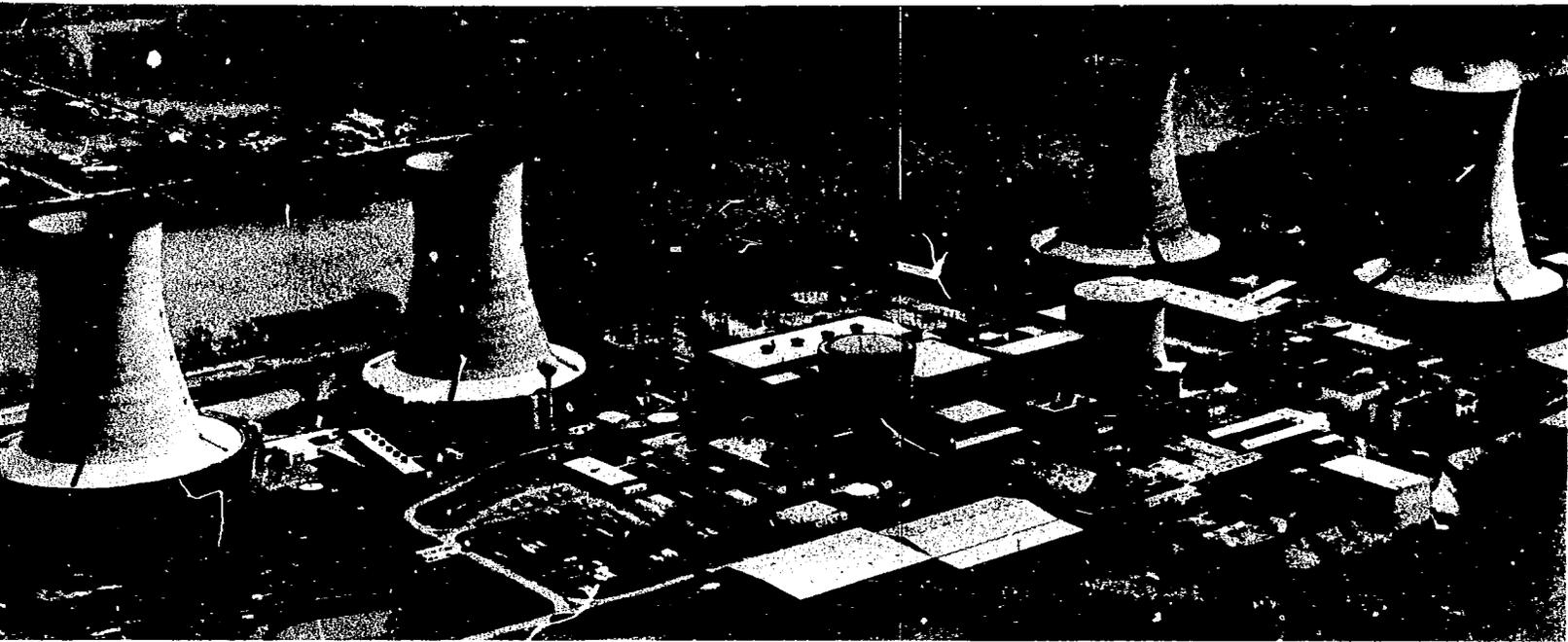


MASTER



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

GEND

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FIELD MEASUREMENTS AND INTERPRETATION OF TMI-2 INSTRUMENTATION: YM-AMP-7023 AND YM-AMP-7025

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

**Prepared for the
U.S. Department of Energy
Three Mile Island Operations Office
Under DOE Contract No. DE-AC07-76ID01570**

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Volume VII**

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**J. E. Jones
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Technology for Energy Corporation

January 1982

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MGW

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Section 1

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.

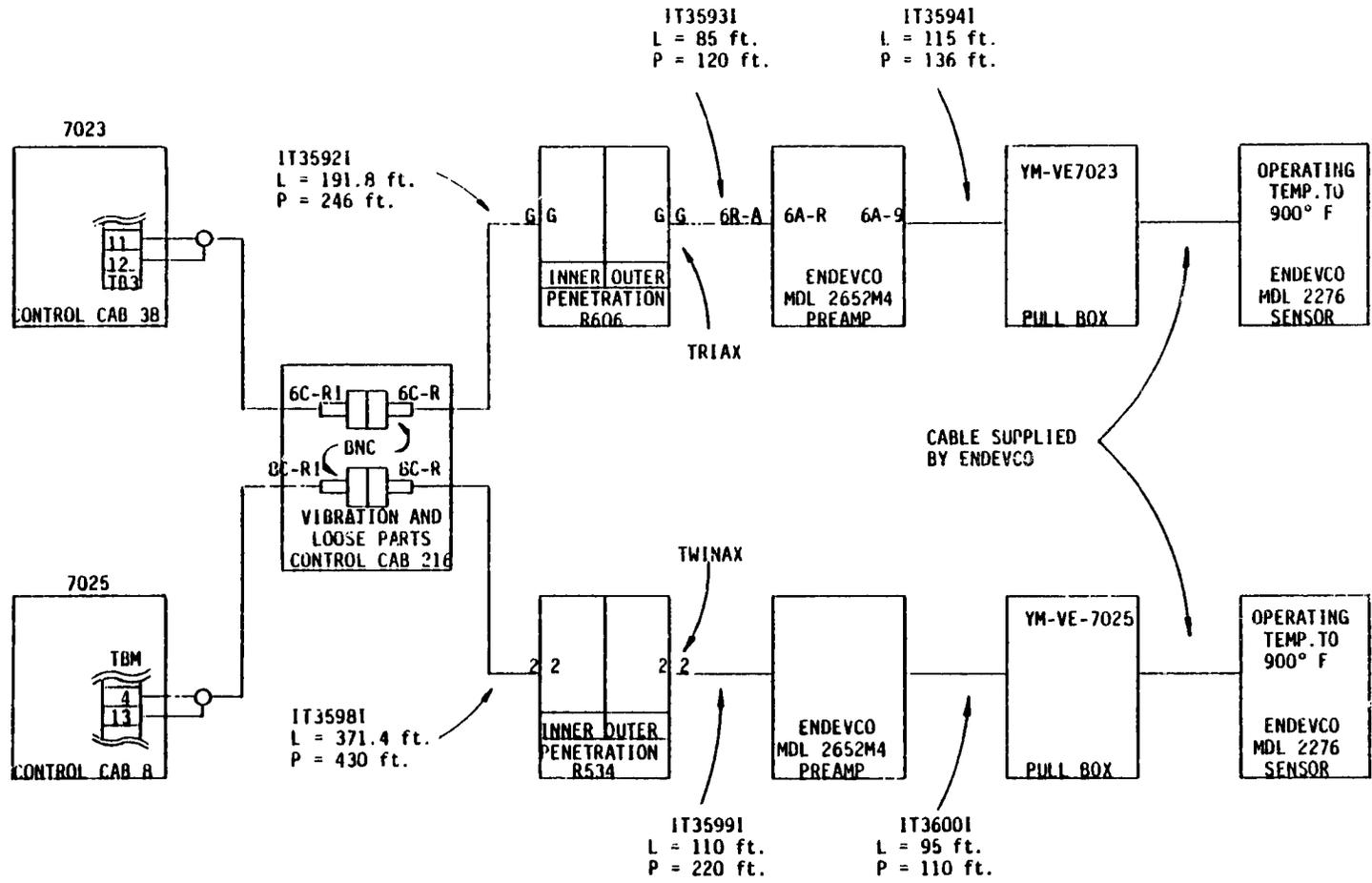
This report describes the measurement and results of the Loose Part Monitor Channels YM-AMP-7023 and YM-AMP-7025. These instruments consist of an Endevco Model 2276 accelerometer and a model 2652M4 charge amplifier connected to the Loose Parts Monitoring System terminals by approximately 400 feet (500 feet for 7025) of cable. The instruments were being incorporated into a B&W supplied system when the measurements were taken; therefore, the equipment was not expected to be fully operational.

Section 2

2. INSTRUMENT LOCATION, CABLING, AND TERMINATIONS

A review of appropriate drawings from Endevco and Burns & Roe (itemized in the Appendices in the measurement procedures) resulted in the composite electrical diagram shown in Figure 2-1. From this information, Table 2-1 gives a list of the appropriate cable identification points for performing measurements in Control Cabinet 216. As noted in Figure 2-1, the cable lengths are approximately 400 feet for YM-AMP-7023 and 500 feet for YM-AMP-7025.

Since the system was in a state of partial operation due to the conversion to a B&W Monitoring System, details of the "as-found" location of signal lines were determined on-site during the measurements.



2-2

Figure 2-1. YM-AMP Composite Electrical Diagram.

Table 2-1

TERMINATION POINTS FOR YM-AMP MEASUREMENTS

Signal	Identification*
YM-AMP-7023 Signal	Cable IT3592I (coaxial)
YM-AMP-7025 Signal	Cable IT3598I (coaxial)

*Cables connected to Cabinet 216 before testing.

Section 3

3. PREPARATION OF MEASUREMENT PROCEDURES

As a result of generating the composite electrical diagram and from a review of Endevco Product Manuals, TEC identified the major types of measurements to be performed:

1. To determine as-found condition of level indication and to record signal output;
2. On each electrical connection, to perform passive measurements (i.e., passively monitor signals) consisting of time domain waveforms, very-high frequency spectrum analysis (i.e., MHz region), and frequency spectra below 100 kHz;
3. To 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 power supplies, the acceleration measurement assembly, cabling, and terminations/connections to the assembly. The Appendices contain the detailed procedures which were followed during the measurement program, and a summary of measurements is presented in the next section.

Section 4

4. MEASUREMENTS

Since the Loose Parts Monitoring System (LPM) was "off" when measurements began, the first data obtained were capacitance, impedance, and resistance data. Table 4-1 shows a comparison of the data obtained for YM-AMP-7023, YM-AMP-7025, and YM-AMP-7025 (after replacement of the charge converter). TDR measurements were also taken on the cables to identify possible defects. The strip chart traces of the results are shown in Figures 4-1 to 4-3.

Following measurements on the powered down state of the channels, power was applied to each instrument. The current and voltage were measured for each channel between the amplifier in Cabinet 216 and the remote charge amplifier. Results are presented in Table 4-2 for each instrument.

The next measurements consisted of photographing the output waveforms of each LPM channel. Figures 4-4 to 4-6 show the resulting time traces. Along with time domain measurements, both high frequency (>1 MHz) and low frequency spectra (<100 kHz) were photographed for each LPM channel. High frequency spectra are shown in Figures 4-7 to 4-9 and low frequency spectra are shown in Figures 4-10 to 4-12.

