As a result, measurements on this instrument were designed to determine if it were properly functioning.

Section 2

INSTRUMENT LOCATION, CABLING, AND TERMINATIONS

A review of appropriate drawings from Bailey Meter Company and Burns & Roe (itemized in the Appendix in the measurement procedure, page A-5) resulted in the composite electrical diagram shown in Figure 2-1. From this information, Table 2-1 gives a list of the appropriate termination points for performing measurements in Control Cabinet 156. Also noted in Figure 2-1 are the cable lengths pulled during instrument installation and lengths after trimming between each termination and/or junction point.

The level sensing assembly is a Bailey Type BY which consists of a differential pressure LVDT, temperature compensation, and calibration adjustment for conversion of pressure difference to level. This instrument has a normal range of 0-14 feet, producing an output of -10 to +10 volts. The functional diagram of the unit is 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 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.

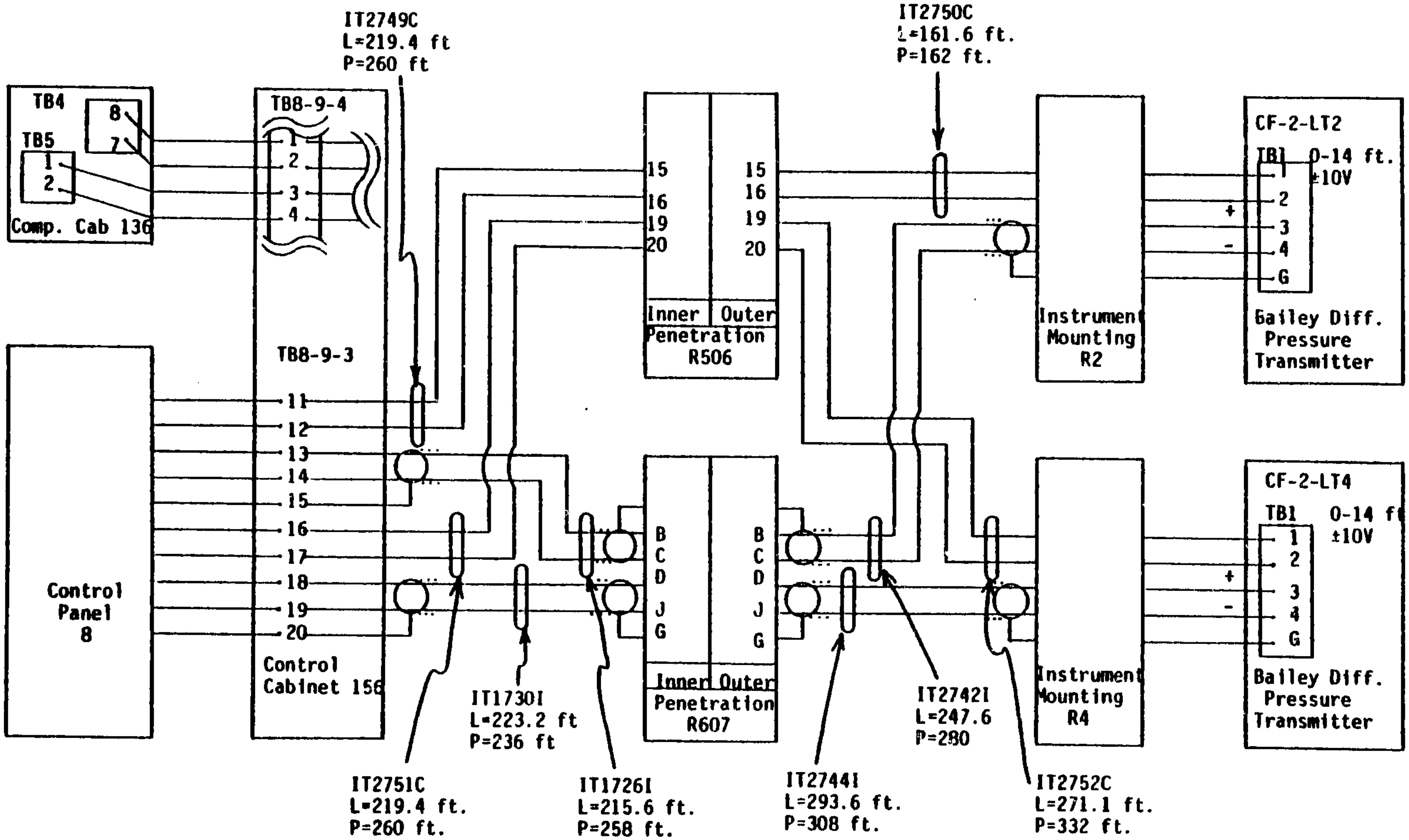


Figure 2-1. Composite Electrical Diagram for Core Flood Tank Level Transmitters CF-2-LT2 and CF-2-LT4.

Table 2-1

TERMINATION POINTS FOR CF-2-LT2 MEASUREMENTS

Signal	Cabinet 156 Identification*
+Signal	TB8-9-3/14
-Signal	TB8-9-3/13
Shield	TB8-9-3/15
118 VAC (H)	TB8-9-3/11
118 VAC (L)	TB8-9-3/12

*From cables IT1726I (signal lines) and IT2749C (118 VAC).

