April 5, 1988

Docket No. 50-461

Mr. Frank Spangenberg
Manager - Licensing and Safety
Clinton Power Station
Post Office Box 678
Mail Code V920
Clinton, Illinois 60690

Dear Mr. Spangenberg:

SUBJECT: SUMMARY OF THE CLINTON POWER STATION SITE VISIT CONCERNING THE INSPECTION OF THE CONFIGURATION AND FUNCTIONAL CHARACTERISTICS OF SEISMIC INSTRUMENTATION

On December 1 and 2, 1987, a site visit was conducted in order to gain a better understanding of the configuration of the seismic instrumentation at the Clinton Power Station and to discuss the problems encountered during and after the June 10, 1987 earthquake. The locations and installation features of all but one of the seismic sensors (the "free field" sensor is buried under several feet of soil) were inspected. It appears that all of the inspected units were installed and anchored properly. This observation includes the Response Spectrum Recorder (RSR) in the circulating water screen house (CWS) whose baseplate has now been properly grouted to the concrete slab foundation. A summary of this inspection tour is enclosed.

In light of the findings and observations summarized in the enclosure, please provide a response which addresses the actions which have either been taken, or are contemplated, to improve the reliability of the seismic instrumentation and the plant reaction procedures in the event of a future significant earthquake event. For further information or clarification, please contact me at (301) 492-1397.

Original Signed by/

Janice A. Stevens, Project Manager
Project Directorate III-2
Division of Reactor Projects - III, IV, V and Special Projects

Enclosure: As stated

cc: G. Giese-Koch, ESGB
S. Ray, SRI
R. Cooper, RIII

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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SUMMARY OF THE CLINTON POWER STATION SITE VISIT CONCERNING THE INSPECTION OF THE CONFIGURATION AND FUNCTIONAL CHARACTERISTICS OF SEISMIC INSTRUMENTATION

Potential problems observed during the inspection tour included the following:

- The metal boxes enclosing the seismic sensors constitute, structurally, an integral part of the baseplate to which the sensors are attached. Thus any severe accidental impact with these boxes caused by plant personnel action would be recorded by the sensors. Partial protective railings have been provided for sensors mounted on or near the floor. However, most sensor units can be accessed from the side which, in some cases, is necessary because the electrical (switch) boxes are mounted above the sensor units. Therefore, sensors are susceptible to falling objects and other impact type disturbances. A solution to this type of accidental excitation would be to protect the units with free standing box-type enclosures.

- The anomalously high accelerations recorded by the (passive) peak recording accelerographs ($\geq$1g) could not be attributed to accidental impact. All three peak accelerographs installed in the plant are mounted in relatively remote areas where accidental impact related disturbances are unlikely. Readings obtained after the units had been equipped with new recording plates showed similarly high accelerations which could not be attributed to any physical phenomenon except perhaps inadvertent recording during plate installations (a problem reported by other utilities as well as the manufacturer).

Following the inspection tour, the seismic monitoring equipment operational characteristics were discussed with technical personnel from the Illinois Power Company (IPC) Engineering Department.

Points of discussion were:

- Circuitry and operational logic for the activation of the seismic recorders, the seismic spectrum analyzer, and the OBE exceedence alarms;

- Redundancy of starting equipment;

- Potential damage from lightning strikes as a result of earlier experience; and

- Electrical noise suppression and shielding practices.

Significant findings as a result of these discussions were:

- The activation of the entire (active) seismic monitoring system depends on the signal generated by one sensor located in the Fuel Building at elevation 712'. Although the system has the option for multiple starts from any number of sensors, the present configuration does not provide for redundancy in the case of malfunctioning of one sensor unit. During the earthquake occurrence of June 10, 1987, all seismic sensors were in an operational mode, although the recording unit had malfunctioned and was not operational at the time. If the system had been equipped with a redundant trigger option, the Response Spectrum Analyzer (RSA) could have been turned on by the system and a response spectrum of the motion recorded could have been obtained from the "on-line" sensor. In that case, only the information from sensors feeding into the recording unit would have been lost.

