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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING APPEAL BOARD

Administrative Judges:

Alan S. Rosenthal, Chairman
Dr. W. Reed Johnson
Howard A. Wilber

March 20, 1986

In the Matter of	)	
CLEVELAND ELECTRIC ILLUMINATING COMPANY, ET AL.	)	Docket Nos. 50-440 OL 50-441 OL
(Perry Nuclear Power Plant, Units 1 and 2)	)	

MEMORANDUM AND ORDER

A. On January 31, 1986, an earthquake occurred in northeastern Ohio (hereafter referred to as the 1986 Ohio earthquake or event). The earthquake measured 5.0 in magnitude and its epicenter was located approximately ten miles south of the Perry nuclear facility.

Three days later, on February 3, intervenor Ohio Citizens for Responsible Energy (OCRE) filed a motion to reopen the record in the Perry operating license proceeding for the purpose of admitting a new contention challenging the adequacy of the facility's seismic design.[1] The

[1] Motion to Reopen the Record and to Submit a New Contention ("motion"). The proceeding is currently before us on the appeals of OCRE and intervenor Sunflower Alliance from the Licensing Board's concluding partial initial decision. LBP-85-35, 22 NRC 514 (1985).

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foundation of the motion was the only information then available to OCRE -- early newspaper accounts to the effect that the 1986 Ohio earthquake had caused vibratory ground motion (acceleration) at the facility of 0.19 to 0.25 g.[2]

In contrast, the design basis Safe Shutdown Earthquake (SSE)[3] for Perry has a nominal peak, or zero period, acceleration of 0.15 g. More precisely, the value of 0.15 g

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[2] The acceleration associated with an earthquake is expressed in terms of a percentage of "g" (one g represents the gravitational acceleration of a free falling body).

[3] As previously explained:

> The SSE for a particular site is that earthquake "which is based upon an evaluation of the maximum earthquake potential considering the regional and local geology and seismology and specific characteristics of local subsurface material" and "which could cause the maximum vibratory ground motion at the site . . . ." 10 CFR Part 100, Appendix A, §III(c), §V(a). The nuclear power plant must be designed so that, should the SSE occur, "certain [specified safety] structures, systems, and components will remain functional". Id., §VI(A) . . . .
>
> In short, the SSE is the earthquake postulated for the purpose of determining the adequacy of the seismic design of the facility. The plant has to be capable of being safely shutdown despite the effects of whatever vibratory ground motion might be experienced at the site as a result of the SSE. (One of the elements of the SSE determination is, of course, an ascertainment of the amount of such motion (Id., V(a)).)

Public Service Co. of New Hampshire (Seabrook Station, Units 1 and 2), ALAB-667, 15 NRC 421, 423 (1982) (quoting from Dairyland Power Coop. (La Crosse Boiling Water Reactor), ALAB-618, 12 NRC 551, 552 (1980)).

is used to anchor the high frequency end of the response spectrum selected to represent the design basis SSE.[4]

After setting forth the reason for its submission, the OCRE motion went on to address the well-established tripartite test governing the reopening of an evidentiary record to consider new evidence:

> (1) Is the motion timely? (2) Does it address significant safety (or environmental) issues? (3) Might a different result have been reached had the newly proffered material been considered initially?[5]

Still further, because it sought to inject a new issue into the proceeding, the motion discussed the five factors set

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[4] The import of this concept can be gleaned from the discussion in our 1982 decision in connection with the seismic reanalysis that was undertaken for the Diablo Canyon facility in the wake of the discovery of a significant geologic fault in proximity to that facility. For the convenience of the reader, we are including the text of that discussion in an Appendix to this order.

