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PY-CEI/NRR-1444 L

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555

Perry Nuclear Power Plant
Docket No. 50-440
Seismic Monitoring Report 18
Final Seismic Evaluation

Gentlemen:

This letter transmits for your review Cleveland Electric Illuminating (CEI) Company's Eighteenth Seismic Monitoring Report. We anticipate this to be our last formal report, as we have achieved the goals and objectives established for our Seismic Monitoring Program monitoring local injection wells. Incorporated in the report is a summary of the last six month period (April 1 through September 30, 1991) and an overview summary of the last six years monitoring and analysis. With the submittal of the enclosed final report and this transmittal letter, CEI will pursue phased retirement of the CEI network in 1992, possibly leading to closure. We will eliminate monitoring report submittals to the NRC staff, effective with this Report 18. Discussions of our network retirement plan and detailed support for this plan are described in the following topics on network phaseout, history, monitoring results and studies, and conclusions.

Network Phaseout

CEI has been operating the local seismic network (monitoring the corridor between the 1/31/86 Leroy epicenter and ICI America injection wells) for almost six years. Our original commitment was to operate the system for two years, beyond which we have operated for almost four additional years.

CEI has performed several in-depth seismological studies with the aid of our consultant, Weston Geophysical, in the six years following the 1/31/86 Leroy earthquake. Through a series of 18 formal reports on monitoring results, incorporating these in-depth studies, CEI has sufficiently evaluated the seismic nature of the local region. CEI believes it has acquired the data necessary to answer the original questions, and that further monitoring will not add any substantial new information. There are no remaining regulatory reasons for continued operation of the network. Any continued monitoring at reduced levels would be strictly for CEI scientific purposes only and will be restricted to an absolute minimum.

In addition to the significant cost of analyzing results and preparing quarterly reports, operation of this system at a very low threshold of detection (Mc=-0.5) to monitor for recording microearthquakes is technically difficult to maintain. Maintaining station reliability is difficult due to telephone failures, electronic equipment problems and required repairs, and personnel time demands. Therefore, we find it necessary to substantially curtail or possibly eliminate monitoring based on the information supplied in this letter. Accordingly, we are implementing the following schedule:

December 1991 - Decision to not repair SCH Station downhole installation
January 1992 - Last Monitoring Report Preparation
February 1992 - Detection Algorithm Threshold Changes
March 1992 - Temporary Sixth Station GEN Closure
April 1992 - Selection of Stations (2 through 5) for Closure
May 1992 - Notification of Closing Stations to Lessors
June 1992 - Power/Phone Eliminated for Closing Sites
July 1992 - Station Closures/Site Restorations commence
September 1992 - New Configuration
October 1992 - Site Lease Expirations
Through 1992 - Evaluate Options Beyond 1992

This schedule anticipates removal of our 6th temporary station, and closure of 2 to 5 permanent sites by September of this year depending on continued lease arrangements, equipment operability, and site technical value. Expiring property leases in October 1992 (all 5 expire this year) will be renegotiated on a case-by-case basis and are not automatic renewals. Any retained stations will be adjusted for a threshold detection level at approximately Mc=2.0, or near "felt" sensitivities. Operation beyond 1992 will be evaluated based on internal CEI restraints, the technical value of maintaining "free field" sources of seismic data, equipment reliability, and cost.

Additionally, CEI will maintain communications with the John Carroll University (JCU) Seismological Observatory to share information on recorded seismicity. CEI has extensively funded the development of their regional network, and has access to their records.

History

Following the 1/31/86 Leroy earthquake (magnitude Mb=5.0 about 11 miles south of PNPP) and subsequent regulatory examination, CEI committed in a June 17, 1986, letter PY-CEI/NRR-0478 to install and operate a seismic network in northeast Ohio for about two years or through 1988. The Leroy earthquake had been extensively studied by CEI as documented by the NRC in Supplemental Safety Evaluation Report No. 9, but some scientific questions remained. The hypothesis of induced seismicity as the origin of the Leroy earthquake was extensively debated among scientific and institutional organizations (following the event occurrence) at public hearings, meetings, and in technical literature. Therefore, as documented in Supplemental Safety

Evaluation Report No. 10, CEI installed the seismic monitoring network to further analyze the seismogenic nature of the area and to evaluate further the hypothesis that the 1/31/86 Leroy earthquake was induced by local injection wells.

A description of the network was proposed to the NRC in the June 17, 1986 letter and also outlined our plan for operation. Those plans primarily consisted of installing a five station digital telemetered network, locating the central receiving station at PNPP, providing the capability to detect and locate coordinates of micro-seismic events (below Mc=0.0), and reporting those results to the NRC.