- Spurious alarm signals from the seismic monitoring equipment which were not related to earthquake induced motion caused several alarm conditions on the seismic alarm panel in the control room. Since the system had been declared "not operational" because of malfunctions in the recording unit, the control room operator turned off the entire active system which prevented any data acquisition by properly functioning components of the system, such as the RSA discussed previously, when the June 10, 1987 earthquake occurred. The problem of erroneous alarms as a result of induced noise was discussed. IPC reported that they had modified the circuitry to eliminate spurious alarms.

- The destruction of the seismic sensor in the "free field" location and the electrical shorts experienced on the seismic control panel inside the control room as a result of a lightning storm were discussed. Conditions which make this conclusion plausible are (a) the free field sensor is anchored to a buried slab of concrete in close proximity to a microwave transmission tower which is provided with an extensive ground-grid to prevent damage by lightning, and (b) the sensor cable which transmits the electrical signal to the control panel within the main plant structure is shielded and grounded to the main plant ground-grid.

  Thus when lightning struck the microwave tower, the microwave tower ground-grid potential was raised with respect to the (distant) ground potential of the main plant structure. The electrical damage experienced within the control panel could very well have been the result of electrical shorts as a result of this condition. IPC reported that they are implementing a lightning arrestor type system to prevent future repetition of lightning related malfunctions of the seismic monitoring system.

- In cases where the OBE levels of ground motion have been exceeded during an earthquake, the control room operator is informed of this condition in two ways: (1) the seismic switch located on the Fuel Building basemat (plant foundation) operates an annunciator on the control room display panel, and (2) the Response Spectrum Analyzer activates an annunciator at the control room display panel indicating that information received for the on-line sensors has exceeded the OBE design spectrum at one or more frequencies. An important feature of the OBE exceedence switch is that instead of being activated at the OBE high frequency acceleration of 0.10g as reported in the Clinton Safety Evaluation Report (Sections 2.5 and 3.7), it is activated at the OBE high frequency level obtained from the actual earthquake time history used in the structural design (Clinton FSAR Section 3.7). IPC reported these accelerations to be 0.11g for horizontal motion and 0.13g for vertical motion.

- During the plant walkdown immediately following the June 10, 1987 earthquake, it was noted that the baseplate of the (passive) Response Spectrum Recorder had not been properly grouted to the concrete floor to which it was anchored by eight 3/4" diameter studs. IPC engineering staff performed an analysis of the plate in its ungrouted configuration and determined that the resonant frequencies in the horizontal and vertical direction were at least an order of magnitude higher than those frequencies of significance to the seismic design of the plant (≤35Hz). Mounting features of several other seismic monitoring sensors which appeared to have flexible mounting were also discussed with IPC. IPC indicated that in all cases the mountings were sufficiently rigid to have resonant frequencies much higher than 35Hz.

At the completion of these discussions with personnel from the IPC Engineering Department, an exit meeting was held with IPC management and engineers. At this meeting, the findings from the inspection tour were discussed and the following improvements were suggested:

- Additional protection for seismic sensors by means of free standing protective covers;

- Additional (redundant) logic circuitry for the seismic recording system to provide multiple triggering of the recording equipment;

- A program of periodic checks of the (passive) peak-recording accelerographs to gain insight into the reported malfunctioning of the equipment; and

- Additional information either in FSAR Section 3.7.4 or in the Technical Specifications indicating the actual Zero Period Acceleration (ZPA) value of the OBE exceedence annunciation.

Engdahl Enterprises, the consultant to IPC on seismic instrumentation, found that the (passive) Response Spectrum Recorder in the circulating water screen house operated properly and that the records obtained from the June 10, 1987 earthquake were reliable ground motion records (site response records). These records indicate that the Clinton OBE response spectrum was exceeded at frequencies of 20 Hz and above.