

# PRELIMINARY REPORT ON THE OHIO EARTHQUAKE OF JANUARY 31, 1986

By Neil J. Monroe, M.EERI, and John D. Stevenson, M.EERI

---

On January 31, 1986 at the precise time of 11:46:49 a.m., an earthquake occurred in Northeastern Ohio. The epicenter is located in the Thompson area at a latitude of 41.656 N and a longitude of 81.094 W which is approximately 30 miles northeast of Cleveland, Ohio. According to USGS at Golden, Colorado, the earthquake had a Richter magnitude of 4.96 and an approximate depth of 8 km. Data from the Perry Nuclear Power Station which is located approximately 10 miles north of the epicenter indicate that the peak ground acceleration was .08g E/W direction and .15g N/S direction. Values near the base of the reactor containment structure showed peak acceleration values of .10g E/W and .18g N/S direction at a dominant frequency of approximately 20 Hz.

According to Halas C. Noltimier, Professor of Geology at Ohio State University, rock layers under the Northeastern United States and Canada have been rising since the glaciers melted a thousand years ago. This rebound has caused minor earthquakes in the region in the last 100 years and is the probable cause for this earthquake. Little research has been done in this region due to the relatively low seismicity.

Father William Ott, Director of Seismology at John Carroll University near Cleveland, developed seismographs of the earthquake. However, due to the proximity of the epicenter and sensitivity of the equipment, recordings of the actual magnitude could not be obtained. (The recording needles were restrained by stops). His review of the data confirms USGS reported findings in terms of time, epicenter, location and depth.

The quake was felt throughout Ohio and in parts of nine neighboring states from Illinois to New York plus Canada, and slightly injured several Ohioans. The reported damage has been confined to cracked plaster, falling ceiling tile, items on shelves and broken window glass. Most reported damage occurred in grocery stores, department stores and schools in the towns of Mentor and Madison, Ohio.

The local telephone, natural gas and water utilities responded to scattered damage reports but reported no serious damage. Bridges in near-by Geauga and Cuyahoga Counties were inspected and showed no visible damage. Detailed inspection of critical spans is planned for a later date.

Skyscrapers in Cleveland (SOHIO Building, Federal Building and Terminal Tower) experienced floor vibrations plus wall and chandelier movement, but no visible damage. The music performance at Severance Hall was stopped because of door noises and chandelier and ceiling panel movements. No unusual activity was reported in the behavior of animals at the Cleveland Zoo.