The methodology of reporting to the NRC staff was established between our licensing staff and the NRC's Structural Engineering and Geosciences staff, as documented in our first Quarterly Report PY-CEI/NRR-0579L, dated February 2, 1987. That resulted in CEI providing to the Staff Quarterly Reports summarizing the monitoring results. Additionally, CEI provided telephone contact with the staff should unusual events occur such as a "felt" earthquake in the region near the plant. Over the time period ending in 1991 CEI has provided 18 formal docketed reports and made 3 or 4 courtesy telephone contacts for informal notification of locally occurring "felt" events by citizens near the epicenter. No events were "felt" by employees at PNPP or detected by our strong-motion inplant instrumentation.

In PY-CEI/NRR-0974L dated February 27, 1989, we indicated an intent to continue monitoring through 1990 to allow time to gather additional data necessary to complete our understanding of the local seismicity. In PY-CEI/NRR-1013L dated June 9, 1989, we provided information that a "temporary" sixth station was to be installed for monitoring the area near Madison on the lake. In the transmittal of Report 14, PY-CEI/NRR-1355 dated June 4, 1991, we indicated that monitoring was sufficiently completed that the program could be re-evaluated. That evaluation result is provided in this transmittal.

Monitoring Results and Studies

Results of our Seismic Monitoring Program have been provided to the NRC staff through a series of 18 reports, with the first submitted on February 2, 1987. Through these reports we have compiled the cumulative seismic record of the local region with an emphasis upon the "corridor" between the 1/31/86 Leroy epicenter and the ICI America deep injection wells, the 1986 epicentral area, and other areas within or near the network aperture. This cumulative seismicity is summarized in Quarterly Reports 18 and 13 in detail, however a general overview is valuable.

The January 31, 1986 Mb 5.0 earthquake occurred at a depth of about 5 km, and was followed by 21 aftershocks, varying in size from -0.2 Mc to +2.8 Mc, and vary in depth from 3.12 km to 6.13 km. The last event occurred on January 17,

1991. The January 31, 1986 event is not considered induced, was purely tectonic and was the only event to trigger in-plant strong motion accelerometers.

Within the monitoring network aperture and in the local proximity of the deep ICI American injection wells, 62 events were recorded over six years, varying in size from -0.7 Mc to +1.9 Mc, maintaining a nominal depth of 2.0 km, or slightly deeper based on the model study presented in Report 18, Appendix B. Most of these events are located to the east and southeast of the injection wells as identified on Figure 3 of Report 18. None of these events were felt by local residents, or detected by in-plant strong motion accelerometers. This seismicity is expected to remain very shallow and at very low energy levels as recorded.

Outside of the network, but within the immediate region, 35 events were recorded, varying in size from -0.5 Mc to +3.5 Mc. The two most notable events were the 1/26/91 Euclid Mc=3.5 event north of Cleveland and the 12/25/88 Madison Mc=2.4 event, both of which were felt by local residents but were not felt by PNPP personnel or detected by in-plant strong motion accelerometers. These are considered typical of the region, and in the Euclid case are locations of historical low level seismicity.

Some of the Historical earthquakes which were theoretically located by "felt" reports to be on-shore, were probably located in the lake similar to the 1/25/91 Euclid event. Therefore the uncertainty of historical events is confirmed, and there is no basis for arbitrarily aligning these events to "fit" theories of origin. There are random in-time naturally occurring small events (less than Mc=3.5) throughout the region which are typical of those evaluated during plant licensing, and are to be expected. Some of these events occur in areas with historical records of seismicity.

Outside of the network at a distance of 25 miles, 8 events were recorded, ranging in size from 1.5 Mc to 3.6 Mc. The most notable of these (Mc=3.6 in July 1987 and a Mc=2.8 in August 1989) were located in the vicinity of Ashtabula, 25 miles east of PNPP near an injection well. Both of these were felt by local residents, but were not felt by plant personnel or detected by in-plant strong motion accelerometers. Report 15 evaluated the Ashtabula events, however this area was not the central focus of our monitoring program.

In order for CEI to better understand the monitoring results and to properly evaluate their significance, special studies were conducted and documented in the Quarterly Reports. A list of the eighteen Seismic Monitoring Reports is provided on Attachment 1 to this letter. Special studies contained in those reports are listed here.

Report No. 4 - Started Incorporating ICI Injection Well Data
Report No. 10 - Intensity Survey of 12/28/88 Leroy Aftershock Mc=2.8
Report No. 13 - Evaluation of 4 years Seismic Monitoring/Well Data

Report No. 13 - Detailed Examination of Seismicity and Injection Wells
Report No. 14 - Evaluation of Local Oil/Gas Wells Influence
Report No. 15 - Summary of Ashtabula Seismicity
Report No. 17 - Intensity Survey of 1/26/91 Euclid Mc=3.5 Event
Report No. 18 - Summary of Crustal Model Investigations
Report No. 18 - Evaluation of 6 Years Seismic Monitoring

CEI Conclusions

These studies, in conjunction with the normal reporting process, have allowed CEI to achieve the objectives identified in Supplemental Safety Evaluation Report 10. Those conclusions related to monitoring are detailed in Monitoring Report 18. Our overall conclusions relating to the monitoring program and its results, and the diminished value for further monitoring, are provided.