Following the frequency spectra measurements, the output of each channel was recorded on an FM recorder for approximately 10 minutes.

Table 4-1

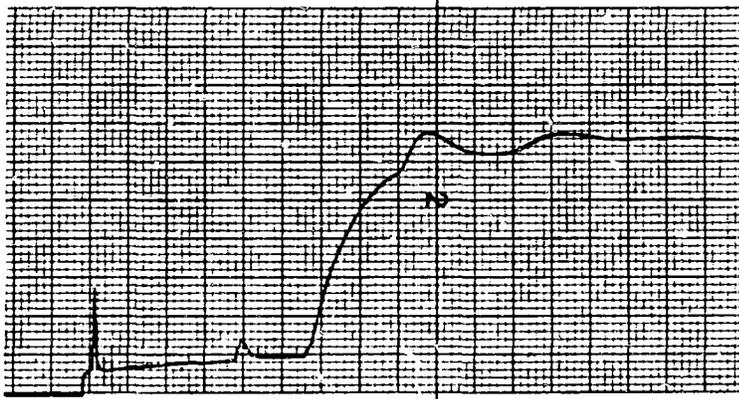
CAPACITANCE, IMPEDANCE, AND RESISTANCE MEASUREMENTS

Instrument	Capacitance			Impedance (ohms)			Resistance*
	100 Hz	1 kHz	100 kHz	100 Hz	1 kHz	100 kHz	
YM-AMP-7023	22nF	10.3nF	10.5nF	7.2k	6.6k	151	10.1k (33.2k)
YM-AMP-7025	28nF	16.4nF	-228nF	7.1k	5.8k	9.11	1.2k (34.2k)
7025 (Replaced)	22nF	16.5nF	-209nF	10.4k	7.2k	9.2	10.8k (37.8k)

*Values in parentheses are the reverse polarity readings.

STRIP CHART 107-1

Cable - IT3592I



Setting - 500 μ p/div

Range - 52.6 ft/div

Sensitivity - 0.25

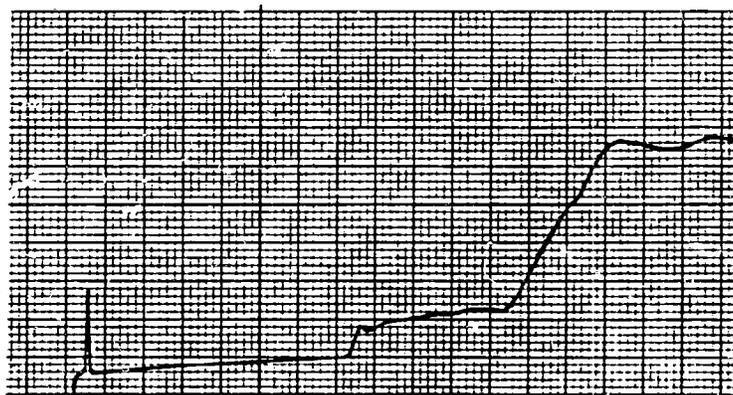
Filter - 15 Hz

Cable dielectric - poly

Figure 4-1. TDR Trace of YM-AMP-7023 Cable.

STRIP CHART 106-1

Cable - IT3598I

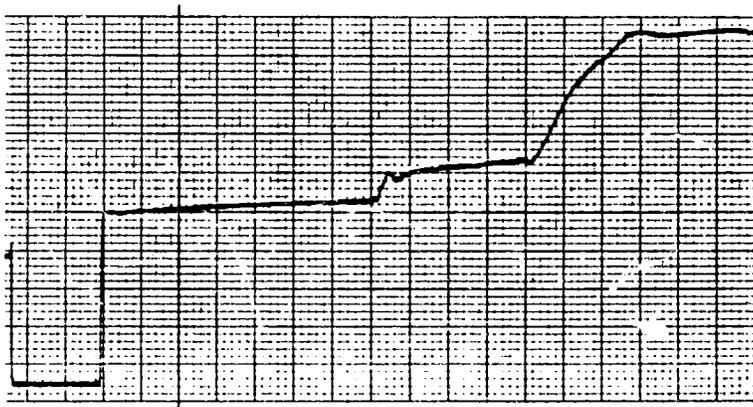


Setting - $500\mu\text{p}/\text{div}$
Range - 52.6 ft/div
Sensitivity - 0.25
Filter - 15 Hz
Cable dielectric - poly

Figure 4-2. TDR Trace of YM-AMP-7025 Cable.

STRIP CHART 107-51

Cable IT35981



Setting - 500m ρ /div
Range - 52.6 ft/div
Sensitivity - 0.25
Filter - 15 Hz
Cable dielectric - poly

Figure 4-3. TDR Trace of YM-AMP-7025 (Replacement) Cable.

Table 4-2

Current and Voltage Measurements*

Instrument	Current	Voltage (VDC)
YM-AMP-7023	4.39 ma	29.6
YM-AMP-7025	0.58 ma	34.7
7025 (replaced)	1.72 ma	35.3

*Measurements between LPM amplifier and cable.

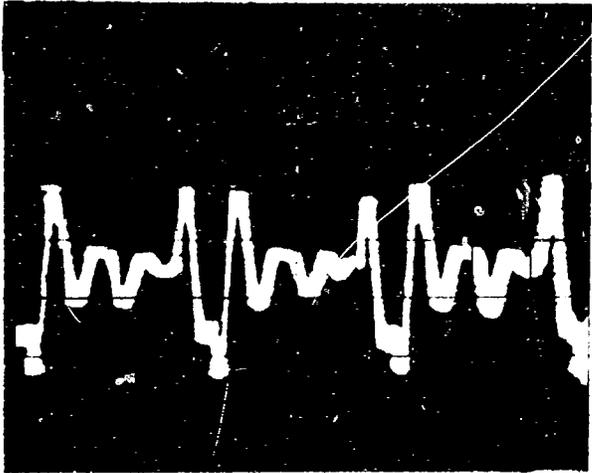


Photo 107-1
Time - 20 μ sec/div
Gain - 0.2 V/div
Signal - SIG

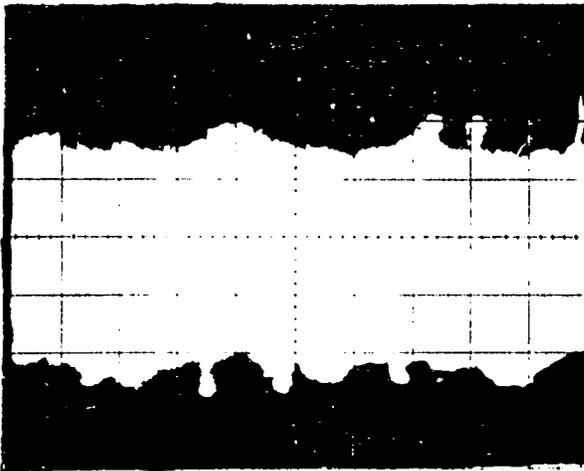


Photo 107-2
Time - 5msec/div
Gain - 0.2 V/div
Signal - SIG

Figure 4-4. Oscilloscope Waveforms from YM-AMP-7023 Signal.



Photo 106-1

Time - 5msec/div

Gain - 2 mV/div

Signal - SIG

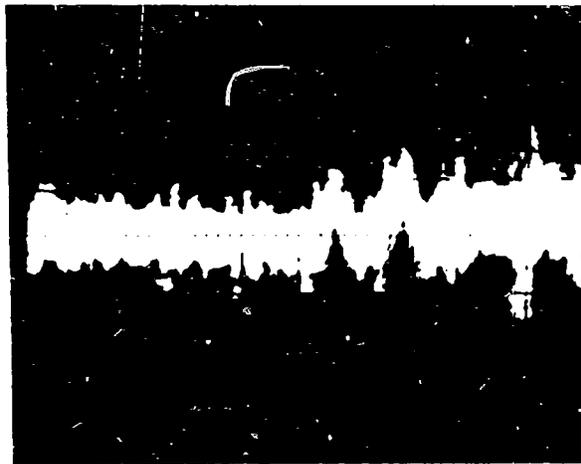


Photo 106-2

Time - 5 μ sec/div

Gain - 1 mV/div

Signal - SIG

Figure 4-5. Oscilloscope Waveforms from YM-AMP-7025 Signal.

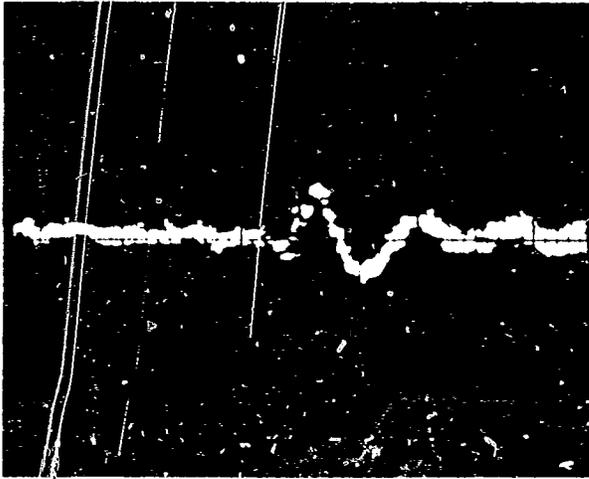


Photo 107-52

Time: 5 μ sec/div

Gain: 1 mV/div

Signal: SIG-Shield

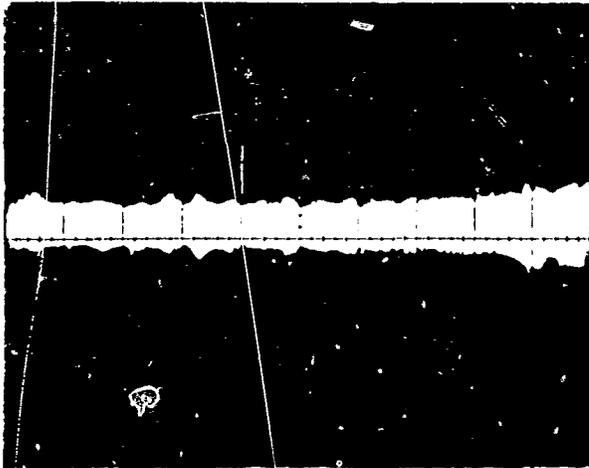


Photo 107-53

Time: 2 msec/div

Gain: 1 mV/div

Signal: SIG-Shield

Figure 4-6. Oscilloscope Waveforms from YM-AMP-7025 (Replacement) Signal.