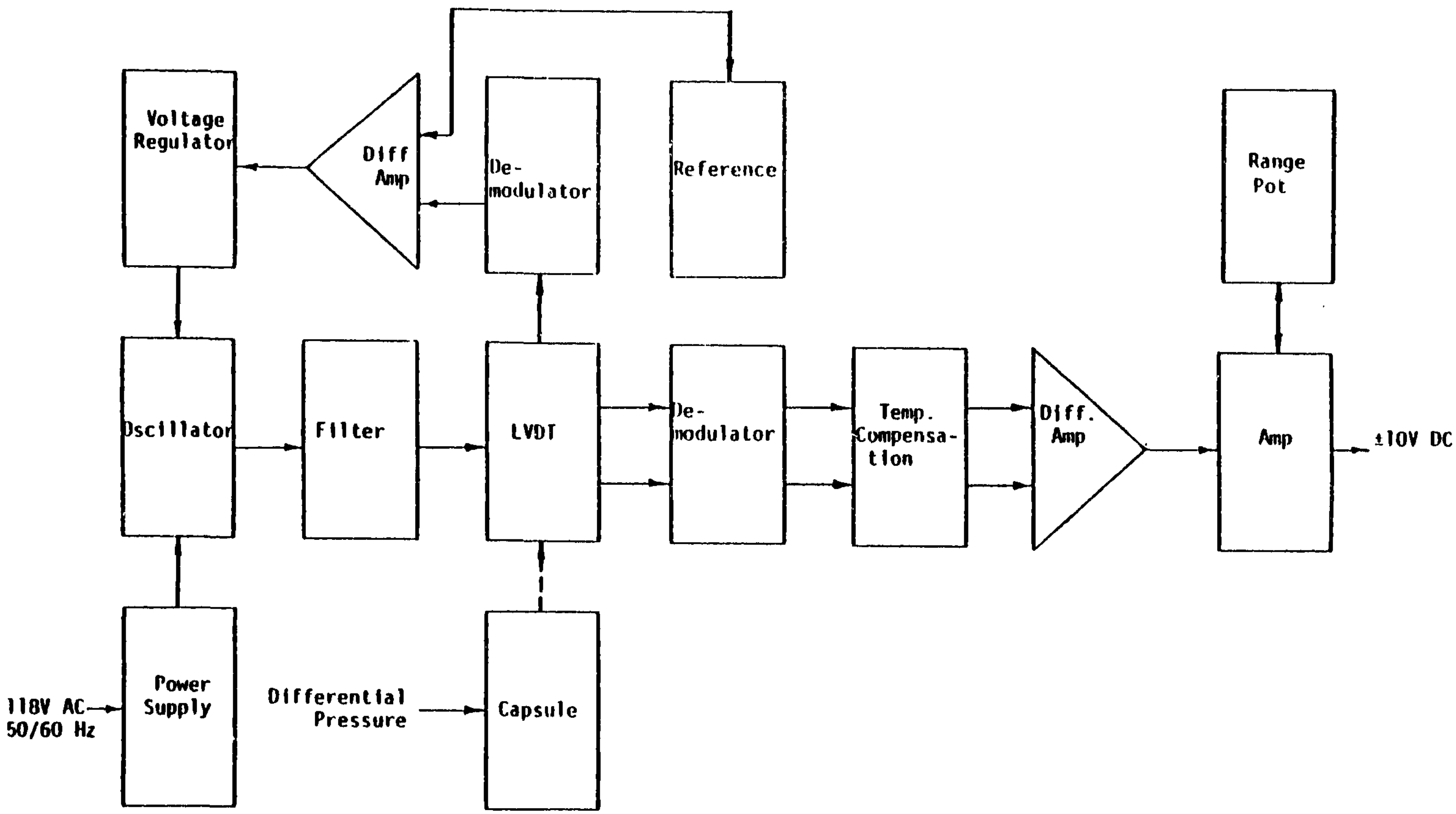


Figure 2-2. Functional Diagram of Bailey Type BY Differential Pressure Transmitter.

Section 3

PREPARATION OF MEASUREMENT PROCEDURES

As a result of generating the composite electrical diagram and from a review of the Bailey Meter Product Instruction E21-17 Manual, the major types of measurements to be performed were identified as:

1. Determine as-found condition of level 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 level measurement 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 output of CF-2-LT2 was designed to cover the range of -10 to +10 volts, the signal could be directly measured without amplification. Before performing measurements, the readout of CF-2-LT2 indicated 7.5 feet for the core flood tank level. The level indication signal was then recorded for approximately 10 minutes on an FM recorder and the voltage outputs measured (with a DVM). The output of the level signal was 0.73 VDC, and the power supply was 116 VAC.

The next measurements consisted of photographing the output waveforms of the level signal and line voltage from a storage oscilloscope. Figures 4-1 and 4-2 show the results of these time trace measurements. Along with the time traces, both high and low frequency spectra (frequency domain) were taken of the level signal. Figure 4-3 shows the measured spectra over both a 6 MHz and 500 kHz bandwidth, while Figure 4-4 shows spectra over both a 100 kHz and 1 kHz range.

