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77 South Wacker Drive
Chicago, Illinois 60606
(312) 567-5050

May 31, 1983

Ivan W. Smith, Esquire
Administrative Judge and
Chairman
Atomic Safety and Licensing
Board
U.S. Nuclear Regulatory
Commission
Washington, D.C. 20555

Dr. Richard F. Cole
Administrative Judge
Atomic Safety and Licensing
Board
U.S. Nuclear Regulatory
Commission
Washington, D.C. 20555

Dr. Dixon Callihan
Administrative Judge
Atomic Safety and Licensing Board
c/o Union Carbide Corporation
P.O. Box Y
Oak Ridge, Tennessee 37830

Re: In the Matter of Commonwealth Edison Company
(Byron Nuclear Power Station, Units 1 and 2)
Docket Nos. 50-454 and 50-455)

Gentlemen:

Please find enclosed a copy of the League's Proposed Findings of Fact and Conclusions of Law, sent pursuant to regulation, Section 2.754 and the Stipulation entered on August 18, 1982.

Also please be informed that three copies of the enclosed document have been mailed to the Secretary, and one copy of same has been mailed to each concerned party, the names and addresses of which are indicated on the attached Service List.

Thank you.

Very truly yours,

David C. Thomas (mm)
David C. Thomas

DCT:mm
Enclosures

D503

SERVICE LIST

* Mr. Ivan Smith
Administrative Judge and Chairman
Atomic Safety and Licensing Board Panel
Room 428
East West/West Towers Bldg.
Bethesda, MD. 20114

* Dr. Richard F. Cole
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Chief Hearing Counsel
Office of the Executive Legal Director
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dr. A. Dixon Callihan
Union Carbide Corporation
P.O. Box Y
Oak Ridge, Tennessee 37830

* Dr. Steven C. Goldberg
Ms. Mitzi A. Young
Office of the Executive Legal Director
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Atomic Safety and Licensing Appeal Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

* Secretary
ATTN: Chief, Docketing and Service Section
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

* Ms. Diane Chavez
SAFE
326 N. Avon St.
Rockford, IL 61103

Dr. Bruce von Zellen
Department of Biological Sciences
Northern Illinois University
DeKalb, Illinois 60115

* Douglass W. Cassel, Jr.
Jane Whicher
BPI
Suite 1300
109 N. Dearborn
Chicago, IL 60602

** Isham, Lincoln & Beale
Three First National Plaza
Chicago, IL 60602

* Federal Express
** Messenger

I. FINDINGS OF FACT

A. League Contention 106 - Seismology

1. Pursuant to stipulation, original contention 106 was altered. Alternate contention 106, as litigated, reads as follows:

> There exist serious seismic related site problems discovered subsequent to the construction permit herein which indicates that the seismic design for Byron is not such that there exist assurance that these problems are adequately resolved in accordance with applicable regulations, including but not limited to 10 CFR 50.57 (a)(3)(i), 50.57 (a)(6) and 10 CFR Part 100, Appendix A. Specifically, the Rockford League of Women Voters contends that due to the lack of reliable information regarding the causes of earthquakes which have been experienced in northern Illinois, Edison should be required to perform strain gauge tests on faults cutting basement rock located in the northern Illinois region where earthquakes of modified Mercalli VII or greater intensity are expected to occur. Further, recent evidence from the central portion of the United States shows that neither the Byron designated safe shut down earthquake peak ground acceleration value of 0.20(g) nor the operating basis earthquake peak ground acceleration value of 0.09(g) are sufficiently conservative. Ground acceleration significantly greater than both of these values are possible at the Byron site. In addition, it is not known if the recently discovered Plum River Fault is a capable fault. This fault is known to approach the Byron site within 5.3 miles and may even be closer if the fault extends further to the east.

2. The League presented as its witnesses, the testimony of Dr. Henry H. Woodard, Ph.D. in Geology, University of Chicago and Chairman of the Geology Department of Beloit College in Wisconsin. Dr. Woodard has worked for the United States Geological Survey and has conducted extensive research into the geologic structures of Central North America. Witnesses for the Nuclear Regulatory Commission were Dr.