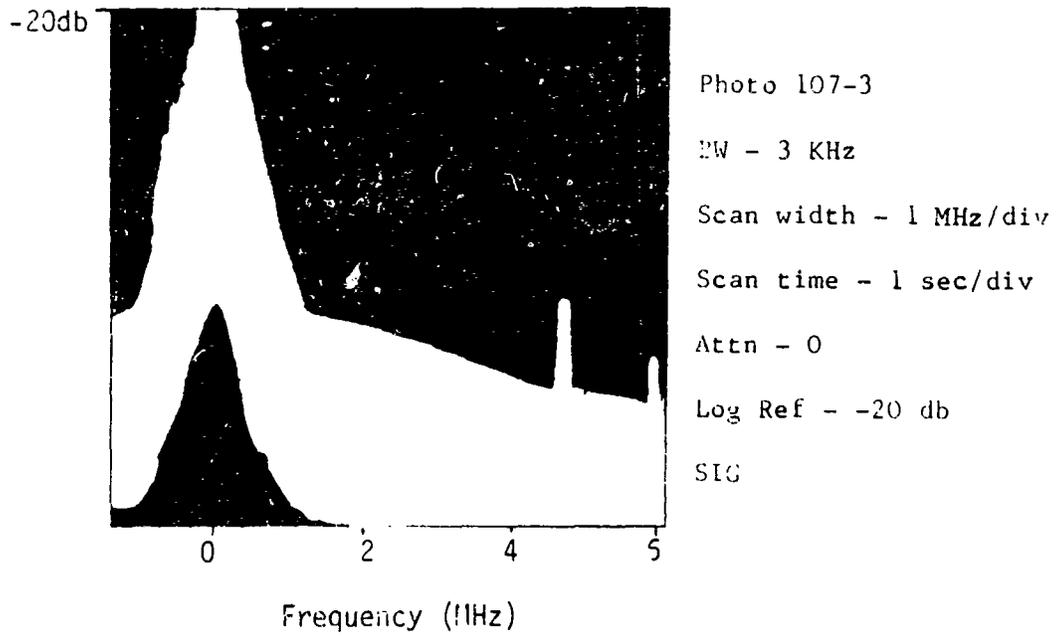


Figure 4-7. High Frequency Spectrum of YM-AMP-7023 Signal.

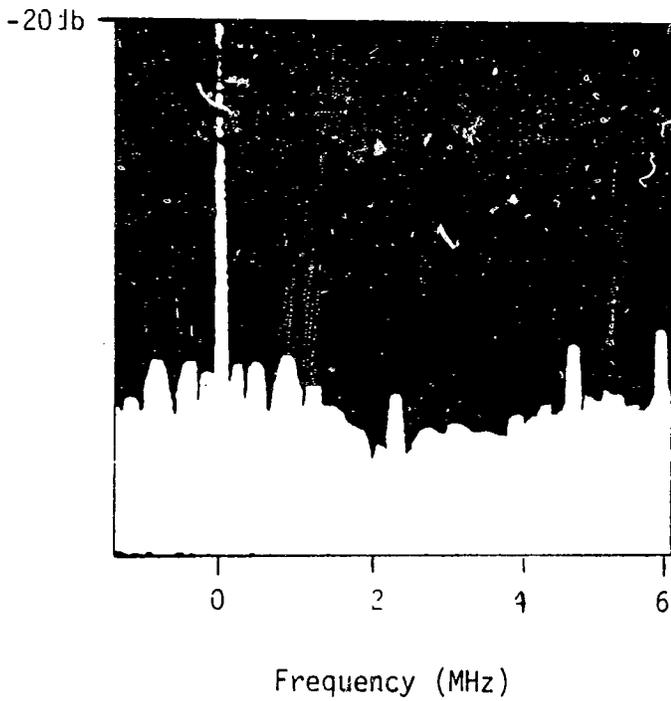


Photo 106-3

BW - 3 KHz

Scan width - 1 MHz/div

Scan time - 1 sec/div

Attn - 0

Log Ref - -20 db

SIG

Figure 4-8. High Frequency Spectrum of YM-AMP-7025 Signal.

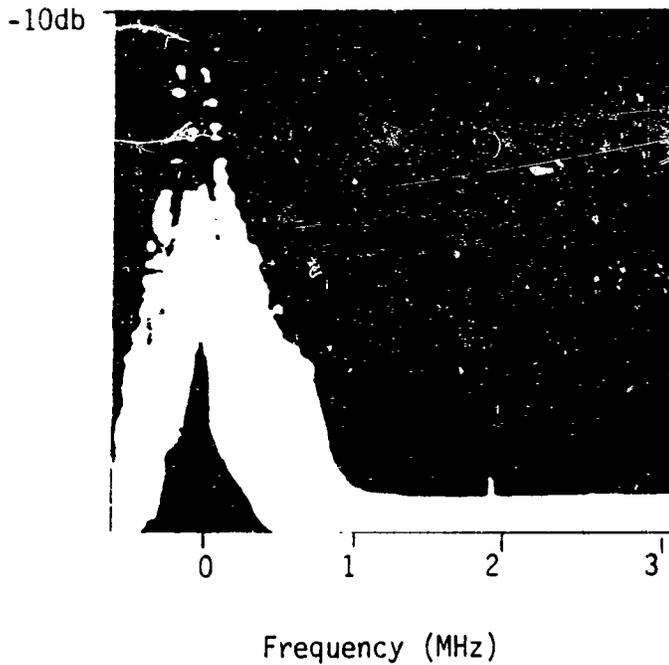


Photo 107-54

BW - 3kHz

Scan width -- 0.5 MHz/div

Scan time - 1 sec/div

Attn - 0

Log Ref - -10 db

SIG - Shield

Note: Gain by 20 externally

Figure 4-9. High Frequency Spectrum of YM-AMP-7025 (Replacement) Signal.

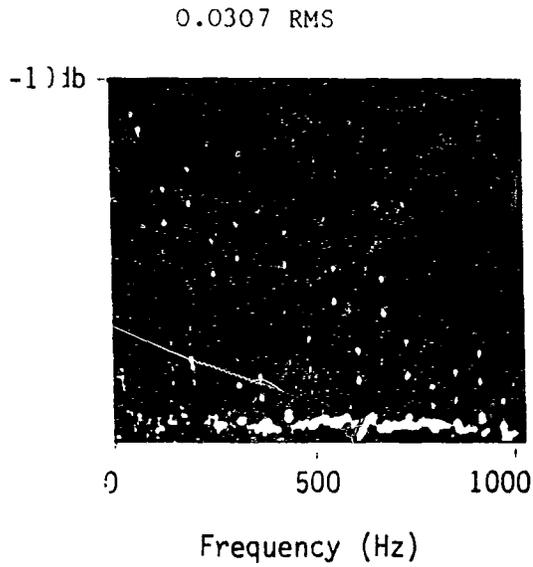


Photo 107-4
1 KHz Range
+10 db Reference

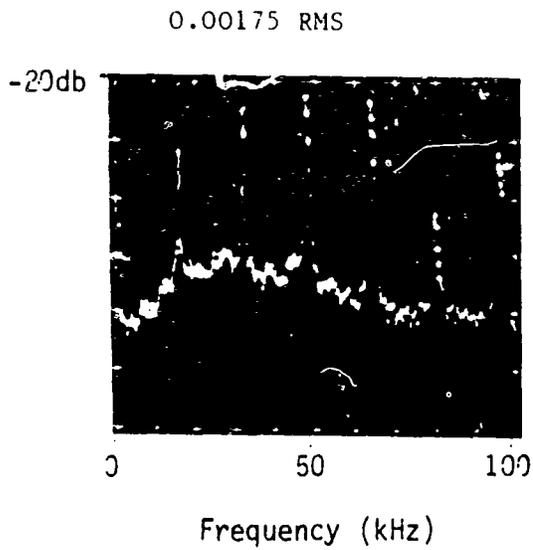


Photo 107-5
100 KHz Range
+20 db Reference

Figure 4-10. Low Frequency Spectra of YM-AMP-7023 Signal.

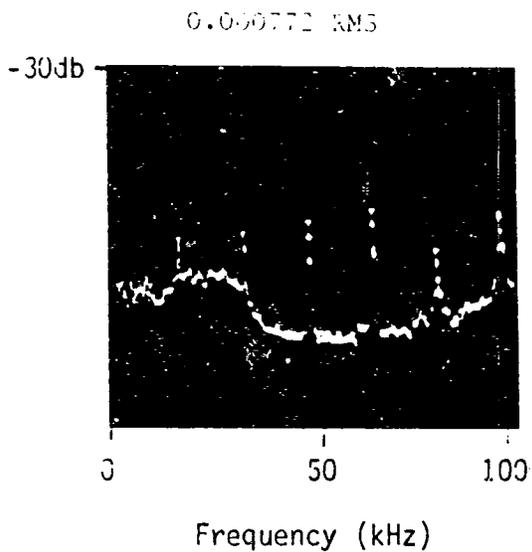


Photo 106-4
100 KHz Range
+30 db Reference

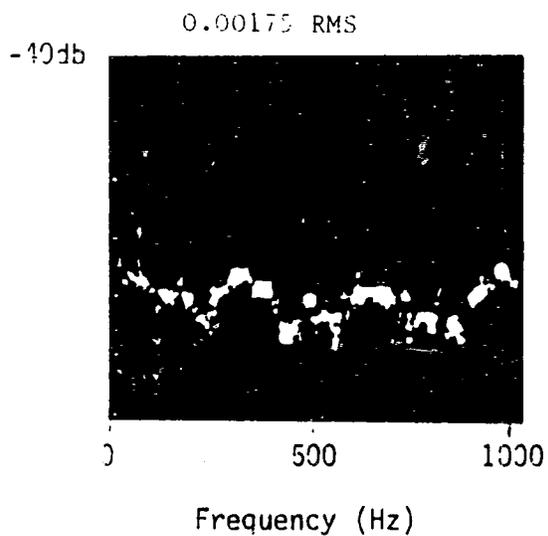


Photo 106-5
1 KHz Range
+40 db Reference

Figure 4-11. Low Frequency Spectra of YM-AMP-7025 Signal.