Following the frequency spectra measurements, electrical calibration was performed on the CF-2-LT2 readout module by a TMI technician. No significant adjustments were noted during this calibration. After electrical calibration, power was removed from CF-2-LT2. The test fixture was removed and all signal lines from cables IT1726I and IT2749IC to 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

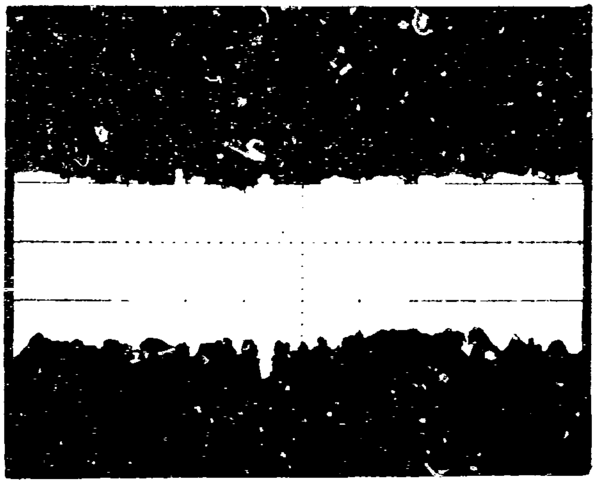


Photo 110-1

Time – 2msec/div

Gain – 20 mV/div

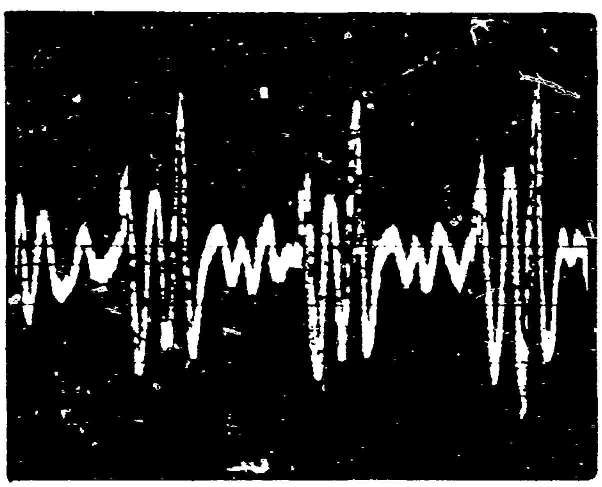


Photo 110-2

Time – 20μsec/div

Gain – 10 mV/div

Figure 4-1. Oscilloscope Traces of Level Signal.

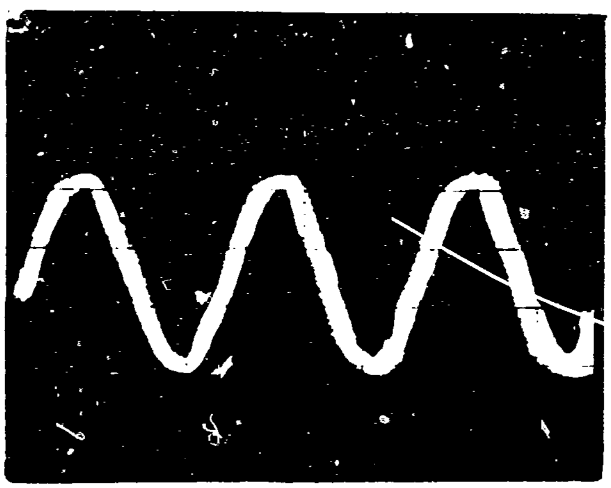


Photo 110-3

Time - 5msec/div

Gain - 10 V/div

Figure 4-2. Oscilloscope Trace of 118 VAC Supply.