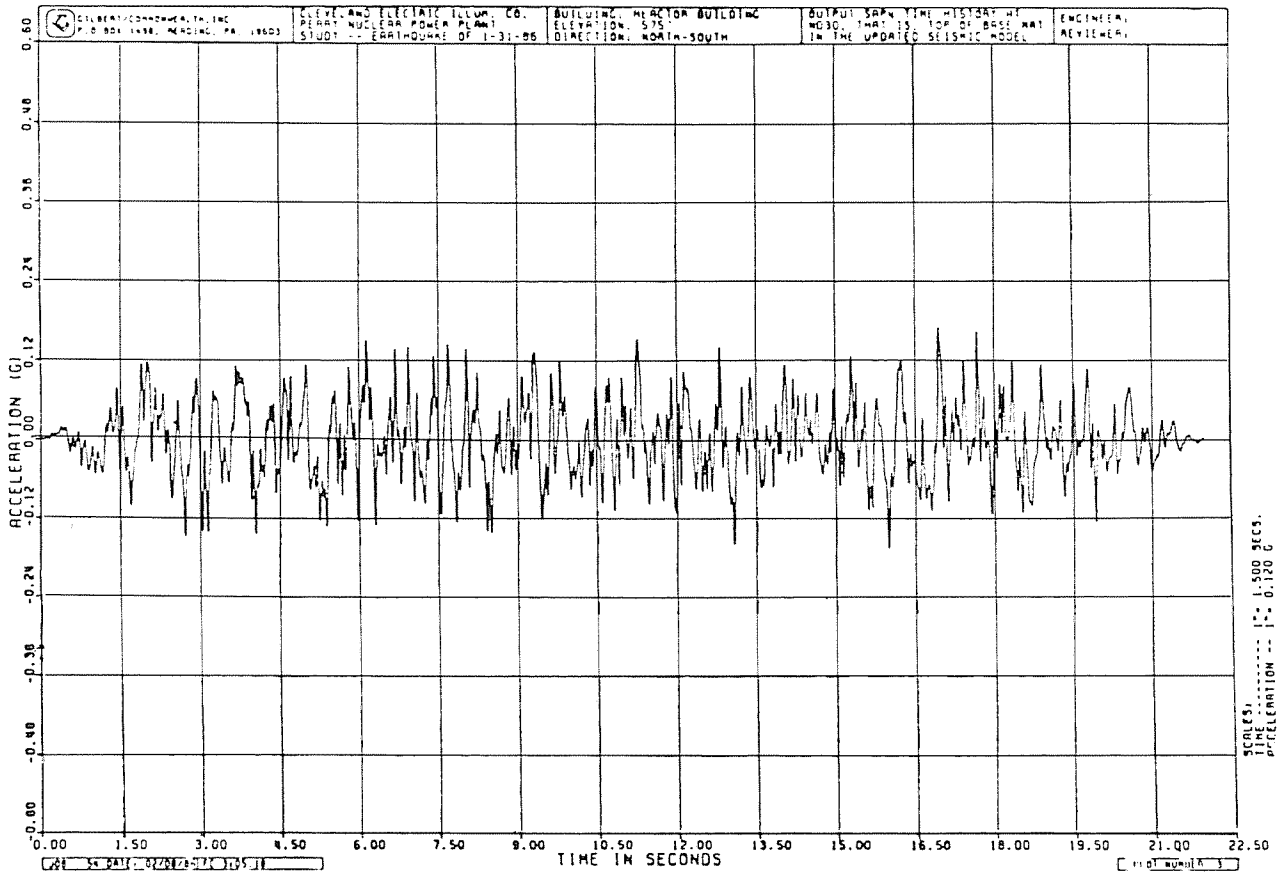


Figure 1. Perry Design Time History Ground Motion Based on R.G. .60 Spectra

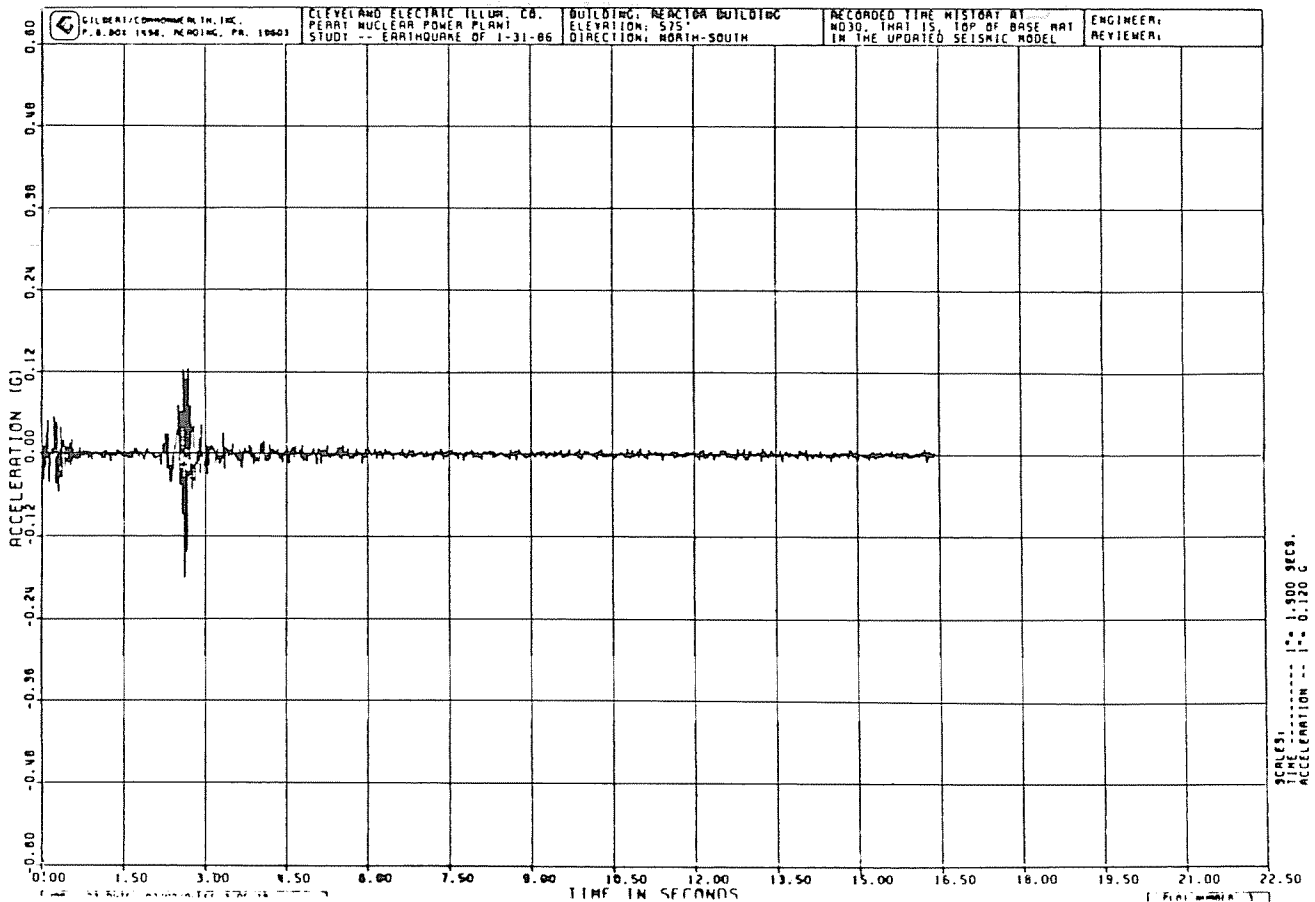


Figure 2. Recorder Motion of Ohio, 1986 Earthquake Motion at Base of Perry Containment Structure