Ina B. Alterman, a staff geologist in the geosciences branch in the Office of Nuclear Reactor Regulation of the NRC, and Dr. Robert L. Rothman, a seismologist in the geosciences branch in the Office of Nuclear Regulation of the NRC. The witnesses for the Applicant were Mr. Alan K. Yonk, a senior geologist at Sargent and Lundy (the Byron station architect-engineer) and Dr. Anand K. Singh, a structural engineer and Assistant Division Head of the Dynamic Analysis Section of Sargent and Lundy.

3. At the construction permit stage of review both the Applicant and the Illinois Geological Survey, on whom it relied, failed to reveal the presence of the Plum River Fault (Alterman, Prepared Testimony, p. 3).

4. Escavation of the Byron site exposed to the Applicant to the fault structure which direct observation indicated had been analyzed incorrectly (Yonk, Prepared Testimony, p. 2; Alterman, Prepared Testimony, p. 2).

5. Sargent and Lundy and Dames and Moore, a geotechnical and environmental consulting firm examined the small faults found in the excavation site. The capability of these faults is not in dispute (Yonk, Prepared Testimony, p. 2).

6. The Applicant relied on a study conducted by the Illinois State Geological Survey (ISGS) to re-evaluate the other fault structures in the vicinity of the plant (Yonk, Prepared Testimony, p. 6).

7. The ISGS survey which re-evaluated the area around the Byron site (Alterman, Prepared Testimony, p. 2) revealed the presence of the Plum River Fault in the bedrock

(Yonk, Prepared Testimony, p. 5; Alterman, Transcript, pp. 763, 867).

8. Essentially, the techniques of seismic refraction and core drilling employed by the ISGS provided sufficiently accurate data to establish the presence of the Plum River Fault in the bedrock (Alterman, Tr. pp. 763, 832, 867-868; Rothman, Tr. pp. 870-871).

9. The critical information yielded by these techniques were the gross observations that 1) there was rock of different types on either side of the drill holes (Alterman, Tr. p. 832) and 2) there was considerable difference in the bedrock velocity which indicated some type of alteration in the lithography (Alterman, Tr. p. 791).

10. The ISGS as well as the study by Dames and Moore, revealed that interglacial residual soil and glacial till, which was deposited 125,000 years ago, overlies the fault zone (Yonk, Tr. p. 461; Alterman, NRC Staff Prepared Testimony, at 8, ff. Tr. p. 753).

11. The eastern end of the Plum River Fault Zone is known to approach the Byron site within 5.3 miles northwest of the Byron plant site (Yonk, Prepared Testimony 5 ff, Tr. p. 478; Alterman, NRC Staff Prepared Testimony at 3, ff., Tr. pp. 753, 812). Because the eastern end of the fault zone is not exposed, it is unclear as of the present whether the fault zone extends inside the five-mile radius circle drawn by the Regulation in Part 100, Appendix A. Also, no investigations were conducted to determine if the Fault does approach the five-mile regulatory limit. (Woodard, Prepared Testimony, p. 2; Alterman, Tr. pp. 814-815).

12. Accordingly, the Board finds that the ISGS data sufficient to establish the presence of a fault in the bedrock but insufficient to establish that the fault does not fall within the five-mile regulatory limit.

13. One of the critical questions for determining whether the Plum River Fault is capable is whether the till has been offset. (Alterman, Tr. pp. 788, 794, 818; Yonk, Prepared Testimony, p. 6).

14. The critical information which would resolve the question of till displacement with the greatest degree of accuracy can only be obtained through direct observation of the interface between the fault and till overlying it (Woodard, Tr. pp. 567-568). These critical observations have not been made (Woodard, Tr. p. 567; Alterman, Tr. p. 830).