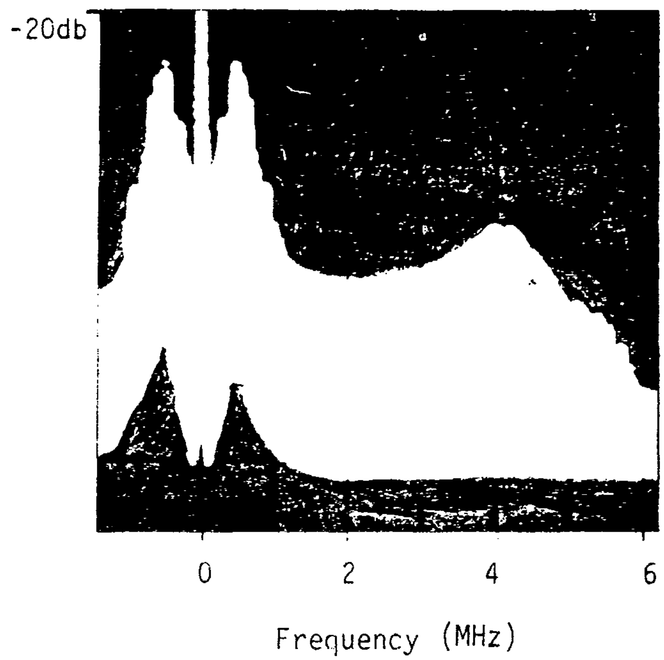


Photo 110-4

BW - 3 Khz

Scan width - 1 MHz/div

Scan time - 1 sec/div

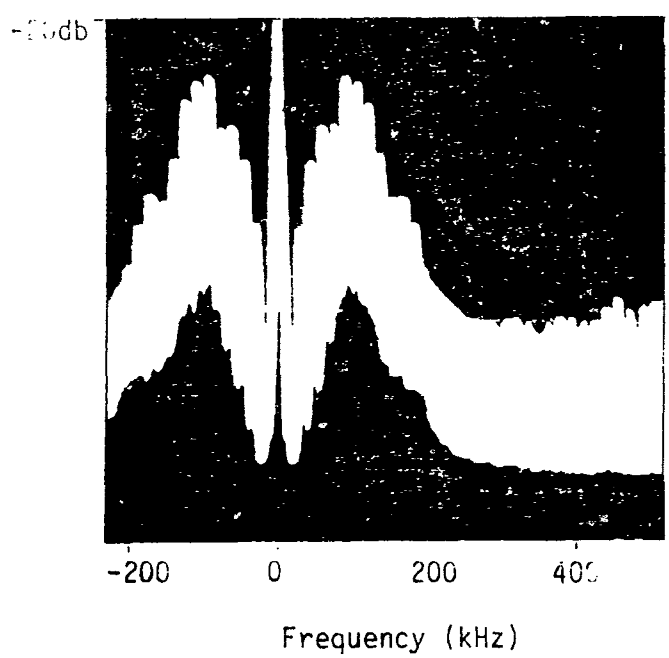


Photo 110-5

BW - 3 KHz

Scan width - 100 KHz/div

Scan time - 1 sec/div

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

0.00328 RMS

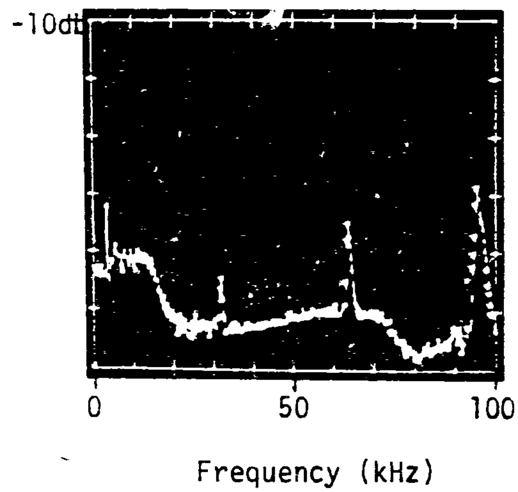


Photo 110-6

100 KHz Range

0.00170 RMS

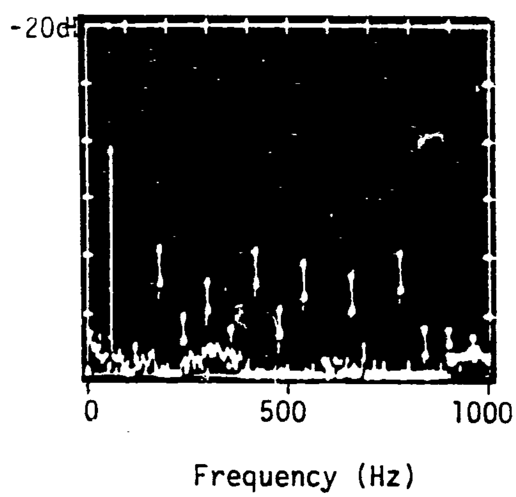


Photo 110-7

1 KHz Range

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

Table 4-1

CAPACITANCE, IMPEDANCE, AND RESISTANCE MEASUREMENTS

Signal	Capacitance (nF)*			Impedance (ohms)			Resistance** (ohms)
	100Hz	1kHz	100kHz	100Hz	1kHz	100kHz	
+Signal -Signal	14	10	-339	4.6K	3.4K	5.2	7K (9K)
+Signal Shield	-15	30	-333	OF†	OF	6	OF
-Signal Shield	.3μf	32	-376	OF	OF	5.4	OF
118 VAC (H) 118 VAC (L)	.3μf	12	-188	11K	13K	11	98 (98)
118 VAC (H) -Signal	6	.16	-260	OF	OF	6	OF
118 VAC (H) Shield	.3μf	6	-118	OF	OF	19	OF

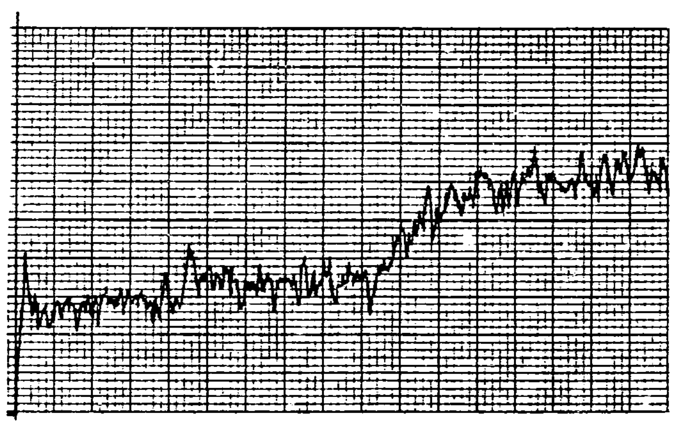
*nF = Nano-farads.

