TASK CLOSE OUT DOCUMENT

Task Scope Instrument Design Review
Compilation of Draft Summary
Reports

To: M. Levenson
S. Levy
E. Zebroski

Task No. 11-4 Date Complete 4/19/82

Reason felt task is complete:
Reported

Members of Committee
D. C. Rahn II
E. Zebroski

M. J. Levenson
Signed
Committee Leader

TO: SIG DISTRIBUTION

April 14, 1979

Attached is a complete compilation of the shift result summaries of the reactor diagnostics by noise analysis covering the period April 8, 1979 through April 12, 1979.

These activities have been reduced in scope to just a routine continuous monitoring with a fast-respond capability if any unexpected system changes occur. No further shift report will be prepared, but if any system changes occur a special summary report will be issued.

Norbert J. Ackermann, Jr.
SIG Coordinator

NA:ms

Via Stello, NRC 4/5/79

N. J. Abercrombie Jr.

Noise Analysis Monitoring at TMI-2

Objectives:

1. To assist in monitoring the status of the reactor system, particularly during transient conditions to give supplementary and complimentary information relative to that in control room
2. To monitor the integrity of various process and special signal channels by signature analysis and trending analysis to give early warning of instrumentation failure and failure mode;
3. To provide secondary monitoring capability in case of failure of primary capability.

Procedure:

1. Provide continuous strip chart recordings of particular signal channels to allow visual correlation among channels and to provide time series trending capability;

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2. Perform spectral analysis on selected signal channels periodically to perform signature analysis and trend analysis

Signal Channels Monitored:

From Patch Panel	Patch Panel #
1. RC Pressure Loop A	24
2. RC Pressure Loop B	25
3. Pressurizer Level (uncompensated)	23
4. Pressurizer Level (compensated)	22
5. Temperature Loop A	31
6. Make-Up Tank Level	96
7. Main Steam Pressure A	58
8. Main Steam Pressure B	59
9. OTSG Level A	49
10. OTSG Level B	51
11. Flow Loop A	

From Signal Cabinets

1. Loose Parts Monitor channels 1-10
2. Incore Thermocouple Channels
3. Incore Flux Detectors
4. Pressurizer Temperature

4/4/79

G. L. Zyler

Noise Analysis Status

6:30 AM, 05/04/79

1. Loose Parts Monitoring:

a. No indication of metallic impacts

b. Sensor # 3, Upper Reactor Vessel A, is showing symptoms of advanced degradation.

c. Sensor # 4, Upper Reactor Vessel B, appears to occasionally exhibit symptoms of degradation.

2. Sensor Performance Degradation:

The following ~~~~ plant parameters are being trended by Spectral Analysis every two hours:

	Path #
OTSG B Pressure, Steam	113
OTSG A Pressure, Steam	112
RCS Pressure A Loop, Wide Range	29
RCS Pressure B Loop, Wide Range	25
OTSG "A" Level Operating Range	99
OTSG "B" Level Operating Range	51
OTSG A Downcomer Temp	53

Every ½ hour, Pressurizer Level 2 spectra is obtained for comparison with

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3. RCS Pressure Fluctuations.

a. RCS Wide Range Pressure A exhibits occasional [7 events] between 2130 hrs and 0630 hrs] small step changes indicative of potential sensor degradation. The number of these step changes has increased in the last 10 hours. These step changes are uncorrelated with other plant parameters.

b. The pressure noise amplitude continues at the same, typical peak-to-peak values as during the previous 96 hours.

4. In-Core Thermocouple Measurements

Reference attached ORNL report.

5. Administrative:

a. Procedure "In-core Instrumentation, Self Powered Neutron Detector Noise Analysis Procedure 2-44 Rev 3.

b. Introduced for coordination by GPU/MetEd "Ex-Core Detector Noise Analysis & Measurements" procedure.

6. Plans:

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a. Loose Parts Monitoring, Sensor Performance Degradation and RCS Pressure Fluctuation monitoring

b. ORNL to perform noise analysis on in-core self-powered neutron detectors per procedure Z-44 rev 1

c. Ex-core ion chamber noise analysis to be performed starting @ 2100 hrs, 05/09/79.

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4/4/79
N J Ackerman

Summary of Findings for 4/4/79

1. A loop & B loop pressure excursions at ~1815 hrs on 4/3 were correlated in time at <u>initiation</u> with each other & with LPM channels 1, 4, 7 & 7 per B&W strip chart recording. No correlation in other channels with termination of the 2 pressure excursions ??

2. TMI Operators have begun cycling pressure & pressurizer level again giving appreciable slow transients.

3. Investigators are looking at incore self powered detectors & find a few still working & suspect they are [illegible] [illegible] [illegible].