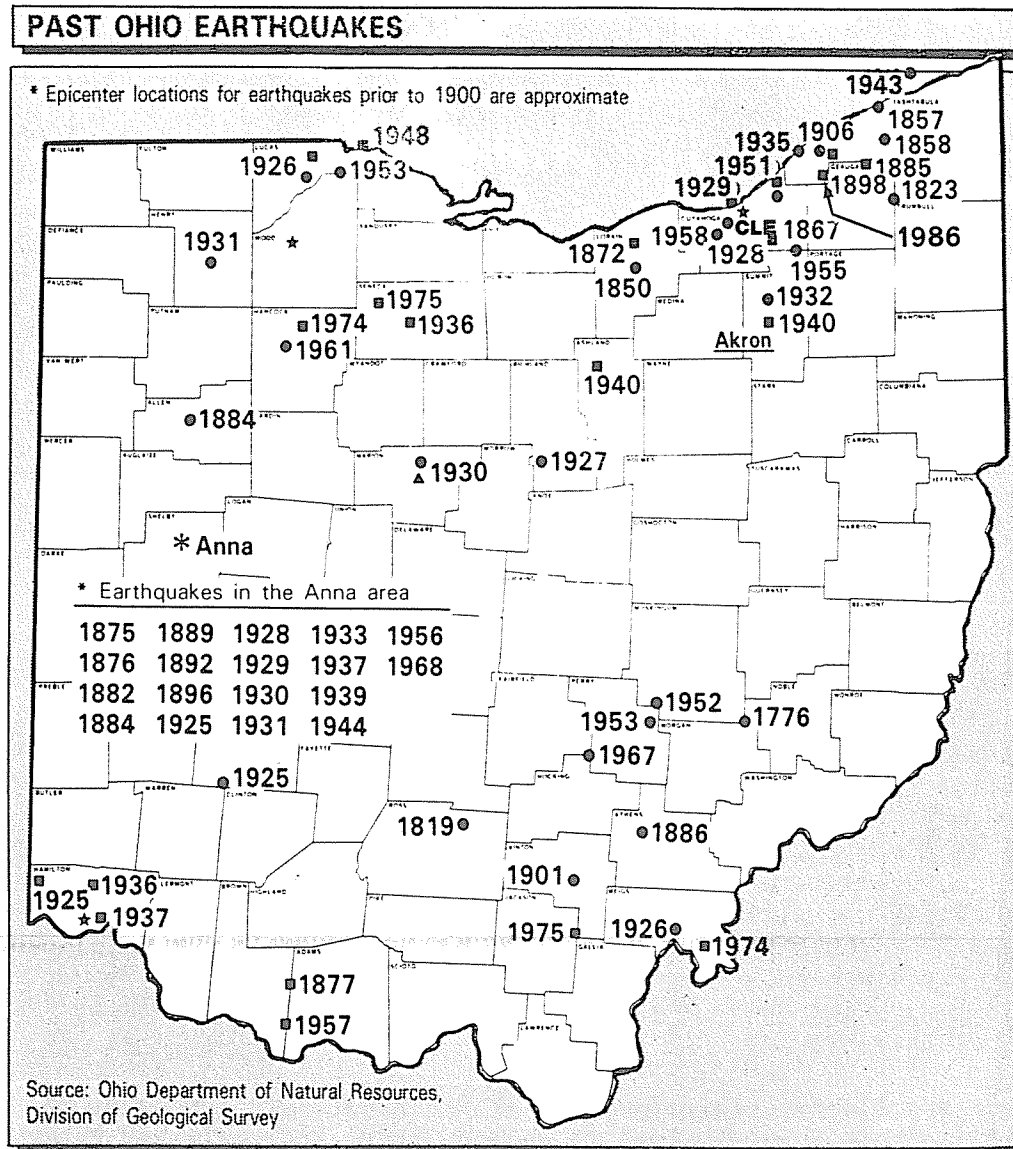


Figure 3. Past Ohio Earthquakes

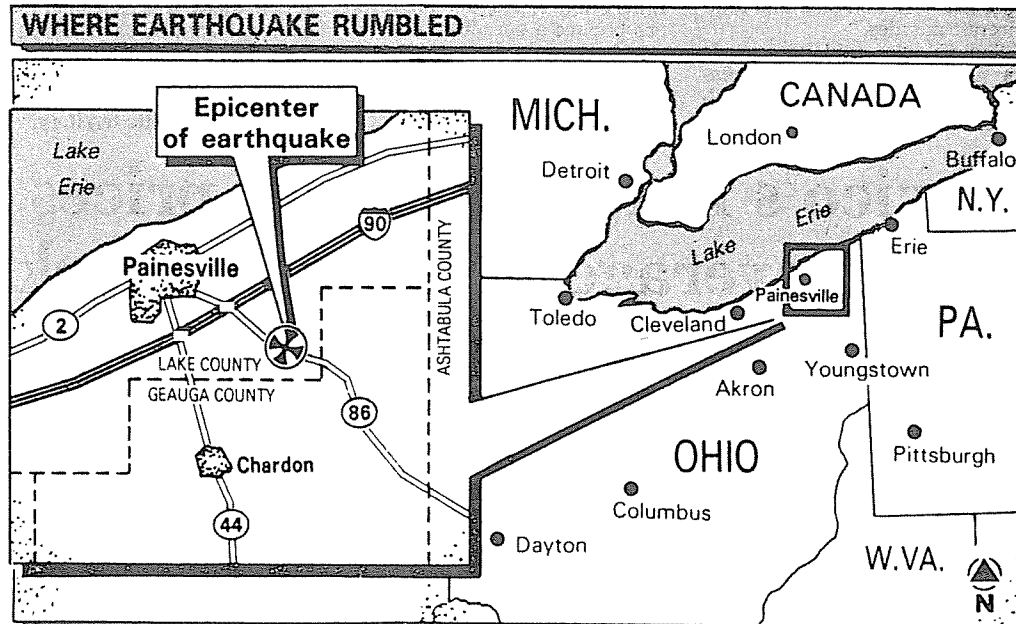


Figure 4. Earthquake Epicenter Near Painesville, Ohio

Two coal fired electric generating units at Cleveland Electric and Illuminating Company's (CEI) Eastlake Power Plant located approximately 12 miles from the epicenter were reduced to minimum load as a result of the earthquake. Because of equipment redundancy no interruption of power occurred. Subsequent inspection indicated no mechanical failure or damage to these systems.

Schools in Mentor and Madison, Ohio located 7 to 15 miles from the epicenter were inspected due to excessive movement and broken glass. Outside consultants were retained to assess the damage to these schools and other public buildings. Their preliminary findings at the Madison school indicate that it is an unreinforced masonry building with steel joists. Its concrete roof is not structurally attached to the support members. Parts of the roof deck showed signs of horizontal movement of approximately  $\frac{1}{2}$ ". Additionally, minor cracks were observed on several of the building's shear panels. Their evaluation is that the original design did not use good earthquake engineering practices and several connections should be repaired and reinforced, but the building is structurally adequate.

At a distance of less than 10 miles from the epicenter is the Perry Nuclear Plant which is a \$5.3 billion dollar facility, nearly complete and designed to generate 1.2 million KW. No nuclear fuel has been loaded into the reactor of the plant. NRC sent inspectors from Chicago and Bethesda to inspect and evaluate the plant for damage. Their reported findings include, hairline floor and wall cracks, and several minor leaks in non-safety piping, all of which were repaired. It could not be determined if the behavior noted was caused by the earthquake. Federal regulators will be reporting very soon their evaluation of the plant's design adequacy and structural integrity.

The Cleveland Electric Illuminating Co. has prepared a comprehensive report entitled "Seismic Event Evaluation Report, Perry Nuclear Power Plant." Docket Nos. 50-440, 50-441, dated February 1986 which has been made available to the U.S. Nuclear Regulatory Commission.

The time history seismic design basis for the Perry Station is shown in Figure 1. By way of comparison, the measured time history from the earthquake is shown in Figure 2. Obviously, the measured earthquake is characteristic of short duration, low energy, high frequency motion with little potential for damage. The design basis motion contains high energy, broad frequency and long duration associated with damaging strong motion earthquakes as shown in the Figure 1 time history motion.