As concluded in the 1986 Report "Investigations of Confirmatory Seismological and Geological Issues" the 1/31/86 Leroy earthquake was a purely tectonic event, was not induced, and has expressed a normal aftershock sequence.

The events recorded since 1/31/86 are considered well located and form a solid basis for assessing the seismic potential of the area. Microevents recorded within the network occur on the average of once a month, are very shallow, and are expected to remain very small. Microevents within the network aperture and near the ICI injection wells are potentially induced, but cannot be "timed" with injection well operating parameters. Microevents near a Fairport Harbor injection well and a series of earthquakes near the Ashtabula deep injection well are also considered potentially induced.

Operation of the CEI Seismic Network has allowed CEI and our consultant to better understand the regional seismicity through significant study and analysis of micro-earthquakes in the local regional area. This information, coupled with earlier CEI geophysical studies following the 1/31/86 Leroy event, will allow quick assessment of future felt events, should they occur. The seismological character of the area is very well understood. Continued long term operation of the network will not significantly expand our knowledge of the area seismicity and causal sources. With the submittal of 18 reports and their combined information, CEI has completed the objective as described in Supplemental Safety Evaluation Report No. 10.

Therefore, based on these conclusions, CEI intends to follow the schedule outlined in this letter for network reduction or elimination. No further monitoring reports will be submitted to the NRC staff and only minimal information will be collected by CEI from reduced seismic network operation. Any retained monitoring stations will be operated until failures appear (electronic equipment failure is expected) and will probably then be retired.

CEI has met its regulatory commitment objective by operating the seismic network over six years, significantly beyond our original commitment, and

collected sufficient data to demonstrate that the Leroy Earthquake of 1986 was not induced. Should your staff have any questions regarding this submittal, please contact us.

Sincerely,

Michael D. Lyster

MDL:MJH:ss

Attachment

cc: NRC Project Manager
NRC Resident Inspector Office
NRC Region III
R. Rothman, NRC
P. Sobel, NRC

NO.	LETTER	REPORT HIGHLIGHT
1	PY-CEI/NRR-0579L February 2, 1987	- First report summarizing 1986 monitoring records utilizing portable analog seismometers in operation since February 1, 1986
2	PY-CEI/NRR-0640L April 27, 1987	- Last report utilizing portable analog equipment
3	PY-CEI/NRR-0697L August 17, 1987	- First report utilizing digital network array - Complete system description - Identification of first Ashtabula earthquake Mc=3.6, about 25 miles east
4	PY-CEI/NRR-0769L January 18, 1988	- Commenced incorporating injection well operating data concurrent with seismicity in each report
5	PY-CEI/NRR-0825L March 15, 1988	- Noted CEI studying oil/gas well relationship to seismicity
6	PY-CEI/NRR-0856L May 6, 1988	- Detailed review of magnitude Mc=1.9 microearthquake, the largest to occur within network and near injection wells
7	PY-CEI/NRR-0905L August 26, 1988	- First recorded offshore seismicity and analysis
8	PY-CEI/NRR-0940L November 28, 1988	- Denotes recording the September 7, 1988 magnitude Mb=4.6 Kentucky earthquake
9	PY-CEI/NRR-0974L February 27, 1989	- Identifies monitoring to extend beyond 1988 commitment, through 1990 - First colored maps provided - Study of the magnitude Mc=2.4 Madison event - Study of role of oil/gas wells
10	PY-CEI/NRR-1013L June 9, 1989	- Intensity survey results of 12/28/88 Mc=2.8 Leroy aftershock event - Analysis of cumulative seismicity and temporary addition of sixth station
11	PY-CEI/NRR-1055L August 29, 1989	- Very little microseismicity
12	PY-CEI/NRR-1105L December 6, 1989	- 6 month report - Noted repeated occurrences of events near Ashtabula, 25 miles east
13	PY-CEI/NRR-1165L April 12, 1990	- Evaluation of all 3 years monitoring data and preliminary conclusions

NO.	LETTER	REPORT HIGHLIGHT
14	PY-CEI/NRR-1215L September 5, 1990	- Detailed evaluation of local oil/gas wells influence on seismicity
15	PY-CEI/NRR-1279L December 17, 1990	- Additional Ashtabula events and comparison to 1/31/86 Leroy earthquake
16	PY-CEI/NRR-1318L March 4, 1991	- Very little microseismicity
17	PY-CEI/NRR-1355L June 4, 1991	- Intensity survey of 1/25/91 Euclid Mc=3.5 event
18	PY-CEI/NRR-1444L February 25, 1992	- 6 month report - Evaluation of all 6 years monitoring results - Summary of Crustal Model Investigation - Elimination of Formal Report Submittal