**Values in parentheses are reverse polarity values.

†OF indicates overflow condition.

results of capacitance, impedance, and DC resistance measurements on some of the field cable lines (see Appendix page A-11 for a complete set). A set of TDR measurements were taken on the signal lines to determine possible cable defects. These TDR traces are shown in Figures 4-5 to 4-8.

STRIP CHART 110-1



Setting - 500μρ/div

Range - 52.6 ft/div

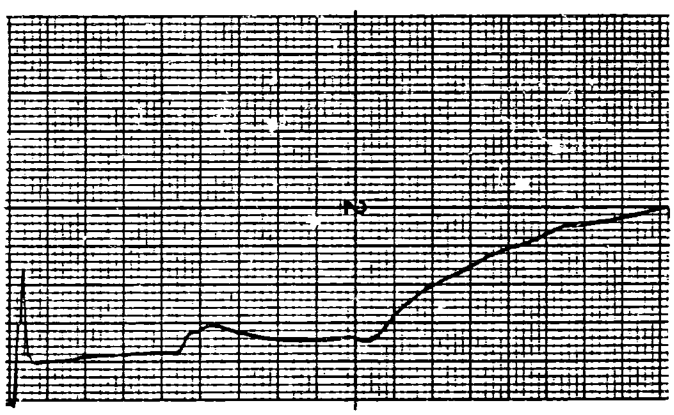
Sensitivity - 0.1

Filter - 5 Hz

Cable dielectric - other

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

STRIP CHART 110-2



Setting - 500μρ/div

Range - 52.6 ft/div

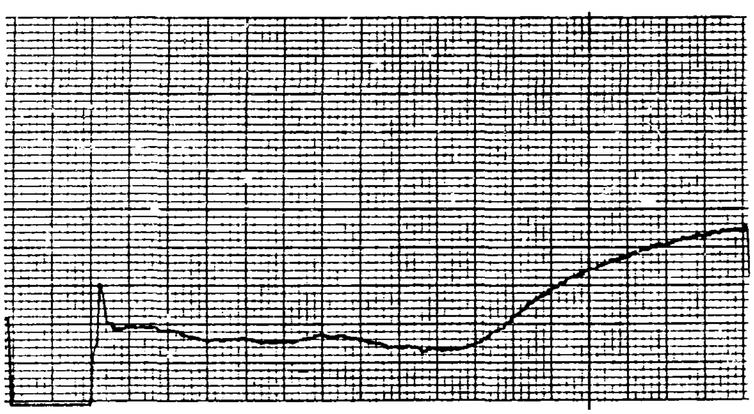
Sensitivity - 0.25

Filter - 5 Hz

Cable dielectric - other

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

STRIP CHART 110-3



Setting - 500μρ/div

Range - 52.6 ft/div

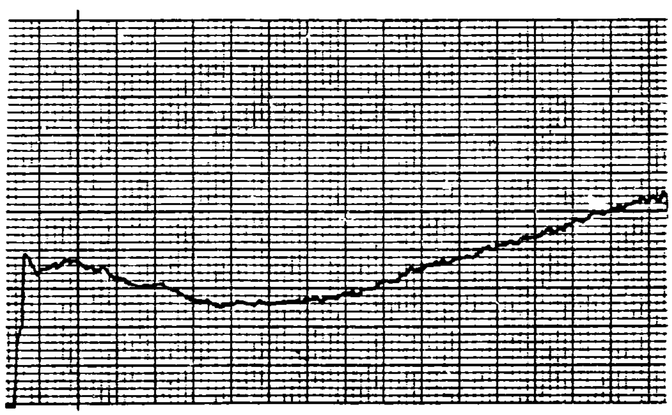
Sensitivity - 0.25

Filter - 5 Hz

Cable dielectric - other

Figure 4-7. TDR Trace of 118 VAC Lines.

STRIP CHART 110-4



Setting - 500μρ/div

Range - 105.2 ft/div

Sensitivity - 0.25

Filter - 5 Hz

Cable dielectric - other

Figure 4-8. TDR Trace of 118 VAC (H) to Shield.

Section 5

INTERPRETATION OF MEASUREMENTS

This section presents a summary of the interpretation of the measurements taken on CF-2-PT2. This interpretation is intended to indicate the condition of the device based on observed data.

Since this device varies from -10 to +10 volts for a 0 to 14 foot level range, the observation of 7.5 foot level readout indicates that the voltage should be 0.71 volts. The measured value of 0.73 volts matches within 1% of this expected value, which indicates the readout meter is correctly calibrated. The 116 VAC value on the power supply line is also well within a normal operating range.

The time traces and frequency spectra do not indicate any serious contamination which would affect the DC readout. Table 5-1 lists the low level AC components present on the level signal. Note that even though up to 60 mV 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 1.7 mV RMS value given for the 60 Hz components.