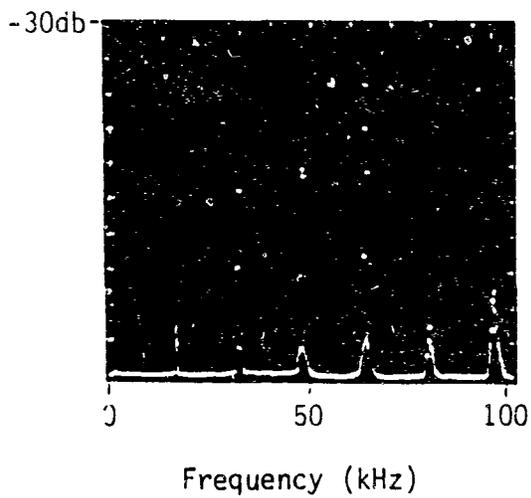


Photo 107-55
100 kHz Range
+30 db Reference
Note: Gain by 20 externally

Figure 4-12. Low Frequency Spectrum of YM-AMP-7025 (Replacement) Signal.

Section 5

5. INTERPRETATION OF MEASUREMENTS

Due to the lack of detailed information concerning the LPM system and the uncertainty caused by replacement of the system, only a summary of the major conclusions can be presented.

The original Rockwell V&LPM in the plant used Endevco accelerometers and charge converters, model 2276 Isobase and model 2652M4 respectively. The Rockwell LPM provided the 18 ma necessary to power the charge converter. The Rockwell system was then replaced by a B&W system without changing the charge amps. This system was designed to provide only 4 ma to the charge converters.

Without proper DC bias, the charge converters probably are not working. However, because of capacitive feedback in the charge converter, accelerometer signals may be present at the V&LPM inputs in a highly attenuated form. This attenuation would be proportional to the length of the cable plus the series capacitance of the feedback capacitor in the charge amp. Because the cable length is approximately 500 feet, the input signals at the LPM may be mostly noise.

About 1 month after the original measurements were made on 7023 and 7025, the charge converter in channel 7025 was replaced. It is not known what type charge converter replaced the 2652M4, but scope photos of the output waveforms show no significant increase of amplitude. After replacement, the output current for channel 7025 only measured

5-2

1.7 ma through a 2k resistor attached at the signal input. Even if the new charge converter operated at the 4 ma current level, it still was not being provided enough current. Therefore, the same situation would exist as with the original charge converter.

Section 6

6. CONCLUSIONS

Based on the measurements and an overall interpretation of the measurements, YM-AMP-7023 and YM-AMP-7025 are not operating properly. Part of the problem is due to a change-over from the Rockwell LPM to a B&W system, but there are indications that proper supply currents are not being provided to the preamplifiers (charge amplifiers). With uncertainties in the current hardware configuration, an interpretation of the operability of the system with proper supply currents is not possible.

APPENDIX A

**ORIGINAL FIELD PROCEDURES AND
DATA SHEETS FOR YM-AMP-7023**

GENERATION CORRECTIVE MAINTENANCE SYSTEM
JOB TICKET FORM (WORK REQUEST)-THREE MILE ISLAND

UNIT 2

208-7

COMPONENT DESIGNATION				LOCATION / UNIT	JOB TYPE	JOB TICKET NUMBER	REQUEST DATE			RECOMMENDED PRIORITY
SYS	COMP TYPE	COMP ID	LOG ID				MO	DAY	YR	
YM	AMP	7023		036002	CM	C5710	09	20	86	2

DESCRIBE MALFUNCTION OR MODIFICATION DESIRED

Perform attached procedure for sensor/cable measurements.

CAUSE OF MALFUNCTION (IF KNOWN)

ORIGINATOR'S EMP NO. 06175	<i>J. Brown</i> ORIGINATOR'S SIGNATURE	9/20/86 DATE	SUPERVISOR'S EMP NO. 06175	<i>J. Brown</i> SUPERVISOR'S SIGNATURE	9/20/86 DATE
-------------------------------	---	-----------------	-------------------------------	---	-----------------

DOE/EG&E Project Account AB

WORK ORDER NUMBER		GC CODE	ACCOUNT NUMBER	PLANT CONDITION				IPRO FAILURE			START				
LOCATION	SERIAL		X001	SU	OP	MO	CO	FF	-S	L	YR	MO	DAY	HR	MIN
03600	0187GA		7876019	1	1	1	1	1	1	1					

REG AGENCY CODE	CHG/MOD NUMBER	ENV CODE	OUTAGE CAUSE CODE	STATUS HOLD CODE
0000		X		

MO	DAY	YR
09	22	86

RESP LOCATION OR CONTRACTOR
203610

Location: Cable Room, 305' elev. Control Building

Limits and Precautions:

- a) Personnel
- b) Equipment
- c) Environment
- d) Nuclear

Comply with the Provisions set forth in AP 1002 and Met Ed Safety Manual

INSURE WORK AREA CLEANED UP AT COMPLETION OF JOB

Post Maintenance Testing required and Acceptance Criteria.

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

**JOB TICKET (WORK REQUEST)
REVIEW - CLASSIFICATION - ROUTING CONTROL FORM**

JOB TICKET NUMBER C5710

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. N/A 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:

R. Siegf _____ Date 9/22/80

11. Maintenance Foreman Assigned: J. H. ... _____

12. Code Inspector Notified Name: _____ Date _____

13. Shift Foreman's approval to commence work: Christine _____ Date 9/23/80

_____ Initial if Shift Foreman signature is not required.

WORK REQUEST PROCEDURE
TMI Nuclear Station
Maintenance Procedure Format and Approval

A-3

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 YM-AMP-7023
Steam Generator B Upper Tube Sheet*

2. Purpose: *To determine current characteristics of signals
from YM-AMP-7023.*

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

YM-AMP-7023 and associated instrument string components.

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 9/22/80

• PORC RECOMMENDS APPROVAL

Engineering Review [Signature]

9/20/80

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.

	TITLE IN-SITU MEASUREMENTS OF CABLES AND SIGNALS FROM LOOSE PARTS MONITOR CHARGE CONVERTER YM-AMP-7023	NO. TP-107
		REV. 1
Technology for Energy Corporation	APPROVED	DATE
PROCEDURE	M.V. Mathis, Director, Tech. Serv. Div.	9/18/80

PURPOSE: The purpose of these measurements is to gather baseline data and information in preparation for removal of Loose Parts Monitor Charge Converter YM-AMP-7023 from the Reactor Building TMI Unit 2. The tests specified in this procedure are designed to assess the condition of the in-containment instrument module (accelerometer, charge converter), 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).

YM-AMP-7023 - Steam Generator B Upper Tube Sheet

PROCEDURE (ADMINISTRATIVE):

A. Limitations and Precautions

1. **Nuclear Safety.** Loose Parts Monitor Charge Converter YM-AMP-7023, located at elevation 347', is part of the overall Loose Parts Surveillance System. ~~It is not a part of the engineering or safety system and is not to be used for safety related activities.~~
2. **Environmental Safety.** Loose Parts Monitor Charge Converter YM-AMP-7023 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 by inserting test signals on appropriate conductors of Cable IT35921.

TEC

TITLE

IN-SITU MEASUREMENTS OF CABLES AND SIGNALS
FROM LOOSE PARTS MONITOR CHARGE CONVERTER
YM-AMP-7023NO.
TP-107

REV. 1

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	---

B. Prerequisites

1. The Shift Supervisor/Shift Foreman shall be notified for concurrence prior to the performance of those measurements. ~~as a work request procedure from the Mins 2-78~~
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. Endevco Dwg. No. AE-E0401, Specifications for Model 2652M4 Charge Converter YM-AMP-7023 (Sheet 3 of 3).
2. Specification Manual for Endevco Model 2276 Accelerometer.
3. Burns & Roe Dwg. 3024, Sh. 105.
4. Burns & Roe Dwg. 3343, Sh. 2.
5. Burns & Roe Dwg. 3045, Sh. 17.
6. Burns & Roe Dwg. 3314, Rev. 8.

TEL	TITLE	IN-SITU MEASUREMENTS OF CABLES AND SIGNALS FROM LOOSE PARTS MONITOR CHARGE CONVERTER YM-AMP-7023	NO.	TP-107
			REV.	1

7. Burns & Roe Dwg. 3174, Sh. 7.
8. Burns & Roe Dwg. 3045, Sh. 17.
9. Instruction Manual, Tektronix model 1502 TDR.
10. Instruction Manual, Hewlett Packard Model 4274 Multifrequency LCR Meter.
11. Instruction Manual, Hewlett Packard Spectrum Analyzer (Model 141T, 85538, 85528 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, YM-AMP-7023 (see attachment).

STEPS

1. Notify Shift Supervisor/Shift Foreman of start of test on YM-AMP-7023.
2. Remove all power from YM-AMP-7023 (Channel 6).
3. Remove cable IT3592I (Channel 6) in cabinet 216.
4. Using the Hewlett-Packard Model 4274 (or equivalent) Impedance Bridge measure the capacitance and impedance at the following test point.

TEST POINT *	FROM	TO
a.	Cable IT3592I (Center Conductor)	Cable IT3592I (Shield)

* Test Connection in Cabinet 216.

TEC

TITLE

IN-SITU MEASUREMENTS OF CABLES AND SIGNALS
FROM LOOSE PARTS MONITOR CHARGE CONVERTER
YM-AMP-7023NO.
TP-107

REV. 1

Record the data required below:

TEST POINT	CAPACITANCE			IMPEDANCE		
	100 Hz	1 kHz	100 kHz	100 Hz	1 kHz	100 kHz
a. Cable IT 3592I Center Conduct- or to shield	22.2 nF 22 nF	10.3 nF 10.3 nF	10.5 nF	7.2 K/ -6°	6.6 K/ -25°	157.5 nF 157.5 nF -87°

5. Using the Tektronix Model 1502 (or equivalent TDR unit) perform TDR measurements on the test point given in Step 4.

Record the data below:

Test Point	High R @ N ft.	Low R @ N ft.	Instrument Settings	Strip Chart Number
			Ampl Range Mult	
a. Cable IT3592I Center Conductor to Shield				107-1

6. Using the Keithley Model 177 (or equivalent DMM) perform resistance measurements on the test points specified and record values in the space provided.

