SEVENTH QUARTERLY REPORT
CEI SEISMIC MONITORING NETWORK
APRIL 1 TH. 3UG. JUNE 30, 1988

Prepared for

CLEVELAND ELECTRIC ILLUMINATING COMPANY

AUGUST 1988

Weston Geophysical
CORPORATION

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1.0 INTRODUCTION

In accordance with its agreement with the U.S. Nuclear Regulatory Commission, Cleveland Electric Illuminating [CEI] continues to monitor the seismic activity in a restricted region of Northeastern Ohio, encompassing the locale of the Perry Nuclear Power Plant, two deep injection wells operated by CALHIO, and the epicentral area of the January 31, 1986 earthquake. This seventh Quarterly Report covers the period from April 1 to June 30, 1988. An update of the CALHIO volumetric injection data is also provided in Appendix A.

2.0 SEISMIC NETWORK

During this period, the Automated Seismic Telemetering and Recording System [AUTOSTAR], fully described in the third Quarterly Report, has performed in a reliable manner. The availability of all of the field stations during this quarter was 87%, slightly less than in the past, due to some accidental damage to two remote station digitizing units and several brief losses of transmission on the ANT telephone line. Despite these problems, CEI's monitoring capabilities of the corridor between the injection wells and the January 31, 1986 epicentral area was not reduced since the three closest stations, SCH, FOR, and WIL remained in operation, and station LEROY of John Carroll's network, very near to CEI station RAD, is an excellent back-up. Figure 1 shows the CEI station locations around the area of interest.

3.0 OBSERVED SEISMICITY

3.1 Epicentral Area of January 31, 1986

There was no earthquake activity within the epicentral area during the present quarter. The last event occurred on February 12, 1987.

3.2 The Corridor Between the January 31, 1986 Epicenter and the Injection Wells

During this quarter, there was no seismic activity observed in the corridor, the primary area of interest. This conclusion is based on the routine review of all the events that triggered the digital system, and also a visual scanning of all the analog recordings from the five stations. The cumulative seismicity map will be reproduced; table 1 gives the complete list of microearthquakes recorded up to this date in the corridor. The last event within the corridor occurred on February 12, 1987.

3.3 Other Events Recorded by AUTOSTAR

During the period covered, AUTOSTAR triggered on several local and regional quarry blasts. It also recorded digitally one microearthquake on April 20, and four others on June 27, 1988, all of them originating outside the CEI network to the northwest.

On Saturday May 28, at 16:18:28 (U.T.), Autostar recorded an event from the coal mining area in the vicinity of Zanesville, Ohio. The signature of this event was almost identical to that of many mine blasts known to occur in that region. Possibly because it occurred on a Saturday, was larger (Mc = 3.4) than usual and was recorded by many stations of the USGS net, it was temporarily identified as an earthquake in southern Ohio and released to the Press as such. Figures 2A and 2B compare this May 28, 1988 event with one from April 16, 1988, also on a Saturday. At present, its nature has been relabeled as "probable explosion", in the Preliminary Determination of Epicenters, Bulletin #22-88 (June 23, 1988). Coordinates given are 39.754N, 81.613W. As stated, CEI concurs with this label of a probable explosion.

On April 20, 1988 a small microear' uake (Mc = 1.4) triggered AUTOSTAR at 16:51:25.52 (U.T.). After exchange of data, the John Carroll University Observatory calculated a preliminary solution placing the epicenter offshore, north of Mentor Headlands.

On June 27, AUTOSTAR recorded a short microearthquake sequence. The main shock and three of its aftershocks were large enough to trigger the digital system; two other smaller aftershocks were only visible on a few of the analog seismograms. The estimated coda magnitudes were: 2.8, 0.2, 1.7, - 0.1, 1.3 and 0.7. Origin times were respectively at 4:46, 4:47, 4:48, 6:55 and 8:29 (U.T.). An M_{blg} = 2.7 was calculated from lg-wave amplitudes of the main shock by the Geological Survey of Canada. From comparison of the digital files, the main shock and aftershocks are inferred to have a common source, based on identical first motions and arrival times. With the use of shared data from the CEI and JCU networks, John Carroll Observatory calculated a preliminary solution placing the epicentral location offshore, north of Painesville-on-the Lake. This sequence was approximately 4.5 miles from PNPP. No seismic triggers (.005g) or alarms were experienced at the site.