One feature of the frequency spectrum of the level signal that is not present gives an indication that the differential pressure LVDT (see Figure 2-2) is not operating. Since the LVDT AC output is "demodulated" by a full-wave rectifier and Resistance-Capacitance (RC) smoothing, a low level ripple must be present at the frequency of the internal

Table 5-1

MAJOR AC COMPONENTS ON THE LEVEL SIGNAL

Frequency	Amplitude
60 Hz and harmonics	1.7 mV RMS
3.5 kHz	<1 mV RMS
48 kHz	<1 mV RMS
64 kHz	<1 mV RMS
96 kHz	1 mV RMS
100 kHz (broadband)	<1 mV RMS
Total Spectrum	60 mV P-P

oscillator. The oscillator for this type device operates at approximately 1000 hertz and the component values of the RC smoothing circuit (R = 100k ohms, C = 0.68 μF) would produce a ripple factor (fraction of AC RMS fluctuations) of 0.001. With the device producing a 0.5 volt output (10.5 volts above base output of -10V), the expected RMS ripple would be approximately 0.5 mV (10.5 mV). From Table 5-1, this AC ripple value is not present on the level signal which indicates that the LVDT oscillator is not producing the output signal. Since the value is near zero, this could be an offset introduced by the amplifier.

The capacitance, impedance, and resistance data given in Table 4-1 is difficult to quantitatively interpret, but qualitative results are possible. Very low effective capacitance values would be expected from the amplifier section of the transmitter, but the signal lines show an effective inductance at higher frequencies. This possibly indicates a path into the LVDT secondary coil, which should not exist if the amplifier were properly operating. However, the 118 VAC (H) to 118 VAC (L) measurement passes through the primary of a transformer. This creates an inductance which appears as negative capacitance at the 100 hertz measurement.

The presence of a 10,000 ohm resistor in the transmitter amplifier and the absence of other direct electrical paths indicates that a resistance measurement near this value should be obtained. The measured values for the level signal were 7000 and 9000 ohms for two polarities. The variation would be caused by active electrical components, and the values are of the magnitudes expected. Since the expected responses are present, there is no obvious indication of instrumentation degradation from the resistance 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 and material composition was performed on the TDR instrument. Some junction points were not identified by these measurements, but the most important observation is the "noisy" nature of the level signal TDR trace shown in Figure 4-5. The noise indicates a contamination signal present even though all power has been removed.

Table 5-2

SUMMARY OF TDR MEASUREMENTS

Signal Lines	Distance* (ft)	Description**	Probable Cause
+Signal†	210	Point R increase	Penetration R607
-Signal	474	Large R increase	Electronics
+Signal	200	Point R increase	Penetration R607
Shield	421	Point R small increase	Terminal block
	463	Large R increase	Electronics
118 VAC (H)	253	Point R increase	Penetration R607
118 VAC (L)	474	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.

†Extremely noisy signal prevents most interpretations.

Section 6

CONCLUSIONS

Based on the measurements, data reduction, and circuit analysis of CF-2-LT2, there is an indication of degradation of the instrument. The only significant contamination present in the level signal that appeared to be abnormal was the 96 kHz component. However, the absence of a low level oscillator ripple at 1000 hertz indicates that the output is not being produced by the LVDT secondary coil. A measurement on another level transmitter (CF-2-LT4) does show the expected oscillator ripple. Therefore, it appears that CF-2-LT2 is not operating correctly and the observed 0.7 volt output is probably due to an offset in the amplifier.

APPENDIX

ORIGINAL FIELD PROCEDURES AND DATA SHEETS FOR CF-2-LT2

208 - 2 / GENERATION CORRECTIVE MAINTENANCE SYSTEM JOB TICKET FORM Page A-1 THREE MILE ISLAND UNIT 2

COMPONENT DESIGNATION				LOCATION / UNIT	JOB TYPE	JOB TICKET NUMBER	REQUEST DATE	RECOMMENDED PRIORITY
SYS	COMP TYPE	COMP ID	LOOP				MO / DAY / YR	
CF	2	Lr2		036002	CM	C5727	092280	2

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. Brunner	9/22/80	06175	J. Brunner	9/22/80

DOE/EG&G Project.

WORK ORDER NUMBER LOCATION	SERIAL	GC CODE	ACCOUNT NUMBER	PLANT CONDITION SU	OP	HO	CO	RF	HS	LR	NPRD FAILURE YR	MO	DAY	START HR	MIN
0360	01/817BD		x COD1 78760019	/	/	/	/	/	/	/					

CHANGE MOD REQ'D		NUC SAFETY	NPRD	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 / DAY / YR	RESP LOCATION OR CONTRACTOR
092480	2 3 / /

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. INSURE WORK AREA CLEANED UP AT COMPLETION OF JOB

COPY 1

ORIGINATOR—SUPERVISOR—SUPERVISOR OF MAINTENANCE—MAINTENANCE FOREMAN—JOB PERFORMER—MAINTENANCE FOREMAN—SUPERVISOR OF MAINTENANCE

WORK REQUEST PROCEDURE

TMI Nuclear Station

Maintenance Pr Page A-2 nd 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 on CF-2-LT2 Core Flood Tank A Level

2. Purpose: To determine the signal characteristics of the transducer as it exists in the Reactor Building.

3. Description of system or component to be worked on. CF-2-LT2 Instrument String

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 [signature] Date 9/29/80

Engineering Review [signature] 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-04 2-78

Technology for Energy Corporation	TITLE IN-SITU MEASUREMENTS OF CABLES AND SIGNALS FROM CORE FLOOD TANK LEVEL TRANSMITTER CF-2-LT2	NO. TP-110
	Page A-3	REV. 0
	APPROVED	DATE
PROCEDURE	M.V. Mathis, Director, Tech. Serv. Div.	