[5] Pacific Gas and Electric Co. (Diablo Canyon Nuclear Power Plant, Units 1 and 2), ALAB-598, 11 NRC 876, 879 (1980), cited with approval in Metropolitan Edison Co. (Three Mile Island Nuclear Station, Unit 1), CLI-85-2, 21 NRC 282, 285 n.3 (1985). The Commission's use of this test has received judicial approval. Three Mile Island Alert, Inc. v. NRC, 771 F.2d 720, 732 (3d Cir. 1985), petition for cert. filed sub nom., Aamodt v. NRC, 54 U.S.L.W. 3463 (U.S. Dec. 18, 1985) (No. 85-1095) (citing San Luis Obispo Mothers for Peace v. NRC, 751 F.2d 1287, 1316-18 (D.C. Cir. 1984), vacated in part and reh'g en banc granted on other grounds, 760 F.2d 1320 (1985)).

forth in 10 CFR 2.714(a)(1) that control the acceptance or rejection of late-filed contentions.[6]

The applicants and the staff oppose the motion to reopen primarily on the ground that the 1986 Ohio earthquake, and the seismic effects and records generated by that event, do not present a significant safety question.[7]

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[6] See Duke Power Co. (Catawba Nuclear Station, Units 1 and 2), CLI-83-19, 17 NRC 1041 (1983).

[7] Applicants' Answer to OCRE Motion to Reopen the Record and to Submit a New Contention (February 25, 1986) ("Applicants' Answer"); NRC Staff Response to Motion to Reopen the Record filed by Ohio Citizens for Responsible Energy (March 5, 1986) ("Staff Response").

Both the applicants and the staff criticize OCRE's failure to establish affirmatively that the earthquake has safety significance for Perry. The criticism is unjustified. With good reason, OCRE obviously felt constrained to file its motion immediately -- i.e., before the implications of the event in terms of the nuclear facility had been ascertained. Beyond that, it was enough for OCRE to call attention to the apparent fact that the earthquake exceeded the design basis SSE in at least one respect. That fact shifted the burden of going forward to the applicants. In short, it became their obligation to demonstrate that there nonetheless was no reason to be concerned about the adequacy of Perry's seismic design.

In addition, the staff (although not the applicants) advances the argument that the timeliness of the OCRE motion is "questionable." The staff recognizes, of course, that "information about the actual earthquake could not have been previously submitted." It maintains, however, that it "could be argued" that "this event per se, does not constitute new information which for the first time raises a concern about the seismic design of [Perry] . . . ." This is said to be so because the earthquake was "within the magnitude of earthquakes" described in the applicants' Final Safety Analysis Report and the staff's Safety Evaluation

(Footnote Continued)

On this score, the applicants' response is accompanied by several attachments which provide a considerable amount of information about the earthquake as it was recorded at the Perry facility, and as it appeared to affect that facility. For its part, the staff's response includes (in the form of affidavits and a separately submitted Supplement to its Safety Evaluation Report) an analysis and evaluation of information provided by the applicants. The ultimate conclusion of the staff experts corresponds with that of the applicants' affiants. We are told that, despite the fact that the 1986 Ohio earthquake caused vibratory ground motion which resulted in response spectra that exceeded the SSE spectra in the high frequency range, the characteristics of that earthquake and its motion were such as to pose no significant threat to Perry structures or equipment -- and hence provide no basis for an alteration in the facility's design basis SSE.

(Footnote Continued)
Report "as historically occurring in the region of the [Perry] site and considered in the [facility's] seismic design." Staff Response at 4-5.

Almost anything "can be argued." But this line of reasoning is so patently insubstantial that its presentation accomplished nothing more than a waste of our time. We need not pause to consider whether, as the staff insists, OCRE had some possible basis for challenging the Perry seismic design in advance of the earthquake. For, be that as it may, it is beyond cavil that, given its location and recorded motion at the plant site, the earthquake was a new development -- in the realm of actuality and not merely theory -- bringing about a fresh possible safety concern.

B. OCRE's motion presents what is, at least on the surface, evidence of a significant safety matter -- a situation in which an earthquake has caused ground motions at a nuclear power plant site which exceed values established for the SSE. On the other hand, the applicants and the staff present strong, technically-based arguments to the effect that, superficial appearances notwithstanding, the 1986 Ohio earthquake did not exceed the design basis in any significant way and, therefore, such an event poses no threat to the facility.