POOR ORIGINAL

4. [illegible] hooked up the pressurizer Temp. (dual element RTD at 305 [illegible] with us looking at RC2-TT2 side). The strip chart reading of 540°F corresponds to [illegible] computer reading [illegible] calibrated properly as shown.

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5. [illegible] Mott, [illegible] & [illegible] [illegible] pressurizer RTD [illegible] could be used as single point level indicator in pressurizer

(2)

4/4/79
w. JA Freiburg

by cycling level so sensor sees liquid then fluid, etc. Self heating test would show dramatic resistance change from change in cooling medium. Need very good constant current source (≈ 20-30 ma) and access directly to RTD bridge. In setting up call Robbie for info support (home # 615-693-5-2..

6. TC noise should focus on incore boiling detection and on pre-TC cross-correlation.

. No change in level #2 & level #3 signals ~~today~~ (lots of switching noise so don't get caught with it).

8. LPM quiet all day.

POOR ORIGINAL

9. JCP wants to know:
   1. current thru RTD for given °reading
   2. Indicated Temp Reading
   need for determining S/N in self heating test.

* 10. Call Newman & Bell at 301-493-2..
   at 2000 hrs!

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11. Watch pressurizer Temp if we get any more long steps in A or B loop pressure -

4/4/79

NJA Findings

12. Contents taken Level 2 PSI's every 30 min and Level 3 PSI's every 1 hour.

13. Plan out a long-term surveillance & diagnostic support to monitor long-term cool down until external source attempt to route natural circulation with maximum overview in case of further trouble.

cc: Fay.
Kuyter
Mays
Zigler

Babcock & Wilcox

09/07/79 G.L. Ziegler

0630 hrs Noise Analysis Summary

RCP 1A Evolution:

No significant events were detected by the Loose Parts Monitor during the R.C.P 1A trip and startup of RCP 2A. The RCS pressure fluctuations for A Loop increased by a factor of approximately 2 whereas the Loop B fluctuations increased by a factor of 1.7. In-core thermocouple noise measurements in progress exhibited no significantly obvious changes.

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RCS Pressure Evolution:

At approximately 23:25 hrs of 09/06/79 the RCS pressure reached a low of approximately 850 psi. The Pressure oscillations for Loop A decreased to a minimum of a factor

of 2 hours before returning to its original values after the RCS pressure increased past 900 psia. The pressure fluctuations decreased by a factor of 5 on the RCS Loop B signals prior to returning to its original value.

Incore Detectors:

Resistance and capacitance measurements using spectral analysis techniques were obtained for three incore neutron detector strings. These measurements will be used by incore analysts to evaluate the incore readings obtained by standard techniques in light of the uncertainty introduced by the "battery" effect.

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Saxon Degradation Monitoring

No significant changes were observed during the last 24 hours.

4/5/79

Shift: 7:00 AM to 7:00 PM

By: J C Robinson

Subject: Significant observations & occurances.

When taking over from Bigler, the operators were attempting to level out pressure at 550 psia. At 550 psia, the behavior of Pressure noise signals were:

A loop: At First reaching lower pressure, the noise reduced from ~50psia to ~25 psia.

B loop: The noise decreased from ~15psia to <5psia.

As the pressure was vented, the pressure noise signals began to increase back to ~~noise~~ original values prior to reducing pressure. The [illegible] of the B loop pressure always lead the A loop.

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When this pressure was reprotected at 500 psi, the A loop noise signal returned to ~40psi (instead of 50 as had been observed on all previous pressure

levels) and the B loop increased to ~20psi noise (becoming more symmetric than in times past).

After degaussing was complete at 500 psi, the operators went into a "spraying" (i.e. pressurizer) mode of operation for ~1 hr. at const pressure. This was followed by opening vent valves for ≥ 30 min. During this mode, the noise level on the A loop pressure signal slowly decreased (over ~40 min) to the level it reached on ~~Tape~~ reducing pressure. The B loop pressure didn't change during this time (remained about 20 psi p-p). When the valves were closed, the A loop pres. noise slowly returned to its' ~40 psi p-p amplitude at 500 psi. When the pressure signals were increased, the noise level of the A loop returned to its' ~5 psi p-p and the B loop went

back to its' ~12psi pp steam pressure fluctuation

The temperature profiles (in core) looked reasonably stable throughout the day. I could see no significant change in the results at 500psi and 750 psi.

B&W personnel ran spectra on the A&B loop pressure signals. Did not see the pump turning speed (~ 16.4Hz), but did see strong resonances in the 6.4 → 6.8 Hz range in A & B loops (plus their harmonics).