PURPOSE: The purpose of these measurements is to gather baseline data and information in preparation for removal of the Core Flood Tank Level Transmitter CF-2-LT2 from the Reactor Building TMI Unit 2. The tests specified in this procedure are designed to assess the condition of the in-containment instrumentation (Level 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. Core Flood Tank Level Transmitter CF-2-LT2 is part of a Redundant Level Monitoring System located at elevation 305'. The unit is part of the engineered reactor safeguards system and is nulcear safety-related.

2. Environmental Safety. Core Flood Tank Level Transmitter CF-2-LT2 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 Cables

IT2749C and IT2751C (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)	≤ 5V rms
Frequency	---	100Hz, 1kHz, 10kHz, 100kHz
Current	≤ 10mA	≤ 100mA
Other	225mV, 110 picosecond pulses	---

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. Bailey Meter Company Transmitter #BY-8231X-A.
2. Bailey Product Instruction E 21-17.

3. Burns & Roe Dwg. 3304, Sh. 24.
4. Burns & Roe Dwg. 3024, Sh. 20.
5. Burns & Roe Dwg. 3045, Sh. 26B, Sh. 26F.
6. Instruction Manual, Tektronix Model 1502 Time Domain Reflectometer.
7. Instruction Manual, Hewlett Packard Model 4274 Multifrequency LCR Meter.
8. Instruction Manual, Hewlett Packard Spectrum Analyzer (Model 141T, 8553B, 8552B Modules).
9. Instruction Manual, Nicolet Model 444A-26 Spectrum Analyzer.
10. Instruction Manual, Tektronix Model 335 Oscilloscope.
11. Instruction Manual, Lockheed Store-4 Recorder.
12. Instruction Manual, Tektronix SC502 Oscilloscope.
13. TEC Composite Electrical Connection Diagram, CF-2-LT2 (see attachment).

SIGNAL	CABLE	CABINET 156
+ Signal	IT1726I	TB 8-9-3/14
- Signal	IT1726I	TB 8-9-3/13
118 VAC (H)	IT2749C	TB 8-9-3/11
118 VAC (L)	IT2749C	TB 8-9-3/12
Shield (Signal)	IT1726I	TB 8-9-3/15

STEPS

1. Notify Shift Supervisor/Shift Foreman of start of test on CF-2-LT2.
2. Verify power is applied to CF-2-LT2.
3. Record present readings from CF-2-LT2 Readout Module.

SIGNAL	LEVEL
CF-2-LT2 Readout	7.5 ft.

3. Connect differential conditioning amplifier TEC Model #901 across TB 8-9-3/14 (+) and /13 (-). Connect output from TEC Model #901 to FM Recorder and record for 30 minutes.

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

SIGNAL	CABINET 156	TEST LEAD	READING
a.	TB 8-9-3/14 TB 8-9-3/13	(+) (-)	Signal 0.727 VOLT
b.	TB 8-9-3/11 TB 8-9-3/12	(+) (-)	118 VAC 116.1 VAC

*CAUTION: 118 VAC

[signature] 9/24/80
Signature/Date

5. Using a Tektronix Model SC502 (or equivalent) oscilloscope observe the de-coupled waveform at the following test points:

SIGNAL	CABINET 156	PARAMETER			
a.	TB 8-9-3/14 TB 8-9-3/13	(+) SIG (-) SIG	Photo 110-1 Time Base 2mS Vert Gain 20mV	Photo 110-2 Time Base 20uS Vert Gain 10mV	Photo ____ Time Base ____ Vert Gain ____
*b.	TB 8-9-3/11 TB 8-9-3/12	118 VAC Power	Photo 110-3 Time Base 5mS Vert Gain 10 V	Photo ____ Time Base ____ Vert Gain ____	Photo ____ Time Base ____ Vert Gain ____

*CAUTION 118 VAC; Use X10 Probe.

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] 9/24/90
Signature/Date

6. 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 8-9-3/14 TB 8-9-3/13	(+) SIG (-) SIG	110-4 110-5

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 10 db LOG	SENSI
3 KHz	1 MEG Hz/DIV	0	1 SEC	-20	0
3 KHz	100 K Hz/DIV	0	1 SEC	-20	0

[signature] 9/24/80
Signature/Date

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

SIGNAL	CABINET 156	PARAMETER	PHOTO #
a.	TB 8-9-3/14 TB 8-9-3/13	(+) SIG (-) SIG	110-6 110-7

[signature] 9/24/80
Signature/Date

8. 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

9. Remove all power from CF-2-LT2.

[signature] 9/24/80
Signature/Date

10. Remove field wires (in table below) from Cables IT2749C and IT1726I (Cabinet 156) leaving test connections attached for direct measurements on field wire signals (from Step A.4.C).

