8101

SECOND QUARTERLY REPORT
CEI SEISMIC MONITORING NETWORK
January 15 - April 15, 1987

Prepared for

CLEVELAND ELECTRIC ILLUMINATING COMPANY

APRIL 1987

Weston Geophysical
CORPORATION

1.0 INTRODUCTION

Cleveland Electric Illuminating [CEI], at the request of the U.S. Nuclear Regulatory Commission, has been operating a seismic network to monitor the activity in a small area encompassing the Calhio injection wells and the January 31, 1986 epicenter. This second Quarterly Report, prepared by its consultant, Weston Geophysical, covers the time period extending from January 15, 1987 to April 15, 1987, and contains an update of the recorded seismicity.

2.0 SEISMIC NETWORK

During the last three months, eight portable MEQ-800 vertical seismographs have been operated in the configuration shown on Figure 1. Compared to last quarter's configuration, the portable network has two additional temporary stations, TUR2 and NARC. The purpose of this change was to improve the locationing ability of the portable array until the new digital network takes over. Figure 1 shows the locations of the eight portable seismometers; it includes also the location of the PNPP, the January 31, 1986 epicentral area, and the two Calhio well locations.

The installation of the five three-component stations of the CEI micronet began on April 10, 1987, and operational testing is expected to be completed by the end of April. It is anticipated that both the portable network and the digital micronet will operate concurrently for a period of time to permit the tuning of the new equipment. When this is achieved, the portable equipment will be removed from the injection wells/1986 main shock corridor.

3.0 OBSERVED SEISMICITY BETWEEN JANUARY 15 AND APRIL 15, 1987

Observed microearthquakes will be reported by areas. First, in the epicentral area of the January 31, 1986 event, then in the injection wells - main shock corridor, and finally in the area east of Cleveland.

3.1 Epicentral Area of the January 31, 1986 Earthquake

One microearthquake [Mc = 1.7] was detected on February 12, 1987 by the portable CEI network, as well as by the John Carroll University network. The calculated epicenter is within the cluster formed by the 15 previous aftershocks. The NRC staff was immediately informed by CEI after a preliminary location was obtained.

Table 1 updates the list of all aftershock locations; Figure 2 shows the aftershock cluster with the recent event identified. The previous aftershock had occurred on July 17, 1986. The February 12, 1987 microearthquake was apparently not followed by any other smaller events.

3.2 Injection Wells - Main Epicenter Corridor

During the last quarter, the CEI portable network has detected and located three small events, all of them in the same area, about four kilometers east-southeast of the two injection wells.

Table 2 presents an update of the recorded microearthquakes, and includes slight revisions of locations reported in the last quarterly report. These revisions are based on additional sensitivity analysis. One of the two detected but unlocated events previously reported, the December 24, 1986 event, has now been located by using one additional arrival time provided by JCU. Figure 3 shows an updated distribution of the recorded activity in the area of interest. Besides the two Calhio wells, four other injection wells - one of them now closed - near Painesville have been included on this figure.

3.3 Other Microearthquakes in the Region

On January 21, and February 28, 1987, two microearthquakes [Mc = 1.5 and 1.4 respectively] were detected by the CEI network. Both are clearly outside the CEI network, too far to be accurately located by the CEI network alone. Both microearthquakes were recorded by some stations of the JCU network, including the station on JCU campus.

The first event occurred before the Mentor station of the JCU network was on line, leaving a large azimuthal gap. Because of that, a stable solution is not yet available. The second event, on February 28, 1987, was located in the Willoughby area by pooling data from JCU and CEI nets [41.62N, 81.44W].

The occurrences of these two events, surely tectonic in nature and not induced, are in agreement with the accepted historical activity in the Cleveland area [FSAR: Appendix 2D-D].

4.0 DISCUSSION

Compared to the last quarter, the recorded seismicity within the CEI network aperture has slightly decreased. The data set from network operations to date is insufficient to establish any relationship between deep injection and event occurrences; similarly, a causal relationship between oil/gas wells and microearthquakes has not gained any further support. The possibility of some seasonal correlation has not been ruled out.

Attempts to improve the confidence in calculated focal depths have not yet given any significant results. A higher average velocity for the first two kilometers, based in part on a sonic log [down to 3,000 feet] and in part on some synthetic estimates, does not seem to improve the mean residuals. On the other hand, recent borings for installation of borehole seismometers of the new digital array confirm that rock is very shallow, 10 to 20 feet, at four of the five sites; at site ANT, rock was reached at 62 feet. On this basis, a thin [0.05 km.] surficial layer of very low velocity does not seem appropriate, given the small aperture of the micronet.