TEC

TITLE

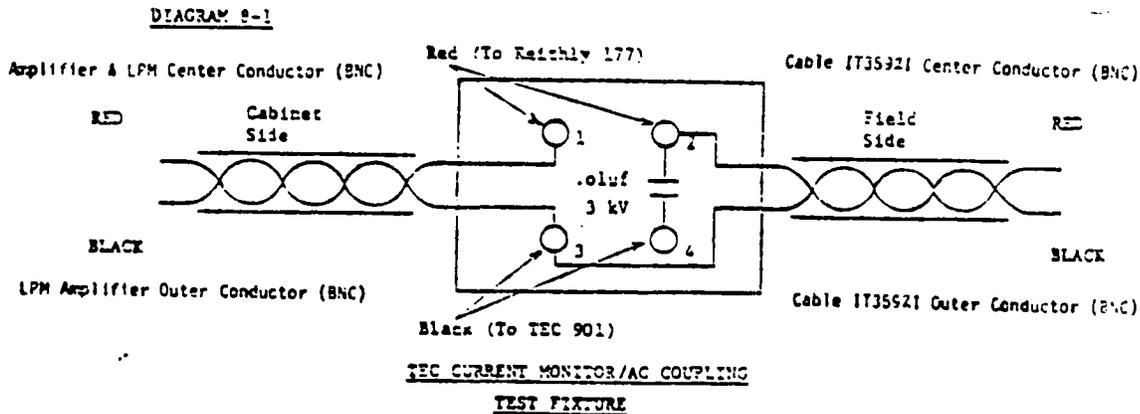
IN-SITU MEASUREMENTS OF CABLES AND SIGNALS FROM LOOSE PARTS MONITOR CHARGE CONVERTER YM-AMP-7023

NO. TP-107

REV. 1

TEST POINT	FROM LINK	TO LINK	20K RANGE	200K RANGE
			POLARITY From = +; To = -	POLARITY From = -; To = +
			RESISTANCE	RESISTANCE
a.	Center Conductor (+)	Shield (-)	10.14 K	33.23 K

7. Connect the TEC Current Monitor/AC Coupling Test Fixture between LPM amplifier and Cable IT3592I per the following diagram:



NOTE: This circuit provides additional access to signals and charge converter current

- 1) Series connection of an ammeter by connecting a BNC with plugs 1 (signal of BNC connector)* and 2 (ground of BNC connector).*
- 2) Access to the signal through a decoupling capacitor is provided by a BNC connecting plugs 4 (signal of BNC) and 3 (ground of BNC).*

* Connections provide for proper polarity.

TEC	TITLE	IN-SITU MEASUREMENTS OF CABLES AND SIGNALS FROM LOOSE PARTS MONITOR CHARGE CONVERTER YM-AMP-7023	NO. TP-107
			REV. 1

8. Connect a Kiethly Model 177 DMM (or equivalent) in series with center conductor of IT3592I (BNC) by connecting across plugs 1 and 2 (the two red plugs) of the TEC Current Monitor/AC Coupling Test Fixture.
9. Connect a TEC 901 Isolation Amplifier with a BNC to Banana plugs 3 (ground) and 4 (signal) (the two black plugs) of the TEC Current Monitor/AC Coupling Test Fixture.
10. Connect an FM Recorder to the output of the 901 Amplifier (the TEC 901 operating in differential mode) and start the recorder.

NOTE: Recording will continue through Step 17.

11. Apply power to YM-AMP-7023(Channel 6 and verify operation through normal instrumentation procedures.
12. Using the Kiethly Model 177 DMM (or equivalent; Precision = $\pm 1\%$) measure the current at the signal test point.

SIGNAL	Cabinet 216	TEST LEAD	SCALE	READING
a.	TEC Current/ Monitor Plug-1 Plug-2	(+) (-)	20mA	4.39mA

* CURRENT READINGS POWER ON \approx 12 MIN
AND VOLTAGE
Q-TS-H 9/23/50
 Signature/Date

13. Using the Kiethly Model 177 DMM (or equivalent; $Z_i \geq 10^7$ OHMS, Range 0-2000V, Precision = $\pm 1\%$) measure the DC Voltage at the signal test point.

SIGNAL	CABINET 216	TEST LEAD	SCALE	READING
a.	TEC Current/ Monitor Plug-1 Plug-3	(+) (-)	200V	29.6V

TEC

TITLE

IN-SITU MEASUREMENTS OF CABLES AND SIGNALS
FROM LOOSE PARTS MONITOR CHARGE CONVERTER
YM-AMP-7023NO.
TP-107

REV. 1

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

<u>SIGNAL</u>	<u>CABINET 216</u>	<u>PARAMETER</u>	107-1	107-2	
a.	TEC Current/ Monitor Plug-4 Plut-3	SIG Shield	Photo <u>107-1</u> Time Base <u>20.45</u> Vert Gain <u>0.2V</u>	Photo <u>107-2</u> Time Base <u>5MS</u> Vert Gain <u>0.2V</u>	Photo _____ Time Base _____ Vert Gain _____

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.

J. T. S. A. 9/23/50
Signature/Date

15. Using a Hewlett-Packard Spectrum Analyzer (Models 1417, 85538, and 8552, or equivalent) perform an analysis of the test signal for spectral content:

<u>SIGNAL</u>	<u>CABINET 216</u>	<u>PARAMETER</u>	<u>PHOTO #</u>
a.	TEC Current/ Monitor Plug-4 Plug-3	SIG SHIELD	<u>107-3</u>

Before photographing each scope presentation 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.

TEC	TITLE	IN-SITU MEASUREMENTS OF CABLES AND SIGNALS FROM LOOSE PARTS MONITOR CHARGE CONVERTER YM-AMP-7023	NO. TP-107
			REV. 1

<u>SPECTRUM IDENT</u>	<u>FREQUENCY</u>	<u>AMPLITUDE</u>	<u>REMARKS</u>
BANDWIDTH 3 kHz	SCAN WIDTH 1 MEG Hz / DIV	INPUT ATTEN 0	SCAN TIME 1 SEC
			LOG REF 10 dB LOG -20 dB

SENS = 0
VAR-

[Signature] 9/24/80
Signature/Date

16. Using the Nicolet Model 444 FFT Analyzer (or equivalent) perform FFT analysis of signals from the signal test point:

<u>SIGNAL</u>	<u>CABINET</u> 216	<u>PARAMETER</u>	<u>PHOTO #</u> <u>OR PLOT</u>
*a.	TEC Current/ Monitor Plug-4 Plug-3	SIG Shield	107-4 107-5

1 kHz
100 kHz

If PSD plots from the signal show high or unusual amplitudes, utilize the zoom feature to provide finer resolution and obtain PSD data in the frequency band of interest.

[Signature] 9/23/80
Signature/Date

17. Continue recording the output signal from YM-AMP-7023 for a period of 10 additional minutes. Remove amplifier and FM Recorder when complete.
18. Remove all power from YM-AMP-7023 (same procedure as Step 2).

TEC

TITLE

IN-SITU MEASUREMENTS OF CABLES AND SIGNALS
FROM LOOSE PARTS MONITOR CHARGE CONVERTER
YM-AMP-7023.NO.
TP-107

REV. 1

19. Remove the TEC Current Monitor/AC Coupling Test Fixture.

20. Notify the Shift Supervisor/Shift Foreman of the conclusion of testing on
YM-AMP-7023.

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

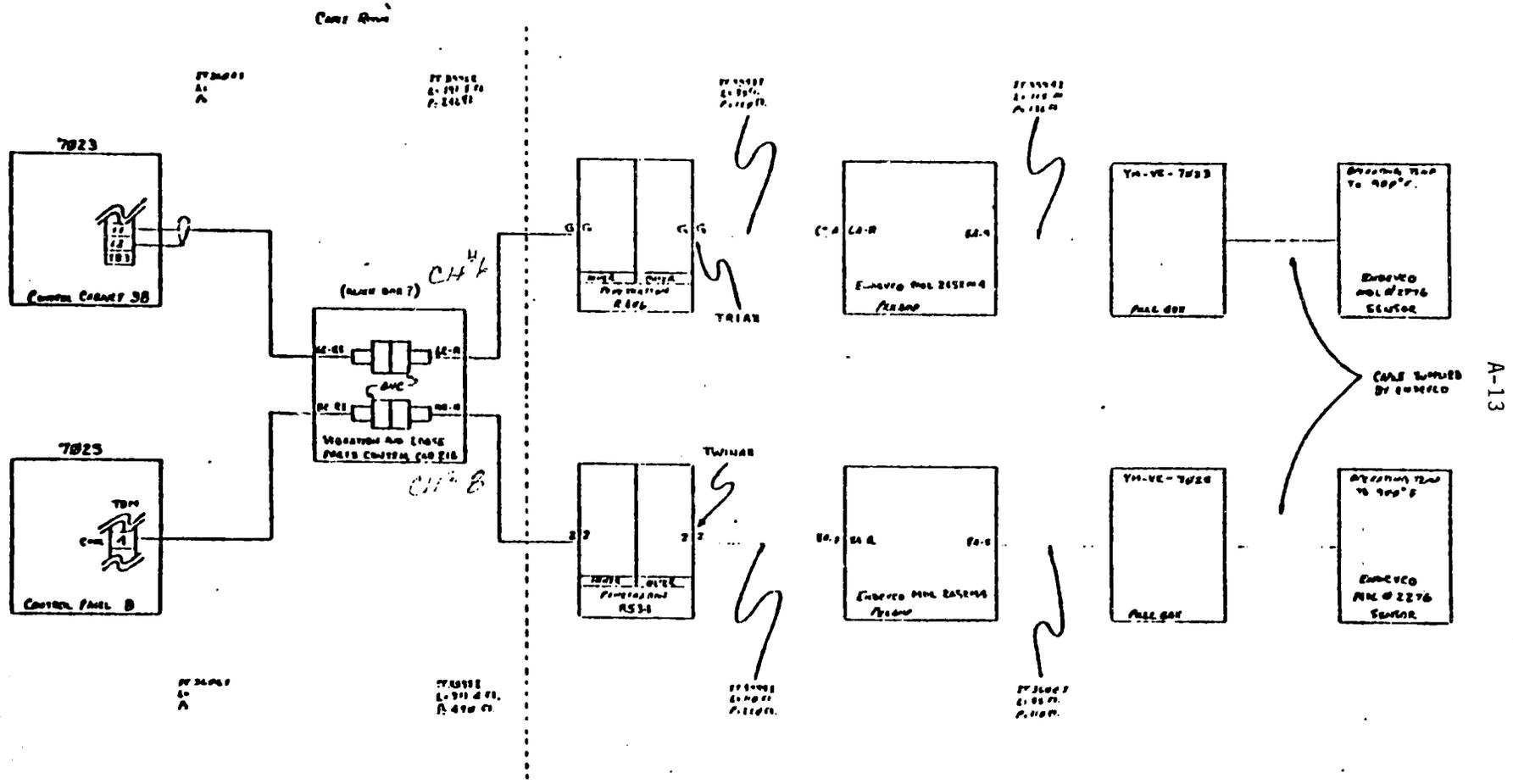
TEC Representative

A. T. S. A. 9/23/80
Signature/Date

Instrumentation

P. R. Gilbert 9/23/80
Signature/Date

REVISED		
ITA	DESCRIPTION	DATE



A-13

NOTE: See length P. 7-11

NO.	DATE	DESCRIPTION

TEC		TECHNOLOGY FOR ENERGY CORPORATION KNOXVILLE, TENNESSEE	
TITLE			
YM-AMP-7023 & 7025			
DATE	ISSUE	REVISED	BY

**GENERATION CORRECTIVE MAINTENANCE SYSTEM
CM STATUS ACTIVITY FORM**

A-14

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					
YM	AMP	7023		0	3	6	0	0	2	C	M	/	C	57	/	09	20	8	0