CABINET 156	SIGNAL IDENT.
TB 8-9-3/14	(+) SIGNAL
TB 8-9-3/13	(-) SIGNAL
TB 8-9-3/11	(H) 118 VAC
TB 8-9-3/12	(L) 118 VAC
TB 8-9-3/15	SHIELD (Signal)

Signature/Date 9/24/80

11. 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 8-9-3/14 (+) Signal	TB 8-9-3/13 (-) Signal
b.	TB 8-9-3/14 (+) Signal	TB 8-9-3/15 Shield (Signal)
c.	TB 8-9-3/13 (-) Signal	TB 8-9-3/15 Shield (Signal)
d.	TB 8-9-3/11 118 VAC (H)	TB 8-9-3/12 118 VAC (L)
e.	TB 8-9-3/11 118 VAC (H)	TB 8-9-3/14 (+) Signal
f.	TB 8-9-3/11 118 VAC (H)	TB 8-9-3/13 (-) Signal
g.	TB 8-9-3/11 118 VAC (H)	TB 8-9-3/15 Shield (Signal)

Record the data required below:

Test Point	Capacitance			Impedance		
Frequency	100 Hz	1 kHz	100 kHz	100 Hz	1 kHz	100 kHz
a. TB 8-9-3/14-13	14 NF	10 NF	-339 NF	4.6K/-2°	3.4K/-12	5.2Ω/117°
b. TB 8-9-3/14-15	0.3 uF	30 NF	-333 NF	0 F	0 F	6Ω/120°
c. TB 8-9-3/13-15	0.3 uF	32 NF	-376 NF	0 F	0 F	5.4Ω/128°
d. TB 8-9-3/11-12	-15 NF	12 NF	-188 NF	11K/60°	13K/76°	11Ω/131°
e. TB 8-9-3/11-14	1 NF	.15 NF	-3.1 NF	0 F	0 F	5.6Ω/71°
f. TB 8-9-3/11-13	6 NF	.16 NF	-260 NF	0 F	0 F	6Ω/88°
g. TB 8-9-3/11-15	.3 uF	6 NF	-118 NF	0 F	0 F	19Ω/135°

[signature] 9/24/80
Signature/Date

12. Using the Tektronix Model 1502 (or equivalent) TDR unit peform TDR measurements at the following test points.

Record data below:

Test Point	Instrument Settings Ampl Range Mult	Strip Chart Number
a. TB 8-9-3/14-13 (±) Signal		110-1
b. TB 8-9-3/14-15 (+) Signal/SHLD		110-2
c. TB 8-9-3/11-12 (118 VAC)		110-3
d. TB 8-9-3/11-15 (118 VAC/SHLD)		110-4

[signature] 9/24/80
Signature/Date

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

20K RANGE

			POLARITY From = +; To = -	POLARITY From = -; To = +
TEST POINT	FROM LINK	TO LINK	RESISTANCE	RESISTANCE
a.	TB 8-9-3/14	TB 8-9-3/13	7K	9K
b.	TB 8-9-3/14	TB 8-9-3/15	~ OPEN	~
c.	TB 8-9-3/13	TB 8-9-3/15	~	~
d.	TB 8-9-3/11	TB 8-9-3/12	98 OHM	98 OHM
e.	TB 8-9-3/11	TB 8-9-3/14	~	~
f.	TB 8-9-3/11	TB 8-9-3/13	~	~
g.	TB 8-9-3/11	TB 8-9-3/15	~	~

Signature/Date

14. Connect field wires from Cables IT2749C and IT1726I at Cabinet 156 (see Step 10) and apply power.

15. Notify the Shift Supervisor/Shift Foreman of the conclusion of testing CF-2-LT2.

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 9/24/80
Signature/Date

Instrumentation ______________________
Signature/Date

JOB TICKET (WORK REQUEST)
REVIEW – CLASS ... ING CONTROL FORM

JOB TICKET NUMBER C5727

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 9/24/80

11. Maintenance Foreman Assigned: [illegible]
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.

TMI-154 2-80

GENERATION CORRECTIVE MAINTENANCE SYSTEM
CM STATUS ACTIVITY FORM

COMPONENT DESIGNATOR				LOCATION UNIT	JOB TYPE	WORK AUTHORIZATION NUMBER	REQUEST DATE		
SYS (5)	COMP. TYPE (8)	COMP. ID. (12)	LOOP (16)	(17–22)	(23–24)	(28–32)	MO (33)	DAY	YR (38)
CF	2	LTZ		036002	CM	C5727	09	22	80

TXN CD (1)	ACT (4)	ECM NUMBER (47–51)
804	A	

TXN CD (1)	ACT (4)	PRTY (66)	RESP. LOCATION OR CONTRACTOR (67–71)	PRTY	ASSISTING CONTRACTOR	PRTY	ASSISTING CONTRACTOR
805	A	2	036N				

TXN CD (1)	ACT (4)	PURCHASE REQUISITION NUMBER (59–66)	PURCHASE ORDER NUMBER (67–73)
807	A		

TXN (1)	ACT (4)	STATUS HOLD CODE (39–40)	START DATE (41–45)	RELEASE DATE (47–52)	% COMPL (53–55)	S/M APPROVAL TO COMMENCE WORK MO DAY YR (56–61)	FIELD WORK COMPLETION DATE MO DAY YR (62–67)
810	A						

CODE	START DATE	RELEASE DATE	
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 80