Table 2 presents the solutions obtained by Rev. W. Ott of John Carroll University. Figure 3 shows the two offshore epicenters, on a cumulative seismicity map.

4.0 DISCUSSION

The absence of seismic activity during this quarter within the CEI's network aperture is not unusual, since in the spring and summer of 1986, similar quiescence had been observed. There is still no clear correlation between observed micro-seismicity within the net and the injection data.

The occurrence of low level activity outside the CEI network, including offshore, is consistent with the historical pattern of

seismicity. The April 20, 1988 microevent is not considered related to the deep injection well located east of Fairport Harbor, because of the separation distance. The possibility of a salt mine subsidence or collapse was considered, in view of the spatial coincidence with mining operations, but at this time cannot be verified. The June 27 sequence is not accurately located because of the large station azimuthal gap to the north. Regardless of the small ERH calculated, the uncertainty should be considered larger. Efforts to obtain arrival times at northern stations in Ontario failed because of a time-signal problem experienced on that day at the University of Western Ontario.

The occurrence of these offshore events is consistent with the possible offshore epicentral location considered for the December 3, 1951 earthquake recently reexamined (WGC. 1988). In general, the occurrence of small events in the region is not surprising but normal within the context of random activity expected in a tectonic province type of seismic hazard zoning. This includes offshore events.

5.0 CONCLUSION

The second quarter of 1988 saw no micro-activity in the corridor monitored by CEI. A small sequence of six events occurred offshore of Painesville-on-the-lake on June 27, with the main shock having an Mc = 2.7. This event was not felt and PNPP seismic instrumentation did not trigger or alarm. A mine blast originating southeast of Zanesville, Ohio was temporarily identified as an earthquake. Some historical events may have been similarily mislabeled.

6.0 REFERENCE

Weston Geophysical Corporation, 1988, Analyses of Northeastern Ohio Seismicity and Tectonics, prepared for the Cleveland Electric Illuminating Company, 64p.

TABLES

TABLE 1

MICROEARTHQUAKES IN THE CORRIDOR BETWEEN THE INJECTION WELLS AND THE MAIN SHOCK

YEAR	MO	DY	HRMISEC	LAT.N	LONG.W	D	RMS	EH	EZ	NP	NS	GAP	MC	SO
1986	03	12	035526.6	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	035449.6	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	189	-.2	WG
1986	12	24	093733.9	41.7487	81.2392	1.0	0.04	8.5	6.7	6	3	306	.3	WG
1987	01	02	024114.8	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
1987	05	01	211332.3	41.7466	81.0872	1.9	0.06	0.3	0.2	7	4	196	-.6	WG
1987	05	01	211352.1	41.7466	81.0921	2.4	0.08	0.2	0.8	15	9	100	1.3	WG
1987	05	02	183307.7	41.7475	81.0932	2.0	0.02	0.1	3.0	6	4	174	-.6	WG
1987	05	02	202526.5	41.7424	81.0889	2.7	0.08	0.3	0.6	14	8	115	.4	WG
1987	07	08	034835.2	41.7392	81.1037	2.7	0.07	0.7	1.1	8	5	166	-.2	WG
1987	08	15	052637.7	41.6994	81.1472	2.8	0.06	0.2	1.0	10	6	133	-.1	WG
1987	10	10	000610.4	41.7430	81.1030	1.9	0.04	0.3	0.2	7	5	166	-.6	WG
1987	10	14	195924.3	41.7250	81.1318	3.4	0.04	1.6	0.7	6	3	190	-.7	WG
1987	11	22	024918.9	41.6989	81.1447	2.2	0.04	0.2	3.8	9	5	120	-.1	WG
1988	01	16	222403.	41.747	81.098						2		-.6	WG*
1988	01	16	223010.	41.747	81.098						3		-.6	WG*
1988	01	16	231704.4	41.7474	81.0981	2.0	0.05	0.5	0.3	9	5	185	1.8	WG
1988	01	17	024821.7	41.7467	81.0997	1.9	0.06	0.5	0.3	10	5	180	0.5	WG
1988	01	17	092236.	41.747	81.098						3		-.6	WG*
1988	01	17	092400.	41.747	81.098						2		-.6	WG*
1988	01	17	131551.	41.747	81.098						2		-.6	WG*
1988	02	05	155537.0	41.7351	81.0907	2.0	0.04	0.4	0.2	10	5	195	0.5	WG