TXN CD	ACT
1	4
8	0
4	A

ECM NUMBER
47
51

TXN CD	ACT
1	4
8	0
5	A

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

TXN CD	ACT
1	4
8	0
7	A

PURCHASE REQUISITION NUMBER	PURCHASE ORDER NUMBER
59	66
	67
	73

TXN	ACT
1	4
8	1
0	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

- 0 1 OUTAGE HOLD
- 0 2 PART HOLD
- 0 3 QUALITY CONTROL PART HOLD
- 0 4 QUALITY CONTROL PROCEDURE HOLD
- 0 5 OPERATIONS HOLD
- 0 6 CHANGE MODIFICATION HOLD
- 0 7 ENGINEERING HOLD
- 0 8 PLANNING HOLD
- 5 0 MANPOWER NOT AVAILABLE
- 5 1 AT PORC
- 5 2 AT QUALITY CONTROL
- 5 3 AT UNIT SUPERINTENDENT
- 5 4 AT READING
- 5 5 POST MAINTENANCE TEST HOLD
- 5 6 AT ALARA

APPENDIX B

**ORIGINAL FIELD PROCEDURES AND
DATA SHEETS FOR YM-AMP-7025**

A-16

208-6

GENERATION CORRECTIVE MAINTENANCE SYSTEM
JOB TICKET FORM (WORK REQUEST)-THREE MILE ISLAND

B-1

UNIT 2

COMPONENT DESIGNATION				LOCATION / UNIT	JOB TYPE	JOB TICKET NUMBER	REQUEST DATE			RECOMMENDED PRIORITY
SYS	COMP TYPE	COMP ID	MO				DAY	YR		
YM	AMP	7025		036002	CM	57110	09	20	80	2

DESCRIBE MALFUNCTION OR MODIFICATION DESIRED

Perform attached procedure for sensor cable measurements.

CAUSE OF MALFUNCTION (IF KNOWN)

ORIGINATOR'S EMP. NO.
06175

J. Brumma
ORIGINATOR'S SIGNATURE

9/21/80
DATE

SUPERVISOR'S EMP. NO.
06175

J. Brumma
SUPERVISOR'S SIGNATURE

9/21/80
DATE

DOE/ESIG Project Account #118

WORK ORDER NUMBER		GC CODE	ACCOUNT NUMBER	PLANT CONDITION:						NPRD FAILURE			START	
LOCATION	SERIAL			SU	OP	MO	CO	RF	MS	LR	YR	MO	DAY	HR
036002	012174A		7876019	1	1	1	1	1	1					

REG AGENCY CODE	CHG/MOD NUMBER
0000	

ENV CODE	OUTAGE CAUSE CODE
X	

STATUS HOLD CODE

COMMENCE DATE
092280

RESP LOCATION OR CONTRACTOR
2036M

Location: Cable Room, 305' elev. Control Building

Comply with the Provisions set forth in AP 1002 and Met Ed Safety Manual

Limits and Precautions:

- a) Personnel
- b) Equipment
- c) Environment
- d) Nuclear

INSURE WORK AREA CLEANED

Post Maintenance Testing required and Acceptance Criteria. UP AT COMPLETION OF JOB

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

COPY 1

**JOB TICKET (WORK REQUEST)
REVIEW - CLASSIFICATION - ROUTING CONTROL FORM**

JOB TICKET NUMBER 05711

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 9/22/80

11. Maintenance Foreman Assigned: [Signature]

12. Code Inspector Notified. Name: _____

Date _____

13. Shift Foreman's approval to commence work: [Signature]

Date 9/23/80

_____ Initial if Shift Foreman signature is not required.

WORK REQUEST PROCEDURE
TMI Nuclear Station
Maintenance Procedure Format and Approval

B-3

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 YM-AMP-7025
Steam Generator B Upper Tube Sheet Vibration/Loose Parts Sensor

2. Purpose: To determine signal characteristics on this instrument string prior to removal.

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

YM-AMP-7025

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 9/22/80

Engineering Review *[Signature]* Date 9/24/80

• 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.

 Technology for Energy Corporation	TITLE IN-SITU MEASUREMENTS OF CABLES AND SIGNALS FROM LOOSE PARTS MONITOR CHARGE CONVERTER YM-AMP-7025	NO. TP-10G
	APPROVED	REV. 1
PROCEDURE	M.V. Mathis, Director, Tech. Serv. Div.	DATE 9/18/80

PURPOSE: The purpose of these measurements is to gather baseline data and information in preparation for removal of Loose Parts Monitor Charge Converter YM-AMP-7025 from the Reactor Building TMI Unit 2. The tests specified in this procedure are designed to assess the condition of the in-containment instrument module (accelerometer, charge converter), 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).

YM-AMP-7025 - Steam Generator B Upper Tube Sheet

PROCEDURE (ADMINISTRATIVE):

A. Limitations and Precautions

1. Nuclear Safety. Loose Parts Monitor Charge Converter YM-AMP-7025, located at elevation 347', is part of the overall Loose Parts Surveillance System. ~~The unit is a part of the pending reactor shutdown system and is not test safety related.~~
2. Environmental Safety. Loose Parts Monitor Charge Converter YM-AMP-7025 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 by inserting test signals on appropriate conductors of Cable IT3593I.

TEC

TITLE

IN-SITU MEASUREMENTS OF CABLES AND SIGNALS
FROM LOOSE PARTS MONITOR CHARGE CONVERTER
YM-AMP- 7025NO.
TP- 106

REV. 1

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	---

B. Prerequisites

1. The Shift Supervisor/Shift Foreman shall be notified for concurrence prior to the performance of those measurements, ~~use work requires~~
~~spoke drive from 2115 02273~~
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. Endevco Dwg. No. AE-E0401, Specifications for Model 2652M4 Charge Converter YM-AMP- 7025 (Sheet 3 of 3).
2. Specification Manual for Endevco Model 2276 Accelerometer.
3. Burns & Roe Dwg. 3024, Sh. 105.
4. Burns & Roe Dwg. 3343, Sh. 2.
5. Burns & Roe Dwg. 3045, Sh. 17.
6. Burns & Roe Dwg. 3314, Rev. 8.

TEC

TITLE

IN-SITU MEASUREMENTS OF CABLES AND SIGNALS
FROM LOOSE PARTS MONITOR CHARGE CONVERTER
YM-AMP- 7025

NO.

TP-106

REV.

1

7. Burns & Roe Dwg. 3174, Sh. 7.
8. Burns & Roe Dwg. 3045, Sh. 17.
9. Instruction Manual, Tektronix model 1502 TDR.
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-25 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, YM-AMP-7025 (see attachment).

STEPS

1. Notify Shift Supervisor/Shift Foreman of start of test on YM-AMP-7025.
2. Remove all power from YM-AMP-7025 (Channel 8).
3. Remove cable IT3598I (Channel 8 in cabinet 216).
4. Using the Hewlett-Packard Model 4274 (or equivalent) Impedance Bridge measure the capacitance and impedance at the following test point.

TEST POINT *	FROM	TO
a.	Cable IT3598I (Center Conductor)	Cable IT3598I (Shield)

* Test Connection in Cabinet 216.

TEC

TITLE

IN-SITU MEASUREMENTS OF CABLES AND SIGNALS
FROM LOOSE PARTS MONITOR CHARGE CONVERTER
YM-AMP- 7025

NO.
TP-106

REV. 1

Record the data required below:

TEST POINT	CAPACITANCE			IMPEDANCE		
	100 Hz	1 kHz	100 kHz	100 Hz	1 kHz	100 kHz
a. Cable IT 3598I Center Conduct- or to shield	20 nf	16.4 nf	-228 nf	7.1 K/ -7°	5.87 / -36°	9.11 / 132°

5. Using the Tektronix Model 1502 (or equivalent TDR unit) perform TDR measurements on the test point given in Step 4.

Record the data below:

Test Point	High R @ N ft.	Low R @ N ft.	Instrument Settings	Strip Chart Number
			Ampl Range Mult	
a. Cable IT3598I. Center Conductor to Shield				106-1

6. Using the Keithley Model 177 (or equivalent DMM) perform resistance measurements on the test points specified and record values in the space provided.

TEC

TITLE

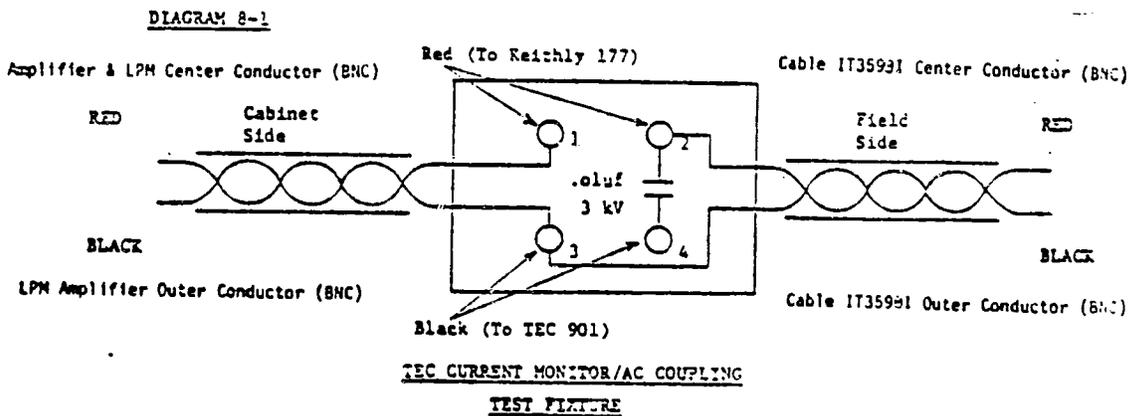
IN-SITU MEASUREMENTS OF CABLES AND SIGNALS FROM LOOSE PARTS MONITOR CHARGE CONVERTER YM-AMP-7025

NO.
TP-105

REV. 1

TEST POINT	FROM LINK	TO LINK	201K RANGE	200K RANGE
			POLARITY From = +; To = -	POLARITY From = -; To = +
			RESISTANCE	RESISTANCE
a.	Center Conductor (+)	Shield (-)	1.2K	34.2K

7. Connect the TEC Current Monitor/AC Coupling Test Fixture between LPM amplifier and Cable IT3598I per the following diagram:



NOTE: This circuit provides additional access to signals and charge converter current

- 1) Series connection of an ammeter by connecting a BNC with plugs 1 (signal of BNC connector)* and 2 (ground of BNC connector).*
- 2) Access to the signal through a decoupling capacitor is provided by a BNC connecting plugs 4 (signal of BNC) and 3 (ground of BNC).*

* Connections provide for proper polarity.