G.L. Zigler

Noise Monitoring Summary

Time: 0615 hrs Period: 1900 hrs – 0700 hrs Date: 8/9/01

Loose Parts Monitoring:

No unusual noises indicative of metal-to-metal impact were detected. Noises encountered were anticipated for the condition of the plant.

Sensor Performance Monitoring:

No significant deviations from baseline signatures were detected for the plant parameters and/or sensors monitored.

RCS Pressure Fluctuations:

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In accordance with SOP Z57, Tier 1, the RCS primary system pressure was reduced from 700 psig to 400 psig. RCS pressure fluctuation for A loop followed expected behaviours for pressure reductions and venting. On return to 500 psig, A loop peak-to-peak amplitude was estimated to be approximately

the same as on the way down, i.e., ~40 psig peak-to-peak. B Loop pressure fluctuations exhibited an increase to ~~18~~ a typical 18 psig peak-to-peak amplitude, up from a typical 7 psig peak-to-peak prior to this last evolution. The increase in the B loop pressure fluctuation is further evidence of "hardening" of the system from a steamed gas point of view.

Other Measurements:

Ex-Core Ion Chambers: Spectral analysis on 5 pairs of detectors were performed. No cross-core correlation was observed. No significant information was identified in the AC component of these signals.

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H-8 Core Location Monitoring: Noise measurements were performed at 450 psig and at 400 psig on the in-core thermocouple at core location H-8. No significant deviations ~~[illegible]~~ from

baseline measurements taken at 600 psig were observed. It should be noted that thermocouple H-8 exhibited less "noise" than [redacted] that other thermocouples exhibiting a [redacted] lower D.C. (i.e., temperature) value.

<u>In-Core Neutron Detectors</u>: Spectral analysis was performed on the three SPNDs at core location 13-C which [redacted] are considered still operable. They are located on levels 1, 3, and 5. No significant information was identified in the AC component of these signals.

J C Robinson

Noise Monitoring Summary

Time 18:40 Period: 0700 → 19:00

4/9/79

Loose Parts Monitoring

Only low level "banging" is being heard which has been heard from the start as monitored by B & W personnel.

RCS Pressure Fluctuations

The system pressure has been held between 900 and 1000 psi throughout the duration of this shift. The noise on the A pressure signal has remained stationary at ~50 psi p-p and that on the B pressure signal has remained stable at about 7 psi p-p. Extensive spectral analysis (attached) has been carried out on these signals but no correlation (at least for frequencies > 1 Hz) [illegible] A loop is driving the B loop. The dominant frequency of the longer [illegible]. We should

continue monitoring the resonant frequency to see if they tend to come together as the gas is removed.

The temperature profiles from the incore ~~detectors~~ thermocouples are remaining stable and continuing to decrease -

Analysis of A & B pressure signals.

For A pressure signal (see Fig 1), we observed a loop resonance at 6.65 Hz and its harmonics. The B pressure signal (see Fig 2) has the same 6.65 Hz (+ harmonics) and other structure. In particular, a resonance (+ harmonics) is present at 8.046 Hz (see Fig 3). We postulated A loop is driving B loop (A loop resonance frequency is 6.65 Hz, B loop resonance frequencies is 8.046 Hz). If so, we should see the sum and difference in these frequencies. The sum (14.7) is shown in Fig 4. The difference (1.41) is shown in Fig 5. This data supports the postulate:

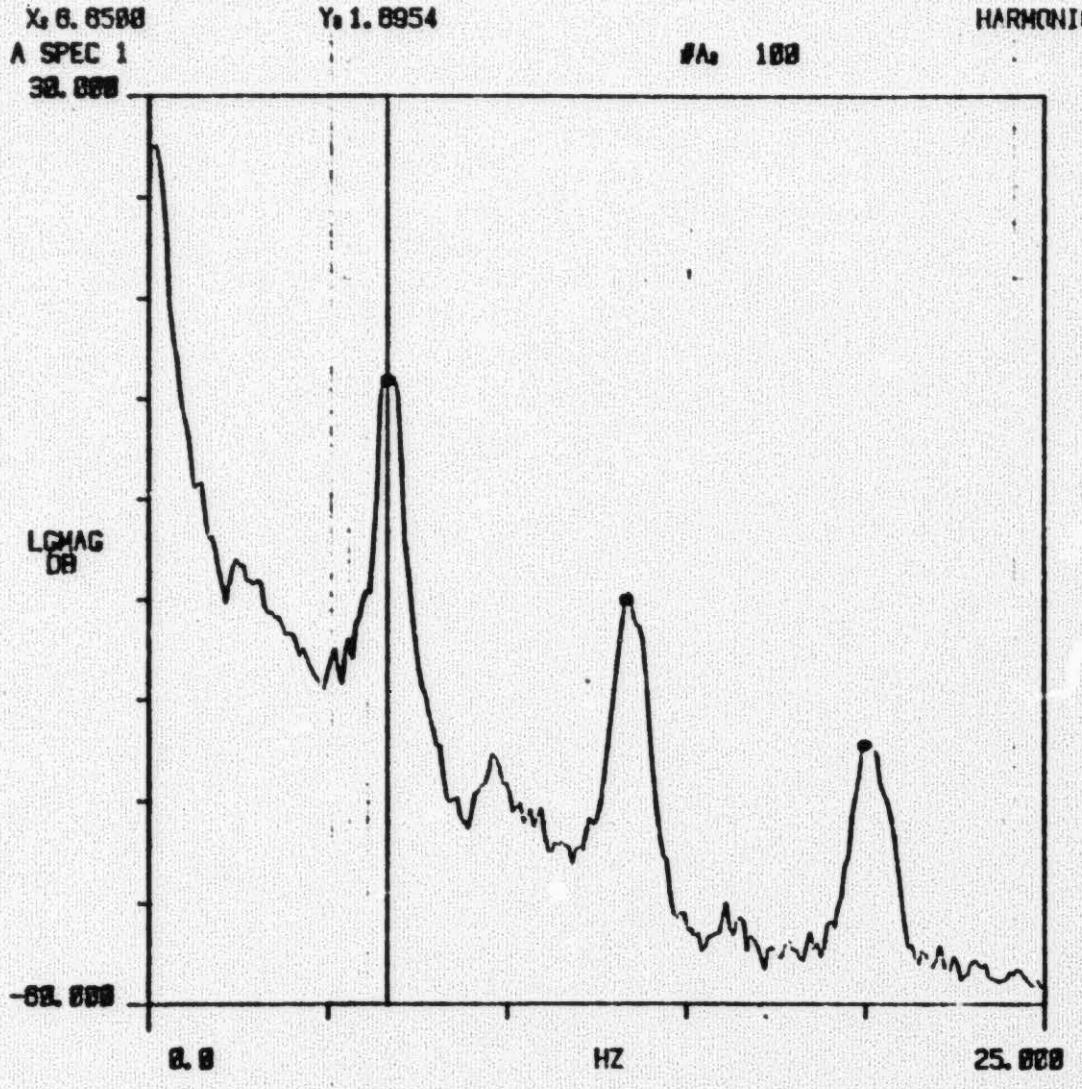
1. A loop has a resonance freq. of 6.65 Hz at these conditions.
2. B loop has a resonance freq. of 8.05 Hz at these conditions.
3. A loop is driving (or is modulating) B loop.

From data B&W ran earlier at lower pressure, we know that the A loop resonance decreased slightly. If B loop resonance were to decrease at a faster rate, then the noise in the B loop in the resonance range* would increase. We will observe this as the pressure is decreased.