REVISED JULY 1988

* LOCATION INFERRED

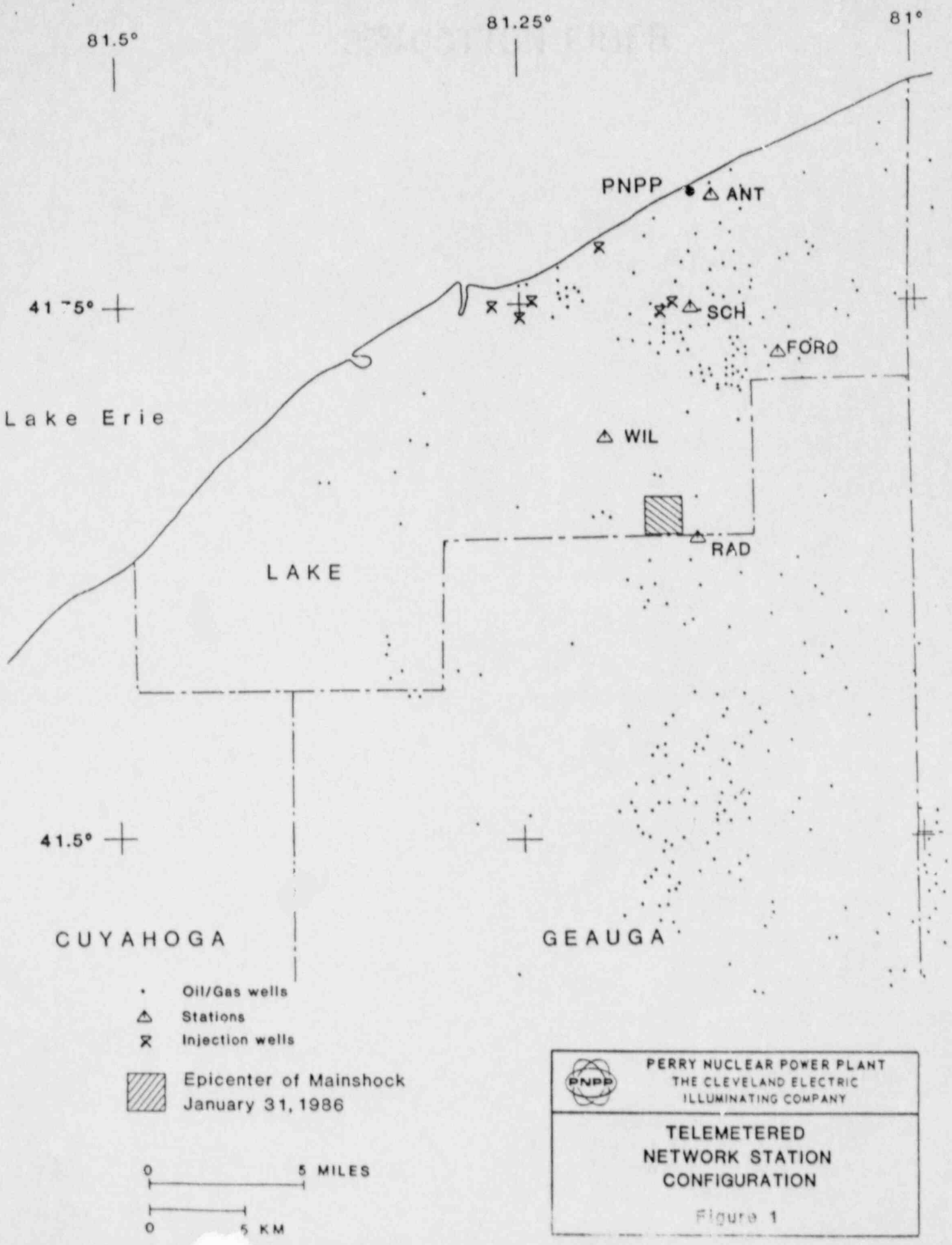
TABLE 2

MICROEARTHQUAKES OUTSIDE THE CORRIDOR -- APRIL TO JUNE 1988

YEAR	MO	DY	HRMISEC	LAT.N	LONG.W	D	RMS	EH	EZ	NP	NS	GAP	MC	SO
1988	04	20	165127.9	41.7738	81.3085	3.3	0.05	0.2	2.0	16	10	221	1.4	JCU
1988	06	27	044621.3	41.8180	81.2293	2.2	0.06	0.2	7.4	22	11	239	2.7	JCU