Even with regard to so seemingly simple an issue as safety significance, it is difficult to make an informed judgment on the basis of preliminary written materials where, as here, the combined and complicated fields of geology, seismology and engineering mechanics come into play. In this connection, our examination of the documentary submissions of the applicants and staff have given rise to several questions that, in our view, require further exploration before we can decide with any degree of confidence whether a reopening of the record is justified. Moreover, to this point at least, OCRE has not given us any cause to believe that, were we to admit its new contention for litigation, it would be able to make a substantial contribution to its resolution. This, too, is a matter that

calls for further exploration in advance of our action on the motion.[8]

To these ends, we intend to hold a hearing at a location in the Cleveland area. The hearing will commence on a date yet to be fixed and should last no more than two or three days. Given its limited purpose -- to aid our determination on whether there is warrant to reopen the record for the admission and full litigation of OCRE's newly proposed seismic contention -- no discovery will precede the hearing.

We will conduct a prehearing conference with the parties by telephone at 3:00 p.m. on Tuesday, April 8, 1986. At that time, we will wish to be informed regarding the witnesses that will be produced at the hearing and whether any party intends to furnish documentary material beyond that already supplied in connection with the reopening motion and the responses to it.[9] A schedule will be

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[8] As earlier noted, the admission of a late contention is governed by the five factors listed in 10 CFR 2.714(a)(1). A particularly important factor is "[t]he extent to which the [contention proponent's] participation may reasonably be expected to assist in developing a sound record."

[9] OCRE may, but need not, present testimony at this hearing. As earlier observed, however, it will be expected to provide a clear indication of the likely nature and extent of its participation in the adjudication of its proposed contention should the motion to reopen be granted and the contention admitted to the proceeding.

established for the submission in advance of the hearing of both (1) any such material and (2) written responses to the requests for additional information set forth later in this order. Moreover, following receipt of the views of the parties, we likely will set during the conference, at least tentatively and possibly finally, the date for the start of the hearing.

Each party is to notify the Secretary to this Board of the name(s) and telephone number(s) of the person(s) who will participate in the conference on its behalf. Such notification can be either by telephone or by letter, but must be received by the Secretary no later than 5:00 p.m. on April 4.

C. In connection with the upcoming hearing, the parties will be free to present documentary material and testimony that is germane to the subject under exploration. We will expect the applicants and the staff to address, at minimum, the matters listed below -- both in writing and through qualified witnesses at the hearing.[10] In addition, each party is to have witnesses at the hearing who are qualified and prepared to answer questions regarding every other submission upon which that party may rely -- whether

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[10] OCRE may likewise address the questions but is not obliged to do so.

the particular submission is now on file or, rather, is subsequently filed on the schedule to be established in the April 8 telephone conference.

These are the matters that we specifically desire the applicants and the staff to address in their prehearing written submissions and at the hearing itself:

1. Seismic motion due to the 1986 Ohio earthquake was recorded at four foundation level locations at Perry by instruments from which response spectra were derived. Two recorders were located at the Auxiliary Building foundation mat (D51-R180 and D51-R190) and two at the Reactor Building foundation mat (D51-N101 and D51-R160).[11] We are told that these recordings would be similar to free-field ground motion.[12] Of the 12 spectra that might possibly have been obtained from the recorders -- a spectrum for the north-south, east-west, and vertical directions for each instrument -- nine appear to exceed the Perry design spectra beyond

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[11] Applicants' Answer, Attachment 5, Tables 1 and 3. Henceforth, attachments to the Applicants' Answer will be referred to simply as "Attachment __."

[12] Staff Response, Lee Affidavit at 4 and 5. Henceforth, references to affidavits filed with the Staff Response will be only to the author (e.g., the "Lee Affidavit").

frequencies in the range 15-to-20 cycles per second (Hz).[13]

(a) In figures in which 1986 Ohio spectra measured at the foundation are compared to Perry SSE design spectra (i.e., Attachment 5, Figures 20-25), the "design" spectra presented appear to be amplified beyond the basic SSE spectra (compare with Figure 2). Explain the basis for the "design" spectra shown in Figures 20-25.