QCR & ONF

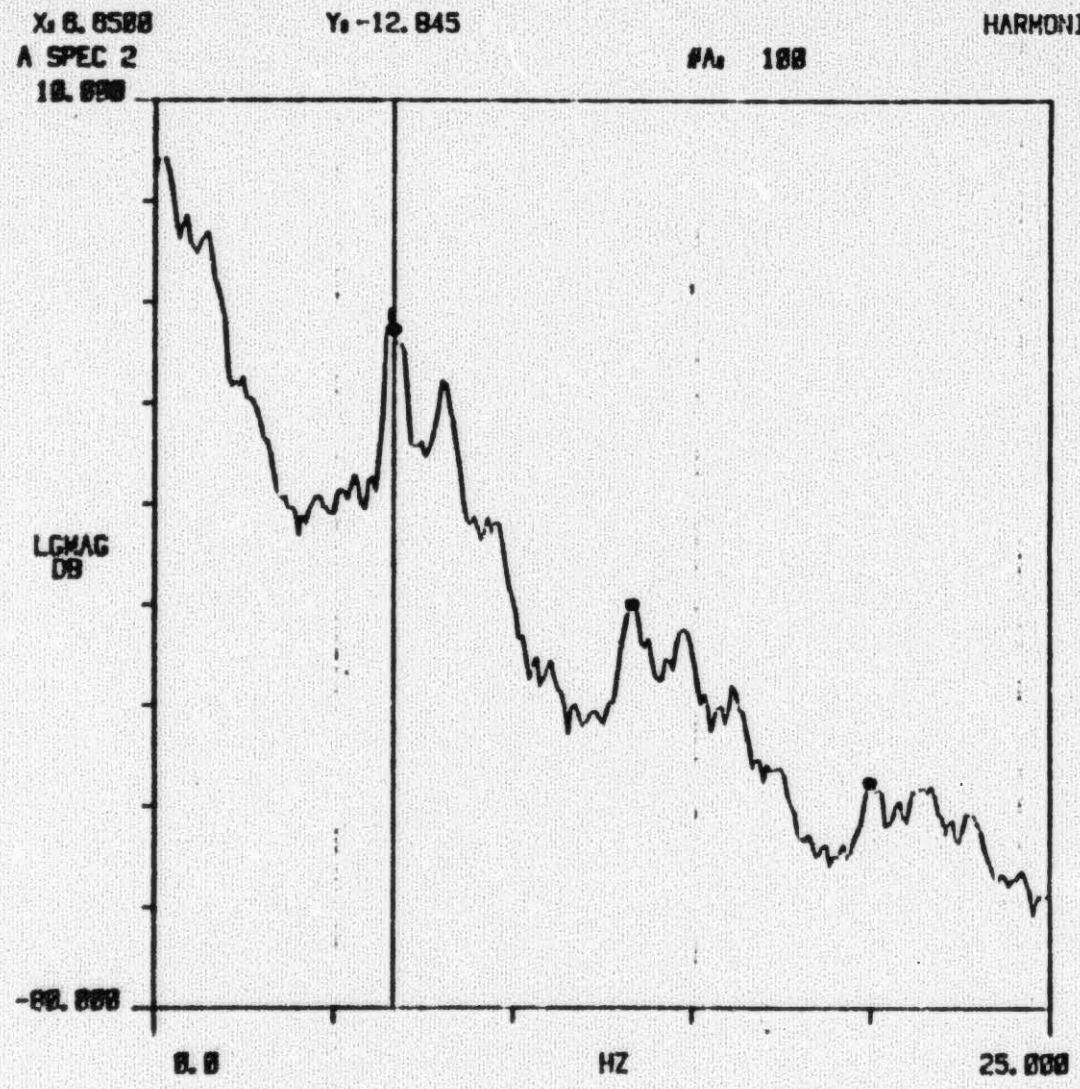
*Since the B loop is driven by the A loop, as the resonances of the two loops come together (in frequency), there will be a more constructive transfer of energy.

~~2004 220~~



RUN 2
TMI A-LOOP PRESS.
16:45 4/9/79
PRESSURE = 950psi
SETUP NO. 2

RUN 2 A Press signal PSD
Fig. 1



RUN 2
TMI B-LOOP PRESS.
16:45 1/9/79
PRESSURE = 950 psi
SETUP NO. 2

RUN 2 B Press signal PSD
Fig. 2

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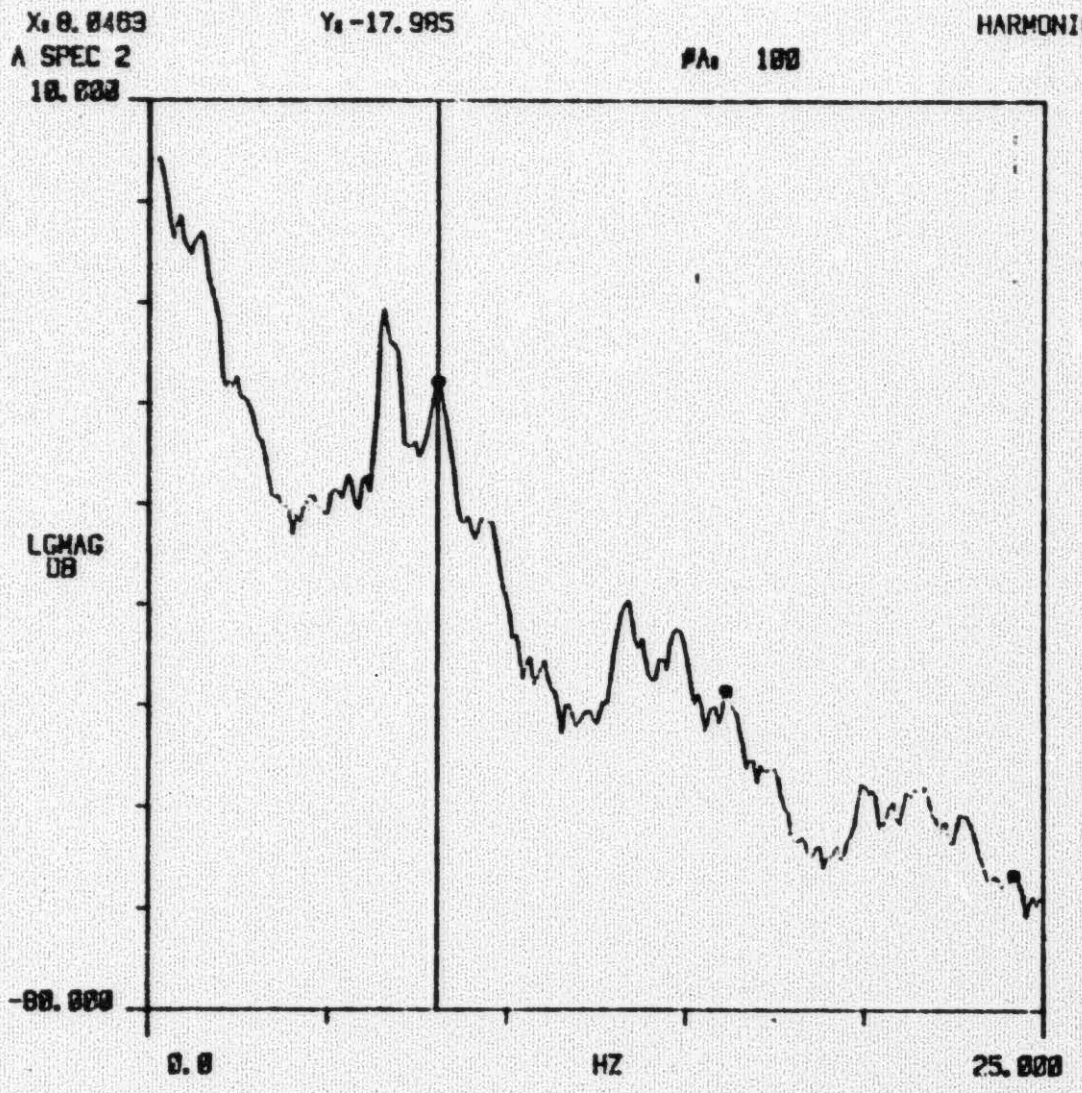