7-1988

FIGURES



PERRY NUCLEAR POWER PLANT
THE CLEVELAND ELECTRIC
ILLUMINATING COMPANY

TELEMETERED NETWORK STATION CONFIGURATION

Figure 1

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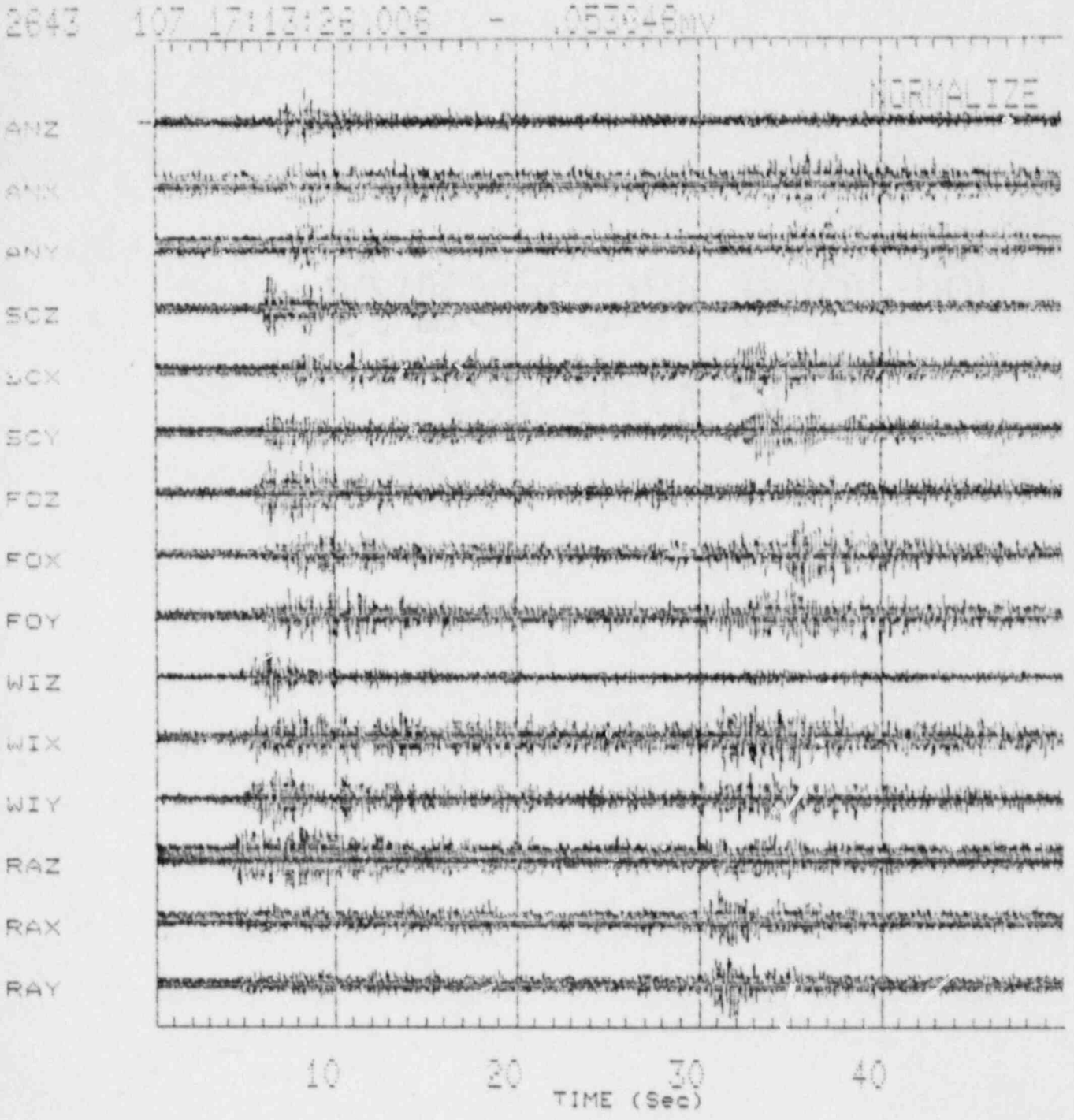