(b) 10 CFR Part 100, Appendix A, § V(a)(1)(iv) requires that the SSE be defined by response spectra. Do not the results cited above demonstrate that Perry does not strictly meet the Part 100 requirements, inasmuch as the specified SSE spectra have been exceeded over a portion of the frequency range? And is this not of safety significance?

(c) A response spectrum represents a shorthand measure of the ability of a seismic event, over its entire duration, to affect structures, systems or components as characterized by their particular natural frequencies. Does not the fact that the

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[13] Applicants' Attachment 5, Figures 20-25, and Attachment 3, p. 10, for east-west data for D51-R160.

SSE response spectra were exceeded in the high frequency range indicate that structures or equipment having frequencies in this range were apt to have been excited beyond their design levels?

2. Attachment 5 relates (at 21-22) that analyses have been performed of the effects of the 1986 Ohio event on pumps and motors having natural frequencies of about 19 Hz. We are told that resulting stresses were "under design allowable." Id. at 21. In apparent reference to these analyses, however, the staff notes that "resulting stresses and deflections at critical locations may slightly exceed the original calculated values" (Lee Affidavit at 3).

(a) Provide in clear and concise form the results of all analyses in which the mechanical effects (i.e., stresses, etc.) of the 1986 Ohio event on structures, systems or components at Perry have been calculated, including a comparison with the results of similar calculations for which the SSE was the input motion.

(b) If the comparison of these analyses indicates that, as implied in the Lee Affidavit, stresses caused by the 1986 Ohio event may exceed those that would be caused by the design SSE, explain why this would not have safety significance.

3. Table 2 of Attachment 5 presents a comparison of design zero period accelerations (ZPAs) with ZPAs recorded during the 1986 Ohio event. The recorded values presented are obtained from five of eight seismic motion recording devices that were located at Perry at the time of the earthquake. Table 2 purports to illustrate that the intensity of the 1986 Ohio event was generally less than that of the SSE (Attachment 5 at 18 and 19).

(a) Explain the bases for the SSE values of ZPA used in the table for the Auxiliary Building and Reactor Building foundation mat locations.

(b) Explain the relevance of ZPA data in an analysis of this kind, in light of the applicants' claim (Answer at 23 to 28) that high acceleration peaks are of little concern in determining earthquake effects.

(c) Data from two recorders on the Auxiliary Building foundation mat (D51-R180 and D51-R190) and one on the Reactor Building foundation mat (D51-R160) are not included in Table 2. Because it appears that the conclusions one might draw from the table would be altered significantly if these data were included, explain their omission. If no good technical reason exists for ignoring these data, recreate those portions of the table in which they

should be included and present the conclusions therefrom.

(d) Explain Note 2 of Table 2 (the data from D51-R170 are presented on page 11 of Attachment 3).

4. The 1986 Ohio earthquake falls almost exactly on a straight line that can be drawn between the 1937 Anna, Ohio earthquake, and the 1929 earthquake at Attica, New York. All three of these events had approximately the same magnitude. Is there any possible seismic significance to be drawn from these facts?

It is so ORDERED.

FOR THE APPEAL BOARD

C. Jean Shoemaker
Secretary to the
Appeal Board

The Appendix to this order follows, p. 14, et seq.

APPENDIX

Excerpt from Pacific Gas and Electric Co. (Diablo Canyon Nuclear Power Plant, Units 1 and 2), ALAB-664, 13 NRC 903, 923-25 (1981) (footnotes omitted except as otherwise indicated):

Earthquake motion can be described in terms of displacement (the distance the ground moves at any given point during an earthquake); velocity (the speed of that ground movement); and acceleration (the rate at which that velocity changes expressed in terms of "g," the acceleration of gravity). In order to assess earthquake effects, a building or mechanical system may be conceived of as a damped, harmonic oscillator having a particular frequency. When such oscillators are subjected to the vibratory motion induced by an actual or postulated earthquake, their maximum reactions in terms of displacement, velocity, and acceleration can be predicted by means of a "response spectrum."[40] The spectrum can then be used both to design