An interesting observation from the last quarter is the occurrence of two small earthquakes with coda magnitude of about 1.5 near Willoughby. This is consistent with the historical seismicity.

It is expected that with John Carroll University's recent acquisition of magnetic tape playback facility, and the installation of the five three-component digital stations of the CEI network, future phase identification and arrival time readings will be more reliable, especially those of the S-phases. For the last two quarters, sensitivity tests on readings and phase identification have shown that true location uncertainties are larger than the calculated errors.

5.0 CONCLUSIONS

During the January 15 - April 15, 1987 period, the CEI network has detected and located three small events, about three to four kilometers east of the Calhio injection wells. In addition, a microearthquake was located in the epicentral area of the January 31, 1986 earthquake. Finally, two microearthquakes occurred to the northeast of JCU campus, tens of kilometers west of the injection wells and the location of the January 1986 main shock. Thus, there appears to be some tectonic activity present in the region at some low magnitude level and totally unrelated to fluid injection. Closer to the Calhio wells, the current seismicity observed has not increased during the last quarter.

FIGURES

TABLE 1

AFTERSHOCK PARAMETERS

YEARMODY	HRMISEC	LATITUDE	LONGITUDE	DEPTH	NP	GAP	RMS	ERH	ERZ	Mc
19860201	185449.35	41N38.67	81W 9.17	4.35	20	94	.09	.3	.5	1.5
19860202	32248.67	41 38.72	81 9.55	4.86	37	72	.07	.1	.2	.9
19860203	194719.77	41 38.92	81 9.48	5.83	52	75	.08	.2	.2	2.0
19860205	634 2.47	41 38.90	81 9.27	3.73	31	52	.08	.2	.3	.1
19860206	183522.44	41 38.72	81 9.61	5.50	50	47	.07	.1	.2	2.5
19860207	152020.38	41 39.03	81 9.22	3.76	44	42	.07	.1	.3	1.1
19860210	200613.61	41 39.10	81 9.39	4.73	29	70	.06	.1	.4	.8
19860223	32946.50	41 39.18	81 9.09	5.48	22	76	.06	.2	.4	-.1
19860224	1655 6.48	41 38.85	81 9.60	3.25	10	91	.09	.5	2.7	.1
19860228	13934.21	41 39.23	81 9.61	3.91	12	91	.06	.3	.5	-.1
19860308	204249.68	41 38.67	81 9.20	3.12	20	65	.10	.3	.7	-.1
19860324	134241.31	41 38.31	81 9.31	3.84	12	79	.12	.5	1.8	1.4
19860410	65805.71	41 38.91	81 9.55	5.11	22	63	.08	.2	.3	-.1
19860617	221633.20	41 38.91	81 9.55	3.40	16	93	.09	.3	.8	.8
19860714	075423.12	41 38.68	81 9.13	4.93	12	99	.08	.3	.8	.3
19870212	011056.67	41 39.10	81 9.11	3.87	13	186	.09	.8	1.0	1.8

Vp1=4.25 km/s Thickness = 2 km
Vp2=6.5 km/s Thickness = 33 km
Vp/Vs=1.78

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TABLE 2

MICROEARTHQUAKES

YEAR	MO	DY	HRMISEC	LAT.N	LONG.W	D	RMS	EH	EZ	NP	NS	GAP	MC	SO
1986	03	12	085526.6	41.7272	81.1707	2.0	0.06	0.7	0.4	10	6	216	-.3	GS
1986	09	28	103604.2	41.7247	81.1091	2.3	0.04	0.3	0.4	11	6	174	.3	WG
1986	10	20	105944.7	41.7587	81.1453	3.0	0.07	1.7	2.0	6	4	337	-.6	WG
1986	10	27	122555.5	41.7435	81.0944	2.9	0.07	2.7	1.5	6	3	221	-.2	WG
1986	11	03	085449.6	41.7098	81.1292	1.8	0.06	0.5	0.5	7	5	145	.3	WG
1986	12	01	050317.5	41.7120	81.1195	2.1	0.07	0.6	5.8	7	5	138	-.2	WG
1986	12	24	092733.9	41.7487	81.2392	1.0	0.04	8.5	6.7	6	3	306	.3	WG
1987	01	02	024114.9	41.7472	81.1027	2.0	0.06	0.3	0.5	10	6	174	.6	WG
1987	01	28	235829.8	41.7399	81.0974	2.1	0.03	0.4	0.7	8	5	199	-.7	WG
1987	02	23	114556.4	41.7284	81.1197	2.0	0.03	0.1	0.3	10	7	100	.5	WG
1987	02	28	204644.5	41.7451	81.0932	2.4	0.07	1.0	1.7	7	4	239	-.4	WG