TEC

TITLE

IN-SITU MEASUREMENTS OF CABLES AND SIGNALS
FROM LOOSE PARTS MONITOR CHARGE CONVERTER
YM-AMP-7025NO.
TP-106

REV. 1

8. Connect a Kiethly Model 177 DMM (or equivalent) in series with center conductor of IT359 I (BNC) by connecting across plugs 1 and 2 (the two red plugs) of the TEC Current Monitor/AC Coupling Test Fixture.
9. Connect a TEC 901 Isolation Amplifier with a BNC to Banana plugs 3 (ground) and 4 (signal) (the two black plugs) of the TEC Current Monitor/AC Coupling Test Fixture.
10. Connect an FM Recorder to the output of the 901 Amplifier (the TEC 901 operating in differential mode) and start the recorder.

NOTE: Recording will continue through Step 17.

11. Apply power to YM-AMP-7025 Channel 8 and verify operation through normal instrumentation procedures.
12. Using the Kiethly Model 177 DMM (or equivalent; Precision = $\pm 1\%$) measure the current at the signal test point.

<u>SIGNAL</u>	<u>Cabinet 216</u>	<u>TEST LEAD</u>	<u>SCALE</u>	<u>READING</u>
a.	TEC Current/ Monitor Plug-1 Plug-2	(+) (-)	2ma	.58ma

Q. T. S. Li 9/23/80
Signature/Date

13. Using the Kiethly Model 177 DMM (or equivalent; $Z; \geq 10^7$ OHMS, Range 0-2000V, Precision = $\pm 1\%$) measure the DC Voltage at the signal test point.

<u>SIGNAL</u>	<u>CABINET 216</u>	<u>TEST LEAD</u>	<u>SCALE</u>	<u>READING</u>
a.	TEC Current/ Monitor Plug-1 Plug-3	(+) (-)	200V	34.7V

TEC

TITLE

IN-SITU MEASUREMENTS OF CABLES AND SIGNALS
FROM LOOSE PARTS MONITOR CHARGE CONVERTER
YM-AMP-7025NO.
TP-106

REV. 1

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

<u>SIGNAL</u>	<u>CABINET</u> 216	<u>PARAMETER</u>			
a.	TEC Current/ Monitor Plug-4 Plug-3	SIG Shield	Photo <u>106-1</u> Time Base <u>5ms</u> Vert Gain <u>2MV</u>	Photo <u>106-2</u> Time Base <u>5ms</u> Vert Gain <u>1MV</u>	Photo _____ Time Base _____ Vert Gain _____

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.

J. T. S. N. 9/28/50
Signature/Date

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

<u>SIGNAL</u>	<u>CABINET</u> 216	<u>PARAMETER</u>	<u>PHOTO #</u>
a.	TEC Current/ Monitor Plug-4 Plug-3	SIG SHIELD	<u>106-3</u>

Before photographing each scope presentation 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.

TEC	TITLE	IN-SITU MEASUREMENTS OF CABLES AND SIGNALS FROM LOOSE PARTS MONITOR CHARGE CONVERTER YM-AMP-7025	NO.	TP-106
			REV.	1

<u>SPECTRUM IDENT</u>	<u>FREQUENCY</u>	<u>AMPLITUDE</u>	<u>REMARKS</u>		
<u>BANDWIDTH</u>	<u>SCAN WIDTH</u>	<u>INPUT P-TEN</u>	<u>Scan time</u>	<u>10 dB/Hz</u>	<u>Linear</u>
3 KHz	1 MHz/10IN	0	1 Sec	-20dB	SENS
					φ

[Signature] 9/23/80
Signature/Date

16. Using the Nicolet Model 444 FFT Analyzer (or equivalent) perform FFT analysis of signals from the signal test point:

<u>SIGNAL</u>	<u>CABINET</u>	<u>PARAMETER</u>	<u>PHOTO #</u> <u>OR PLOT</u>
*a.	216		
	TEC Current/ Monitor Plug-4 Plug-3	SIG Shield	106-4 106-5

100K SCALE
1K SCALE

If PSD plots from the signal show high or unusual amplitudes, utilize the zoom feature to provide finer resolution and obtain PSD data in the frequency band of interest.

[Signature] 9/23/80
Signature/Date

- 17. Continue recording the output signal from YM-AMP-7025 for a period of 10 additional minutes. Remove amplifier and FM Recorder when complete.
- 18. Remove all power from YM-AMP-7025 (same procedure as Step 2).

TEC

TITLE

IN-SITU MEASUREMENTS OF CABLES AND SIGNALS
FROM LOOSE PARTS MONITOR CHARGE CONVERTER
YM-AMP-7025NO.
TP-106

REV. 1

19. Remove the TEC Current Monitor/AC Coupling Text Fixture.

20. Notify the Shift Supervisor/Shift Foreman of the conclusion of testing on YM-AMP-7025.

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

J. T. S. A. 9/23/80
Signature/Date

Instrumentation

T. R. Gilbert 9-23-80
Signature/Date

APPENDIX C

ORIGINAL FIELD PROCEDURES AND
DATA SHEETS FOR YM-AMP-7025
AFTER PREAMPLIFIER REPLACEMENT

B-16

**GENERATION CORRECTIVE MAINTENANCE SYSTEM
CM STATUS ACTIVITY FORM**

C-2

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
V	M	H	M	P	7	0	2	3	0	3	0

TXN CD	ACT
1	4
8	0
4	A

ECM NUMBER	
47	51

TXN CD	ACT
1	4
8	0
5	A

P R T Y	RESP. LOCATION OR CONTRACTOR	P R T Y	ASSISTING CONTRACTOR	P R T Y	ASSISTING CONTRACTOR
66	67	71			
	2036N				

TXN CD	ACT
1	4
8	0
7	A

PURCHASE REQUISITION NUMBER	PURCHASE ORDER NUMBER
59	66 67 73

TXN	ACT
1	4
8	1
0	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	

- 0 1 OUTAGE HOLD
- 0 2 PART HOLD
- 0 3 QUALITY CONTROL PART HOLD
- 0 4 QUALITY CONTROL PROCEDURE HOLD
- 0 5 OPERATIONS HOLD
- 0 6 CHANGE MODIFICATION HOLD
- 0 7 ENGINEERING HOLD
- 0 8 PLANNING HOLD
- 5 0 MANPOWER NOT AVAILABLE
- 5 1 AT PORC
- 5 2 AT QUALITY CONTROL
- 5 3 AT UNIT SUPERINTENDENT
- 5 4 AT READING
- 5 5 POST MAINTENANCE TEST HOLD
- 5 6 AT A I I A

	TITLE IN-SITU MEASUREMENTS OF CABLES AND SIGNALS FROM LOOSE PARTS MONITOR CHARGE CONVERTER YM-AMP-7023	NO. TP-107
		REV. 1
Technology for Energy Corporation	APPROVED	DATE
PROCEDURE	M.V. Mathis, Director, Tech. Serv. Div.	9/18/80

PURPOSE: The purpose of these measurements is to gather baseline data and information in preparation for removal of Loose Parts Monitor Charge Converter YM-AMP-7023 from the Reactor Building TMI Unit 2. The tests specified in this procedure are designed to assess the condition of the in-containment instrument module (accelerometer, charge converter), 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).

YM-AMP-7023 - Steam Generator B Upper Tube Sheet

PROCEDURE (ADMINISTRATIVE):

A. Limitations and Precautions

1. Nuclear Safety. Loose Parts Monitor Charge Converter YM-AMP-7023, located at elevation 347', is part of the overall Loose Parts Surveillance System. ~~The unit is a part of the reactor safety system and its removal or damage would be a safety hazard.~~
2. Environmental Safety. Loose Parts Monitor Charge Converter YM-AMP-7023 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 by inserting test signals on appropriate conductors of Cable IT35921.

TITLE IN-SITU MEASUREMENTS OF CABLES AND SIGNALS
FROM LOOSE PARTS MONITOR CHARGE CONVERTER
YM-AMP-7023

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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	---

B. Prerequisites

1. The Shift Supervisor/Shift Foreman shall be notified for concurrence prior to the performance of those measurements. ~~use of request procedure 250711-111-214-72~~
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. Endevco Dwg. No. AE-E0401, Specifications for Model 2652M4 Charge Converter YM-AMP-7023 (Sheet 3 of 3).
2. Specification Manual for Endevco Model 2276 Accelerometer.
3. Burns & Roe Dwg. 3024, Sh. 105.
4. Burns & Roe Dwg. 3343, Sh. 2.
5. Burns & Roe Dwg. 3045, Sh. 17.
6. Burns & Roe Dwg. 3314, Rev. 8.

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7. Burns & Roe Dwg. 3174, Sh. 7.
8. Burns & Roe Dwg. 3045, Sh. 17.
9. Instruction Manual, Tektronix model 1502 TDR.
10. Instruction Manual, Hewlett Packard Model 4274 Multifrequency LCR Meter.
11. Instruction Manual, Hewlett Packard Spectrum Analyzer (Model 141T, 85533, 85528 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, YM-AMP-7023 (see attachment).

STEPS

1. Notify Shift Supervisor/Shift Foreman of start of test on YM-AMP-7025.
2. Remove all power from YM-AMP-7025 (Channel ⁸ ~~8~~).
3. Remove cable IT3598I (Channel ⁸ ~~8~~) in cabinet 216.
4. Using the Hewlett-Packard Model 4274 (or equivalent) Impedance Bridge measure the capacitance and impedance at the following test point..

TEST POINT *	FROM	TO
a.	Cable IT3598I ⁹²⁷ (Center Conductor)	Cable IT3598I (Shield)

* Test Connection in Cabinet 216.