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[40] More definitively, a response spectrum is the result of an analytical procedure whereby a number of one-degree-of-freedom harmonic oscillators, each having the same degree of damping but with different natural frequencies, are driven by the time-dependent motion characteristic of a real or postulated seismic event. For a particular event and degree of damping there will be a time-dependent response which varies for oscillators of the different frequencies. The maximum values of the response of the oscillators in terms of acceleration, velocity and displacement, may be plotted as a function of the frequency of the oscillators being excited. Such a plot can be produced for any one of the three parameters taken

(Footnote Continued)

and to analyze structures, components, and systems for their capability to withstand earthquake induced stresses. The development of such response spectra is required by the governing regulations. 10 CFR Part 100, App. A, § VI(a).

For the reanalysis of the Diablo Canyon facility the applicant and the NRC staff each prepared a basic response spectrum to characterize the motion at the Diablo Canyon site assuming a magnitude 7.5 earthquake on the Hosgri Fault. Both took a value of 0.75g for the high frequency

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(Footnote Continued)
individually. Because of the relationship among acceleration, velocity and displacement under harmonic motion, a tripartite plot showing the maximum responses in acceleration, velocity and displacement as a function of oscillator frequency may also be prepared (see, e.g., Regulatory Guide 1.60, Figure 1).

The term "damping", as it pertains to the response of a simple harmonic oscillator, relates to internal, friction-like processes by which the initial kinetic and potential energy of the oscillating system are transformed into heat, thus reducing the amplitude of the oscillation. The analysis of the motion of the harmonic oscillator system proceeds under the assumption that the motion is in the linear or elastic range (i.e., the restoring force is directly proportional to the displacement). * * * *

Response spectra tend to have jagged peaks and valleys. For engineering analysis and design purposes these can be evened out either (1) by drawing a smooth curve enveloping the peaks (or by averaging the peaks and valleys), or (2) by statistically combining individual spectra derived from similar earthquakes. When so smoothed they are sometimes called "design response spectra." See NRC Regulatory Guide 1.60 at p. 1.60-3 (Rev. 1, December 1973).

anchor point acceleration for the spectrum.[43] Variations of these spectra, modified to reflect specific effects believed to be active at that site, were then used to provide the basis for the seismic reanalysis of the Diablo Canyon facility. * * * *

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[43] * * * * The most commonly measured characteristic of earthquake motion, obtained using a seismograph, is the time-dependent acceleration of the ground (or some other foundation of the seismograph) during the earthquake * * * *. In an earthquake, a hypothetical very rigid structure (i.e., one with very high natural frequencies) would shake in phase with the motion of the ground itself -- and the ground motion would not be amplified in the building. For this reason, the high frequency or "zero period" portion of the response spectrum provides a convenient point from which to scale the standard spectrum; hence the high frequency end of the spectrum is called the anchor point. In Regulatory Guide 1.60 the staff indicates that a building whose natural frequency is 33 hertz or greater will move with the acceleration of the ground. The natural frequencies of nuclear facility buildings lie in the range of 1 to 10 hertz and, in that range, structures will experience some motion amplification * * * *.

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NUCLEAR REGULATORY COMMISSION

In the Matter of	
CLEVELAND ELECTRIC ILLUMINATING COMPANY, ET AL. (Perry Nuclear Power Plant, Units 1 and 2)	Docket No.(s) 50-440/441-OL

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing LB Order re: Motion to Reopen have been served upon the following persons in accordance with the requirements of 10 CFR section 2.712.

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Dated at Washington, D.C. this
20 day of March 1986

Office of the Secretary of the Commission

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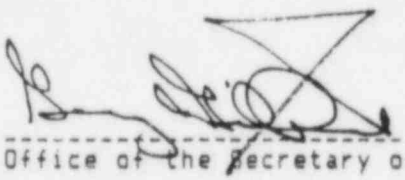
Dated at Washington, D.C. this
20 day of March 1986



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