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TABLES

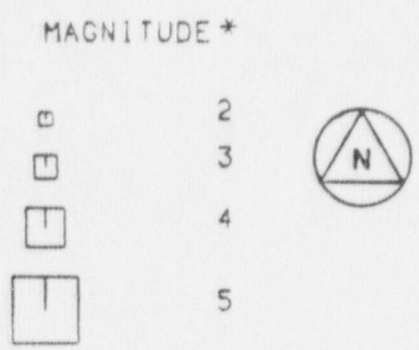
81.17W

81.14W

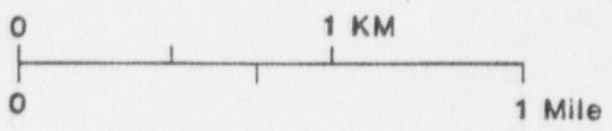
41.67N

2/12/87

41.63N



* Size proportionate to magnitude.



PERRY NUCLEAR POWER PLANT
THE CLEVELAND ELECTRIC
ILLUMINATING COMPANY

JANUARY 31, 1986
AFTERSHOCK SEQUENCE

FIGURE 2

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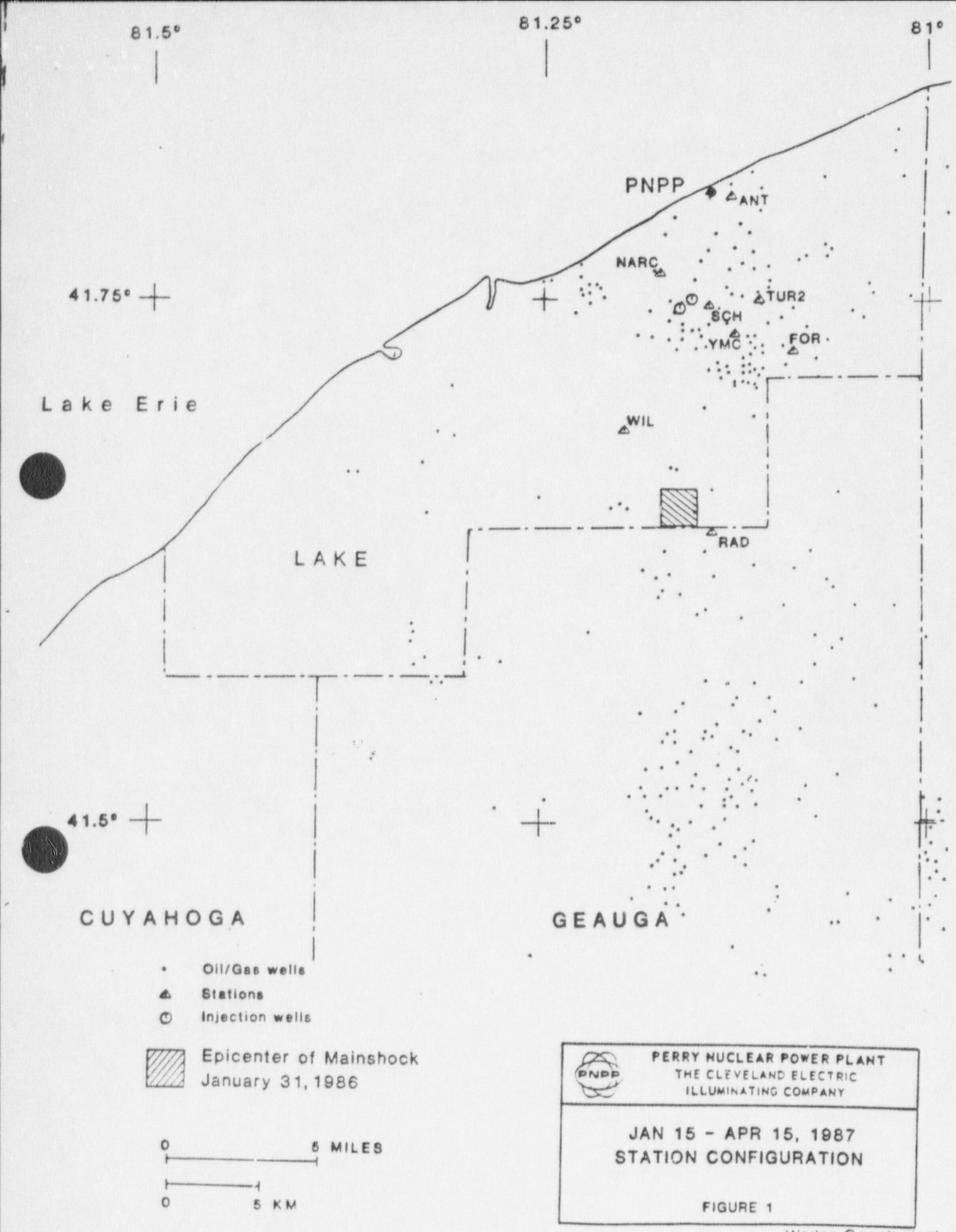