RUN 2

TMI B-LOOP PRESS.

16:45 4/9/79

PRESSURE = 950 psi

SETUP NO. 2

RUN 2

Fig. 3

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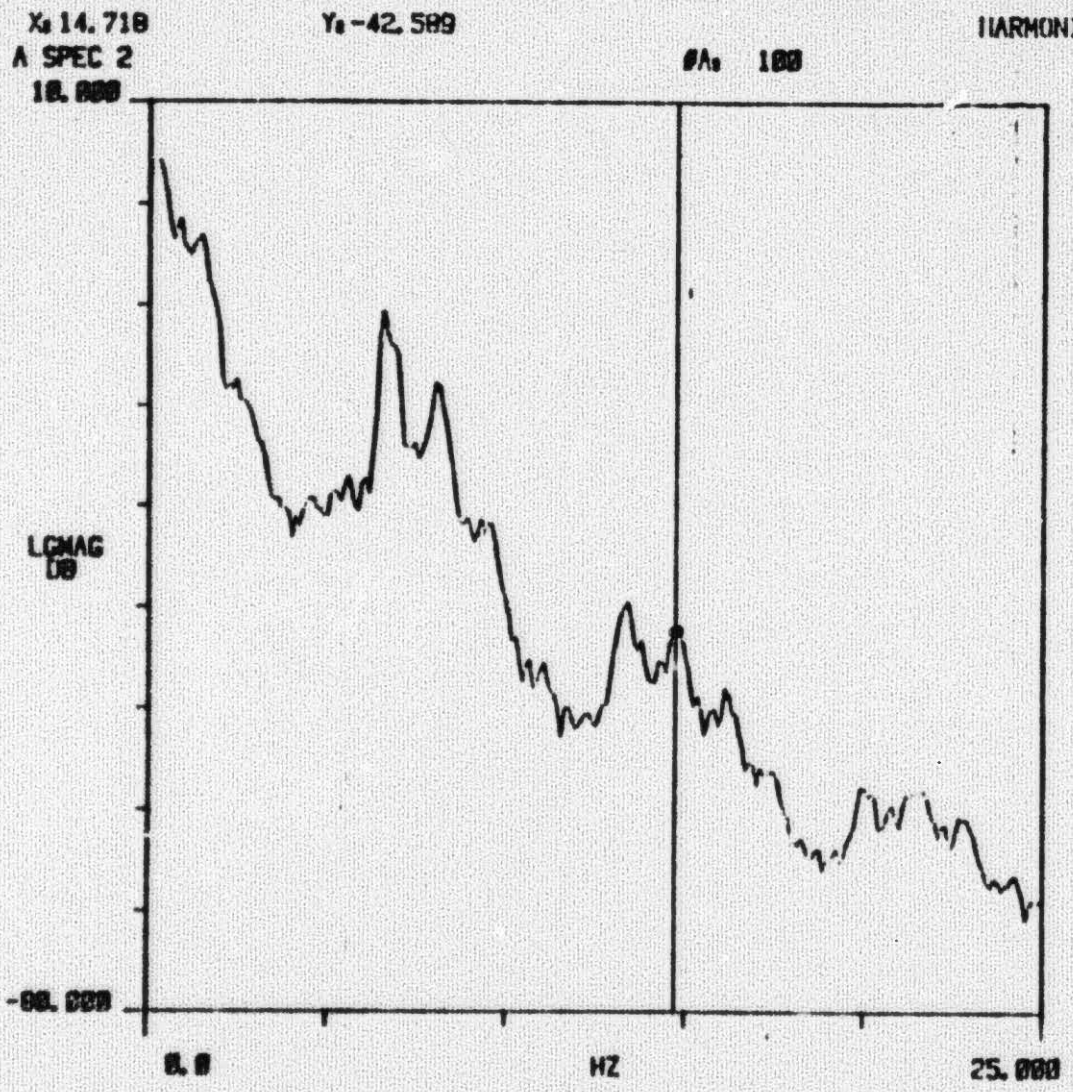