15. One of the most reliable means of directly observing the till-fault interface is by excavation with a backhoe across the Plum River Fault (Woodard, Tr. p. 594). This method is certainly a feasible exercise because the excavation need only extend a few tens of feet to reach the bedrock (Woodard, Tr. p. 574).

16. In addition, no evidence has been adduced to indicate an overburden sufficiently deep on the Plum River Fault, at least at a juncture 5.3 miles near the Byron site, which would obscure the Plum River Fault and thus make the measure proposed by the League either impossible or unpractical.

17. The Applicant chose indirect methods over direct observation for determining whether the till was dis-

turbed once in the past 35,000 or in a recurring pattern in the past 500,000 years. The Applicant contends that the techniques employed to determine the presence of the fault in the bedrock are sufficiently accurate to conclude that there has been no movement of the till in the last 35,000 years and that there has been no recurring fault movement in the past 500,000 years (Yonk, Prepared Testimony, pp. 6-8; Tr. p. 418).

18. The techniques of core drilling and seismic refraction are not sufficiently accurate to make the determination that there has been no displacement of the till (Woodard, Tr. p. 571). Core boring cannot determine the dating of the fault (Alterman, Tr. p. 867). The usefulness of seismic refraction is limited to identifying the presence of the fault in the top of the surface of the bedrock (Alterman, Tr. p. 869). The NRC does not dispute that seismic refraction data cannot yield data of a significant degree of accuracy to determine if the Plum River Fault is capable or not. (Rothman, Tr. p.798.)

19. These techniques are inadequate for at least two major reasons. First, displacement in the till of only a few inches, which if it had occurred in the last 35,000 years would demonstrate a capable fault, would in all probability fail to show up through either of these methods. (Rothman, Tr. p. 798.) Second, If there had been a horizontal movement along the fault neither method would isolate that movement. (Woodard, Tr. 572.)

20. Even accepting the Applicant's conclusion of

125,000 years of no movement, the Board can find no support for the contention that there has been no recurring motion within the past 500,000 years. (Woodard, Tr. 599; Alterman, p. 756.) The Applicant has provided no evidence to establish his contention that there has been no recurring movement in the past 500,000 years. (Yonk, Prepared Testimony, p. 7.)

21. The Board finds that the Applicant has failed to perform the feasible and most accurate form of investigation to determine the capability of the newly discovered Plum River Fault. In addition, the Board finds that the indirect methods of analysis relied on by the Applicant are insufficiently accurate to conclusively resolve the question of whether the Plum River Fault is Capable.

22. Accordingly, the Board is unable to find that the Plum River Fault is noncapable.

23. The NRC's regulations, as set forth in 10CFR Part 100, Appendix A, require that the safe shutdown earthquake, also commonly referred to as the design basis earthquake, is that earthquake which is based upon an evolution of the maximum earthquake potential considering the regional and local geology and seismology and specific characteristics of local subsurface material. It is the earthquake that produces the maximum vibratory ground motion which the structures, systems, and components that are necessary to enable a reactor to shut down and avoid major offsite exposures are designed to withstand. (Singh, Applicant Prepared Testimony, at 3, ff. Tr. 451.)

24. The operating basis earthquake is that earthquake which, considering the regional and local geology and seismology and specific characteristics of local subsurface material, could reasonably be expected to affect the plant site during the operating life of the plant. It is the earthquake that produces the vibratory ground motion for which those features of the nuclear power plant necessary for continuous operation without undue risk to the health and safety of the public are designed to remain functional. If the vibratory ground motion exceeding that of the operating basis earthquake occurs during the life of the plant, the Commission's regulations require that the plant be shut down and that, prior to resuming operations, it must be demonstrated that no functional damage has occurred to those features of the plant necessary for that continued operation without undue risk to the health and safety of the public. (Singh, Applicant Prepared Testimony, at 3-4, ff. Tr. 431.)

25. The selection of ground acceleration values is connected to the determination of the intensity of the earthquake for which a facility is designed. (Singh, Applicant Prepared Testimony, at 4, ff. Tr. 431.)