PERRY NUCLEAR POWER PLANT
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RECORDED SIGNALS
FOR MAY 28, 1988
MINE BLAST

Figure 2a

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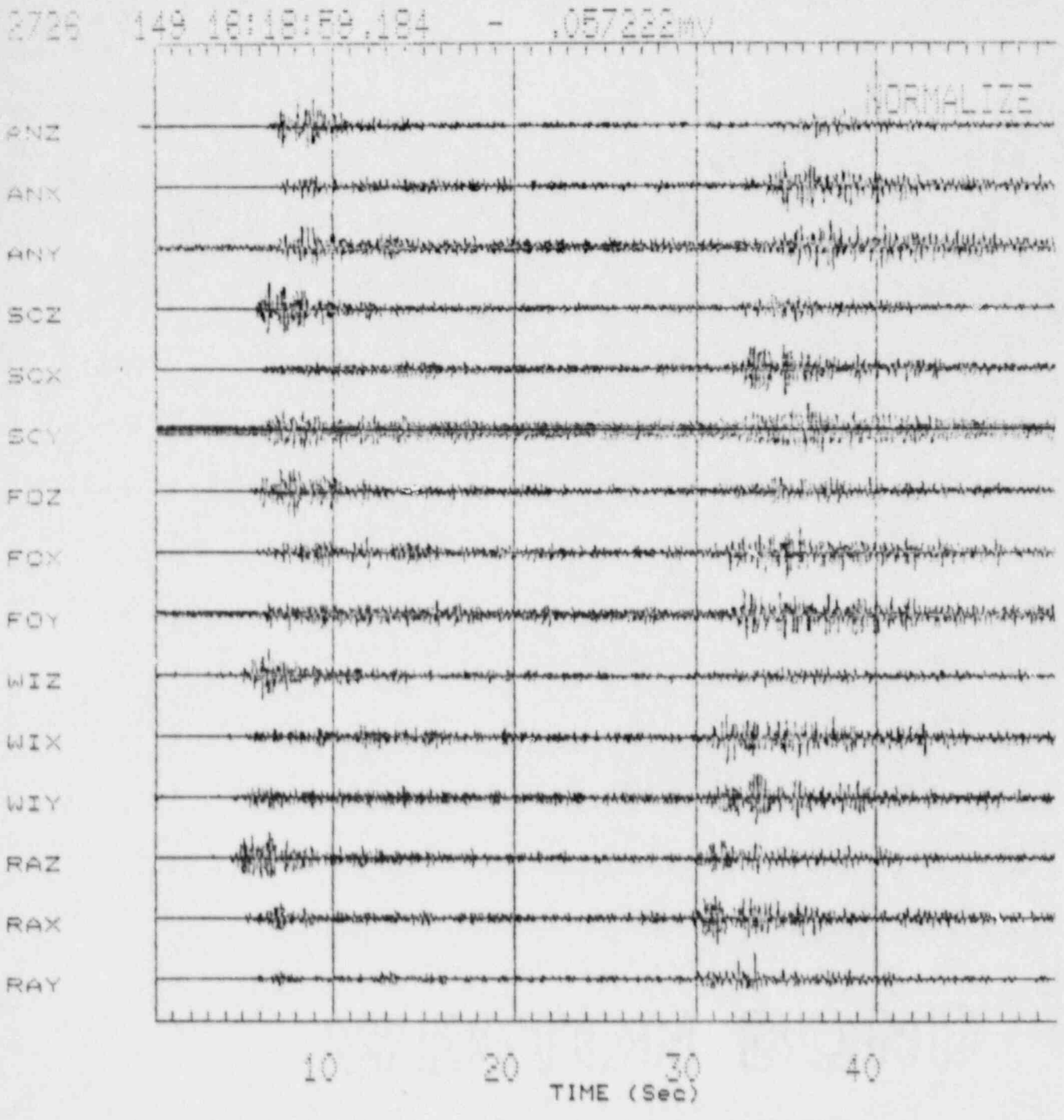
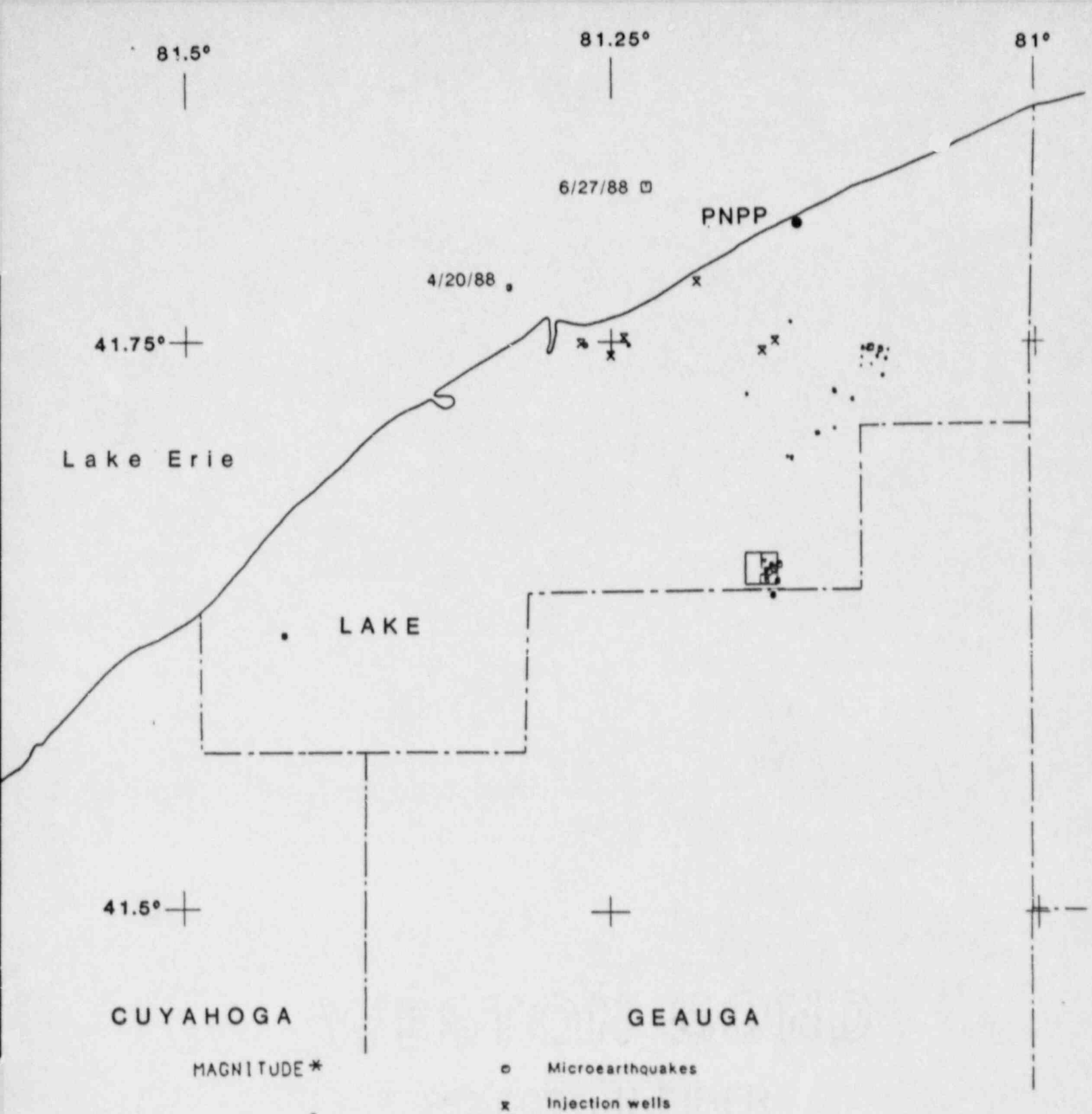


PERRY NUCLEAR POWER PLANT
THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