RUN 2
TMI B-LOOP PRESS.
16:45 4/9/79
PRESSURE = 950 psi
SETUP NO. 2

RUN 2
Fig. 4

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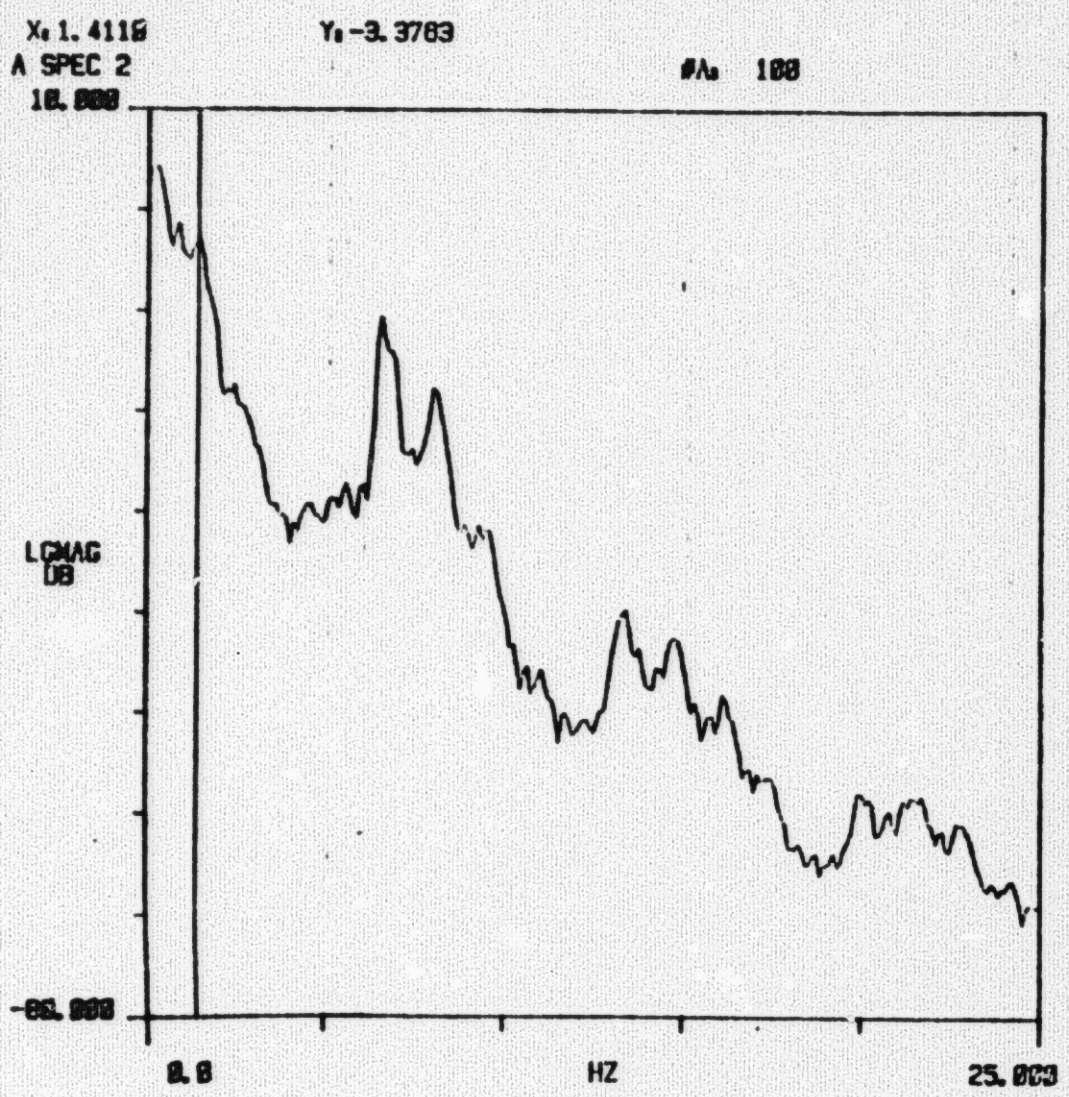