TITLE

 IN-SITU MEASUREMENTS OF CABLES AND SIGNALS
 FROM LOOSE PARTS MONITOR CHARGE CONVERTER
 YM-AMP-7023

REV. 1

Record the data required below:

TEST POINT	CAPACITANCE			IMPEDANCE		
	100 Hz	1 kHz	100 kHz	100 Hz	1 kHz	100 kHz
a. Cable IT 3598I Center Conduct- or to shield	22 nF	16.5 nF	209 nF	10.4 k Ω $\theta = -8.5^\circ$	7.15 k Ω -47.8°	9.2 Ω 125.4°

5. Using the Tektronix Model 1502 (or equivalent TDR unit) perform TDR measurements on the test point given in Step 4.

Record the data below:

Test Point	High R @ N ft.	Low R @ N ft.	Instrument Settings	Strip Chart Number
			Ampl Range Mult	
a. Cable IT3598I Center Conductor to Shield			100 ft/div 500 mV/div	107-51

6. Using the Keithley Model 177 (or equivalent DMM) perform resistance measurements on the test points specified and record values in the space provided.

TITLE

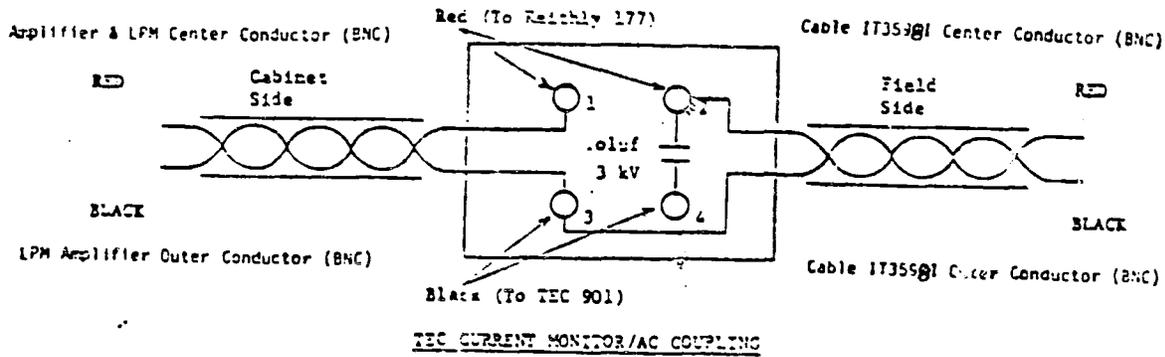
IN-SITU MEASUREMENTS OF CABLES AND SIGNALS FROM LOGIC PARTS MONITOR CHARGE CONVERTER YM-AMP-7023

REV. 1

TEST POINT	FROM LINK	TO LINK	20K RANGE	200K RANGE
			POLARITY From = +; To = -	POLARITY From = -; To = +
			RESISTANCE	RESISTANCE
a.	Center Conductor (+)	Shield (-)	10.8 kΩ	37.8 kΩ

7. Connect the TEC Current Monitor/AC Coupling Test Fixture between LPM amplifier and Cable IT3592I per the following diagram:

DIAGRAM B-1



NOTE: This circuit provides additional access to signals and charge converter current

- 1) Series connection of an ammeter by connecting a BNC with plugs 1 (signal of BNC connector)* and 2 (ground of BNC connector).*
- 2) Access to the signal through a decoupling capacitor is provided by a BNC connecting plugs 4 (signal of BNC) and 3 (ground of BNC).*

* Connections provide for proper polarity.

TABLE

TITLE

IN-SITU MEASUREMENTS OF CABLES AND SIGNALS FROM LOOSE PARTS MONITOR CHARGE CONVERTER YM-AMP-7023

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8. Connect a Kiethly Model 177 DMM (or equivalent) in series with center conductor of IT3598I (BNC) by connecting across plugs 1 and 2 (the two red plugs) of the TEC Current Monitor/AC Coupling Test Fixture.
9. Connect a TEC 901 Isolation Amplifier with a BNC to Banana plugs 3 (ground) and 4 (signal) (the two black plugs) of the TEC Current Monitor/AC Coupling Test Fixture.
10. Connect an FM Recorder to the output of the 901 Amplifier (the TEC 901 operating in differential mode) and start the recorder.

NOTE: Recording will continue through Step 17.

11. Apply power to YM-AMP-7023 (Channel B) and verify operation through normal instrumentation procedures. *Note: system was originally in powered state due to replacement of J.E. Jones pre-amp.*
12. Using the Kiethly Model 177 DMM (or equivalent; Precision = $\pm 1\%$) measure the current at the signal test point.

SIGNAL	Cabinet 216	TEST LEAD	SCALE	READING
a.	TEC Current/Monitor Plug-1 Plug-2	(+) (-)	20 mA	1.72 ma

* Note:
3.5 V
Recorded Across
2k Ω Resist.
@ Amp.
Source.

* CURRENT READINGS POWER ON \approx 12 MIN
AND VOLTAGE
J.E. Jones 10/30/80
Signature/Date

13. Using the Kiethly Model 177 DMM (or equivalent; $Z_i \geq 10^7$ OHMS, Range 0-2000V, Precision = $\pm 1\%$) measure the DC Voltage at the signal test point.

SIGNAL	CABINET 216	TEST LEAD	SCALE	READING
a.	TEC Current/Monitor Plug-1 Plug-3	(+) (-)	200 V	35.3 V

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

<u>SIGNAL</u>	<u>CABINET 216</u>	<u>PARAMETER</u>			
a.	TEC Current/ Monitor Plug-4 Plut-3	SIG Shield	Photo <u>107-52</u> Time Base <u>5μsec</u> Vert Gain <u>1mV</u>	Photo <u>107-53</u> Time Base <u>2msec</u> Vert Gain <u>1mV</u>	Photo _____ Time Base _____ Vert Gain _____

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.

 10/30/80
Signature/Date

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

<u>SIGNAL</u>	<u>CABINET 216</u>	<u>PARAMETER</u>	<u>PHOTO #</u>
a.	TEC Current/ Monitor Plug-4 Plug-3	SIG SHIELD	<u>107-54</u>

Before photographing each scope presentation 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.

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--	---	---------------

<u>SPECTRUM IDENT</u>	<u>FREQUENCY</u>	<u>AMPLITUDE</u>	<u>REMARKS</u>
BANDWIDTH	SCAN WIDTH	INPUT ATTEN	SCAN TIME
.5 MHz/div	3 kHz	0	1 sec/div
			Local Ref 10 db LOG -10

note: Gain = 20 from 901 Amps
J.E. Jones

J.E. Jones 10/30/80
 Signature/Date

16. Using the Nicolet Model 444 FFT Analyzer (or equivalent) perform FFT analysis of signals from the signal test point:

<u>SIGNAL</u>	CABINET 216	<u>PARAMETER</u>	PHOTO # OR PLOT
*a.	TEC Current/ Monitor Plug-4 Plug-3	SIG Shield	107-55

note: Gain = 20 from 901 amps
J.E. Jones

If PSD plots from the signal show high or unusual amplitudes, utilize the zoom feature to provide finer resolution and obtain PSD data in the frequency band of interest.

J.E. Jones 10/30/80
 Signature/Date

17. Continue recording the output signal from YM-AMP-7023 for a period of 10 additional minutes. Remove amplifier and FM Recorder when complete.

18. Remove all power from YM-AMP-7023 (same procedure as Step 2).

TEC

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- 19. Remove the TEC Current Monitor/AC Coupling Test Fixture.
- 20. Notify the Shift Supervisor/Shift Foreman of the conclusion of testing on YM-AMP-7023.

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

J.E. Jones 10/30/80
Signature/Date

Instrumentation

R. J. [unclear] 10/30/80
Signature/Date

FIELD SERVICE DATA SHEET

PL Name J. Jones

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Page No. 2

DATA SHEET - PLANT: TMI

UNIT 2 RUN 2 DATE 10/30/80
 TIME TAPE ft PWR TAPE 1154
 START _____ 150 _____ SPEED 15 ips
 STOP _____ _____ _____ BAND FM & Direct

ROD POSITION: GROUP _____, _____; GROUP _____, _____; GROUP _____, _____.

BORON (ppm) _____ EFPD _____ CYCLE _____

RECORDER CHANNEL	SIGNAL	AMP	BW	GAIN	VDC
1	<u>LPM</u>	<u>3</u>	<u>500</u>	<u>2x10</u>	_____
2	_____	_____	_____	_____	_____
3	<u>LPM</u>	<u>3</u>	<u>500</u>	<u>2x10</u>	_____
4	_____	_____	_____	_____	_____
5	_____	_____	_____	_____	_____
6	_____	_____	_____	_____	_____
7	_____	_____	_____	_____	_____
8	_____	_____	_____	_____	_____
9	_____	_____	_____	_____	_____
10	_____	_____	_____	_____	_____
11	_____	_____	_____	_____	_____
12	_____	_____	_____	_____	_____
13	_____	_____	_____	_____	_____
14	_____	_____	_____	_____	_____

Serious Problems with recorder?

COMMENTS:

230' start 60 IPS → 1350'
470' - 525' operator "touched" channel 3!
1350' - 1450' attempted restart ⇒ ch 3 not working!
1450' - 1500' all 4 channels recorded

1520' - 1620'
G = 5x20
1620' - end
G = 5x20

FIELD SERVICE DATA SHEET

PL Name [Signature]

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Page No. 1

DATA SHEET - PLANT: TMI

UNIT 2 RUN 1 DATE 10/30/60
 TIME TAPE ft PWR TAPE 1154
 START 12:55 30 --- SPEED 15 ips
 STOP 1:11 120 --- BAND File Direct

ROD POSITION: GROUP ---, ---; GROUP ---, ---; GROUP ---, ---.

BORON (ppm) --- EFPD --- CYCLE ---

RECORDER CHANNEL	SIGNAL	AMP	BW	GAIN	VDC
1	<u>CALIBRATION *</u>	<u>1</u>	<u>50K$\frac{1}{2}$</u>	<u>1</u>	<u>---</u>
2	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>
3	<u>CALIBRATION *</u>	<u>2</u>	<u>50K$\frac{1}{2}$</u>	<u>1</u>	<u>---</u>
4	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>
5	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>
6	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>
7	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>
8	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>
9	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>
10	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>
11	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>
12	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>
13	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>
14	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>	<u>---</u>

COMMENTS:

* 1000 Hz @ 1.0 V P-P
 Chnl 3 - Intermittent problem (Direct)
 Chnl 1 - OK