RECORDED SIGNALS
FOR APRIL 16, 1988
MINE BLAST

Figure 2b

Weston Geophysical



PERRY NUCLEAR POWER PLANT
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CUMULATIVE SEISMICITY
1/1986-6/1988

Figure 3

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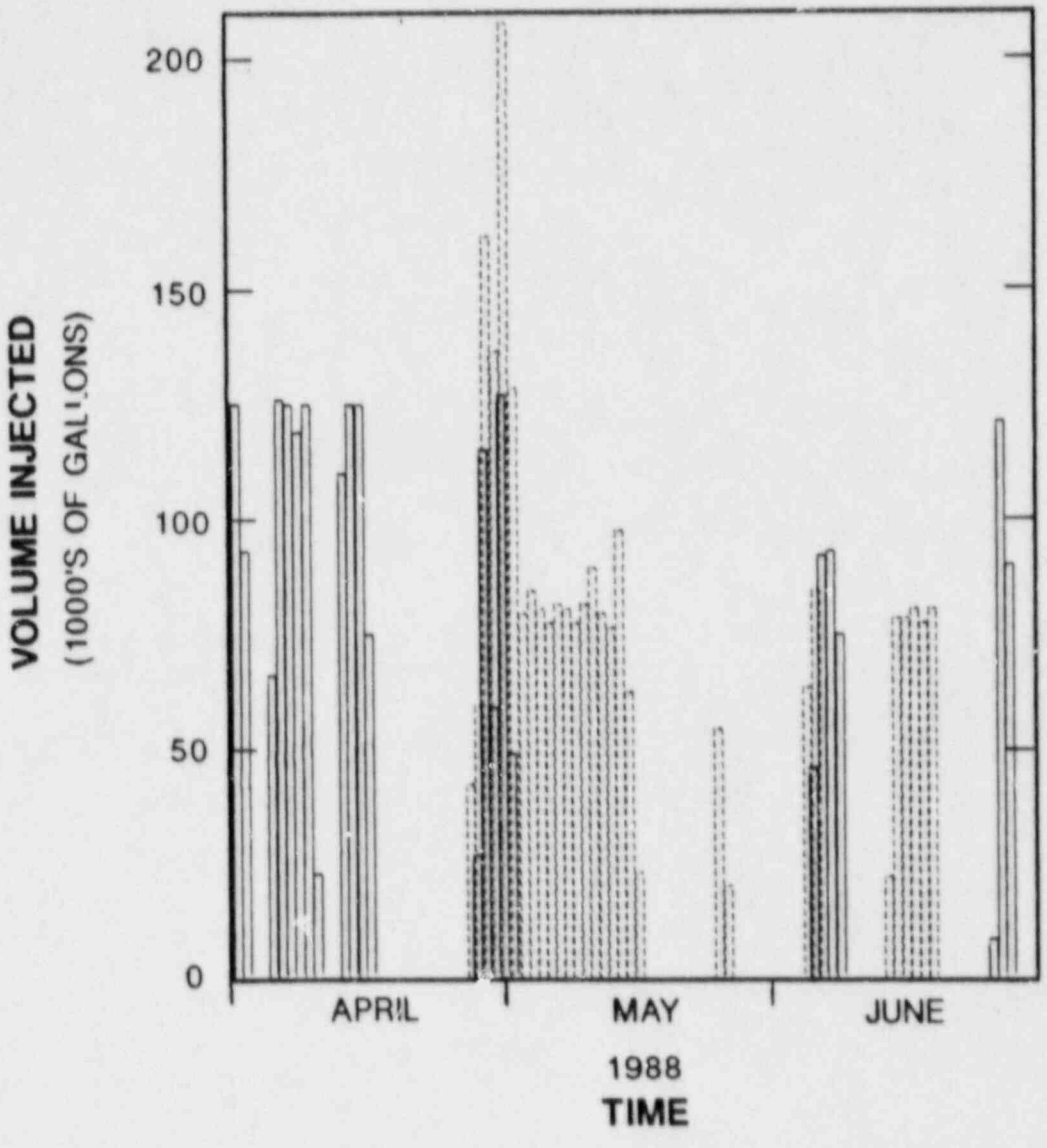
APPENDIX A

SEISMICITY

NO SEISMICITY RECORDED



Solid lines represent data from Calhio well #1

Dashed lines represent data from Calhio well #2

Injection well volume data from Calhio Chemical

PERRY NUCLEAR POWER PLANT
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DAILY INJECTION VOLUME
AND OBSERVED SEISMICITY
1988
Figure A1