26. Seven earthquakes have occurred in northern Illinois between 1804 and 1972 with, according to P.C. Heigold, Modified Mercalli intensities ranging from IV to VI. (Yonk, Tr. 466; Woodard, Tr. 551, 553-556, 558.)

27. The seven earthquakes depicted by Heigold have

been interpreted as having Modified Mercalli intensities as high as VII, (Yonk, Applicant Prepared Testimony, at 10, ff.; Tr. 446-447, 478.)

28. The controlling earthquake for the Byron plant is the 1937 Anna, Ohio (which is also located in the Central Stable Region) Modified Mercalli intensity VII-VIII earthquake. (Singh, Applicant Prepared Testimony, at 5, ff. Tr. p. 431).

29. The SSE for Byron is based upon an earthquake with a Modified Mercalli intensity of VIII, which is greater than any earthquake ever recorded in either northern Illinois or the entire Central Stable Region. (Singh, Applicant Prepared Testimony, at 5, ff. Tr. p. 431; Rothman, Tr. p. 849).

30. The Applicant reviewed studies which considered the intensity versus magnitude and earthquakes experienced in the Central United States and selected a magnitude value of 5.8. (Singh, Applicant Prepared Testimony, p. 5).

31. The Applicant did not, however, compute a site specific response spectrum to arrive at an appropriate ground acceleration value. (Singh, Applicant Prepared Testimony, p. 5; Tr. p. 480). Instead, the Applicant reviewed a site specific response spectrum calculated for the Tennessee Valley Authority's Sequoya Nuclear Power Plant, (Singh, Applicant Prepared Testimony, p. 5; Tr. p. 480) and adopted the value of 0.2g computed for sequoyah site.

32. The Applicant changed its approach when it calculated a ground accelerating value for the operating basis earthquake. For the safe shutdown earthquake it

justified the selection of 0.2g surface ground motion by postulating sufficiently conservative estimate of earthquake intensity. (Singh, Applicant Prepared Testimony, p. 5).

33. For reaching an appropriate ground acceleration for the operating basis earthquake, the Applicant began its calculations by first selecting a modified Mercalli intensity VI---value and determined the ground acceleration value from that (Singh, Applicant Prepared Testimony, p. 6).

34. The Applicant justifies its adoption of .09 which is less than the regulatorily required value of .1 (Singh, Tr. p. 489) because of the probabilistic study of the recurrence interval that was calculated without any site-specific basis.

35. Modified Mercalli intensity values are calculations done after an event; they are not the same as instrumental measurements (Yonk, Tr. p. 457-8).

36. The Applicant has ignored the only instrumentally measured data available for determining ground accerlation values. (Woodard, Tr. p. 601 ff.) Data from an earthquake swarm from the central United States was collected in 1982 near Conway, Arksansas. The data suggests that the MM intensities on which the Applicant based its calculations are not conservative enough (Woodard Prepared Testimony, p. 3 ff.; Tr. pp. 601-604).

37. This data revealed that in similar kinds of basement rock that are present at or around the Byron site an earthquake of a magnitude (3.8) significantly less than that postulated for the operating basis earthquake (5.8) generated an acceleration value (.59) almost three times

the ground acceleration value determined for the safe shutdown earthquake. The other value recorded at Arkansas (.19) is also significantly in excess of the ground acceleration value calculated for the Byron generating basis earthquake (Woodard Prepared Testimony, p. 4; Rothman NRC Staff Prepared Testimony, p. 6).

38. There is no satisfactory explanation for the discrepancy (Rothman, Prepared Testimony, p. 4). The fact that the shed in Arkansas containing the records was not damaged was irrelevant because this was an earthquake of extremely short duration which released little energy (Rothman, Prepared Testimony, p. 6).

39. Based on the presence of instrumentally measured ground motion in rock similar to Byron the Board finds that the selection of the Modified Mercalli intensity value is not conservative enough. The evidence prescribed does not justify waiving the 1/2 regulatory requirement for the relationship between the OBE ground acceleration value and the SSE ground acceleration value.