RUN 2
Fig 5

RUN 2
TMI-B-LOOP PRESS,

16:45 1/9/79

PRESSURE = 950psi

SETUP NO. 2

G.L. Zigler

Noise Monitoring Summary

Date: 9/10 April 79

Time: 0630 hrs Period: 1900hr – 0700 hr

Loose Parts Monitoring:

No unusual noises indicative of metal-to-metal impact were detected.

Seismic Performance Monitoring:

At 1735 hrs LT-2 (Pressurizer Level) exhibited erratic behaviors by spiking to full scale value and returning back to correct indication. No switching or electrical checks were being performed. LT-3 was switched as the main level indicator at the onset of the erratic behaviors of LT-2. 3004 226 Two

minutes later, LT-2 was switched back on and indicated normal behavior. Spectral analysis before and after this occurence indicated no significant changes.

At 0455 hrs the computer trending of LT-2 indicated another transient peaking. The computer values of such fast transients should be taken with caution in view of the one minute sample period.

No readings can be made of the two non-controlling pressurizer level indicators by noise analysis personnel in order to asses their status.

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Remaining plant parameters and

remains being trended showed no indications of degradation.

RCS Pressure Fluctuations:

RCS pressure remained between 1000 and 800 psig. RCS pressure fluctuations exhibited no significant changes during this reporting period.

Other Activities:

This unevent-ful period was spent in further documentation and investigation of the spectral characteristics of the RCS pressure fluctuations. These

investigations concentrated on the lower portion of the spectrum (below 2H which contain about 90% of the signal content of the A loop fluctuations. Other activities included documentation and general clean-up of previous operations.

J C Robinson

Noise Monitoring Summary

Time 17:28 Period 07:00 → 17:00

4/10/79

Loose Parts Monitoring

The tingling sound that has been heard is not being heard now.

SPD:

Some of the SPD's were being stripped out. These readings [illegible] about 08:30. This was found to be introduced by [illegible] being used. Very [illegible] check of In-core Thermocouples at this time revealed no change between 07:00 and 09:00.

Pressure Level indicators.

Both LT-2 and LT-3 indicators gave some erratic behavior throughout the day. The LT-2 indicator has been very stable throughout the pressure decrease which began at 13:37. The behavior is sharp spikes on strip chart which could possibly be introduced by power supply. This possibility is being explored!

2004 230

Pressure decent.

The pressure had been reduced to [illegible] psi at 17:00. This operation went [illegible] smooth. There was no apparent gas (significant) reduction in pressure zone [illegible] to this pressure (was reduced to [illegible] psi previously). At about 450, the noise on pressure [illegible]

signal began to increase and that in the A loop began to decrease (as observed previously). The spectra revealed that the ~6.7 Hz peak in A loop decreased slightly. The ~8.0 Hz in B has decreased significantly to ~6.9 Hz. It appears that the noise in both loops are tending toward the same order of magnitude and similar (in) frequency behavior.

Thermocouples (In-core)

The incore thermal couples 7F and 8F are continuing to read low (less than the inlet water). We looked at the noise on these couples and decided they appear as valid as any other couple. Further, these sensors are trending downward with all other readings with time. Thusly, we postulate these couples are shorted out ~~(which would be a~~ (to the steel) which would be a thermocouple with a smaller emf/degree and hence "normal" readings.

2004 231

E. L Zigler

Noise Analysis Summary

Time: 1600 – 1900 hrs 9/10/79

RCS Pressure Evolution:

SOP 2-57 Rev 2 was used to bring the RCS pressure to 500 psig and vent at 450 psig. Pressure was dropped to 425 psig for baseline measurements of the back-up pressurizer level [redacted] instrumentation. Pressurizer level increased to 250 inches and let-down could not keep up with the level increase. 2-57 Rev 2 was aborted by increasing pressure to 550, venting while holding 550, and increasing to 800 - 900 psig. RCS pressure fluctuations behaved as expected with good outgassing occurring at the 550 vent.

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Incore Instrumentation Checks

TDR techniques were attempted

on the incore instrumentation In agreement with previous experience in the use of this technique with oxide cables the results were inconclusive. No significant new information was obtained on the structural integrity of these detectors.