PERRY NUCLEAR POWER PLANT
THE CLEVELAND ELECTRIC
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JAN 15 - APR 15, 1987
STATION CONFIGURATION

FIGURE 1

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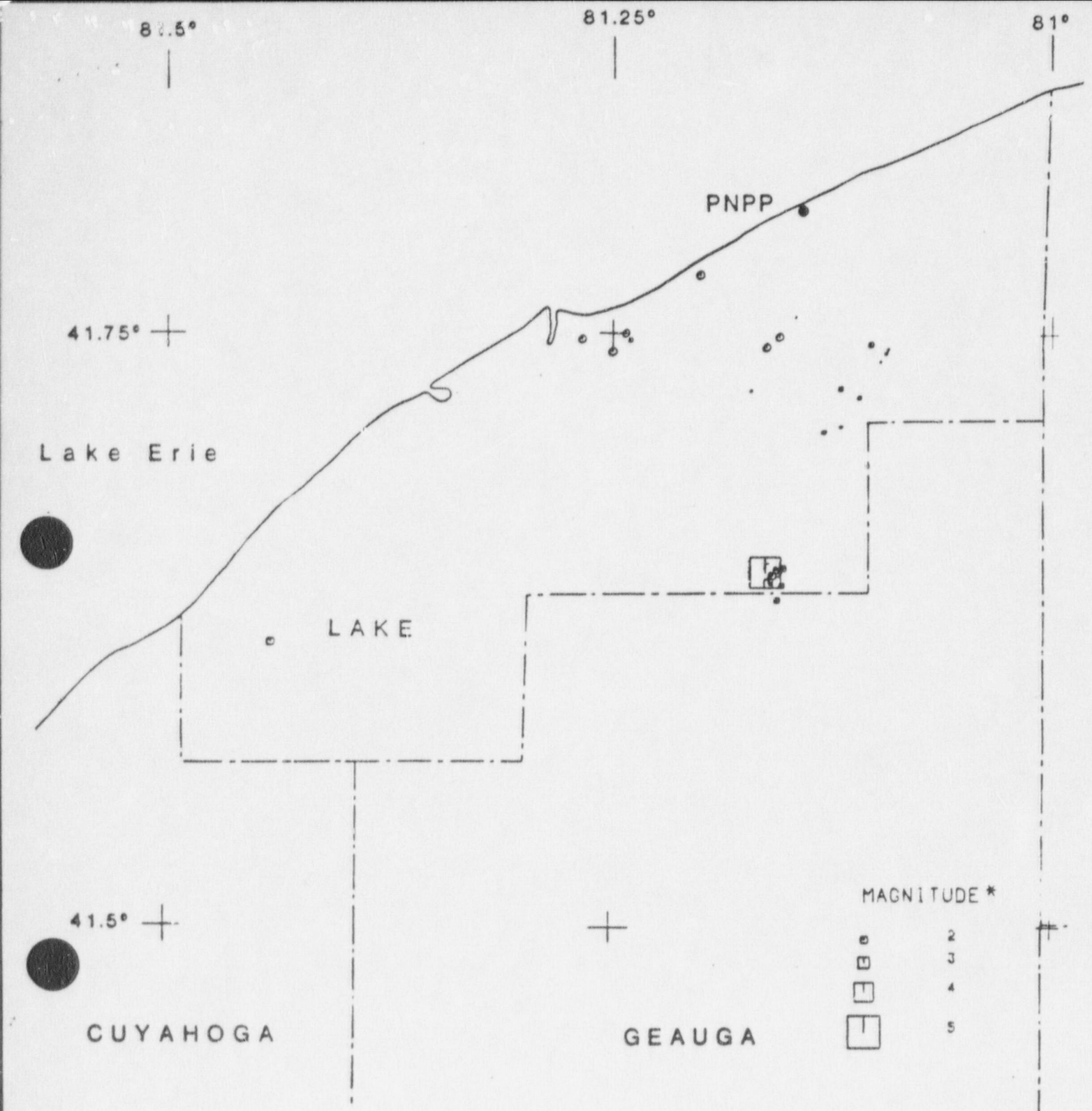

PERRY NUCLEAR POWER PLANT
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CUMULATIVE SEISMICITY
1986-1987

FIGURE 3

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