Date: February 15, 1983

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In The Matter of	)	
	)	
	)	
COMMONWEALTH EDISON COMPANY	)	Docket Nos. 50-454 0L
	)	50-455 0L
	)	
(Byron Nuclear Power Station, Units 1 & 2)	)	

SUMMARY OF TESTIMONY OF ALAN K. YONK

Mr. Yonk is a geologist, employed by Sargent and Lundy, the Byron Station architect-engineer. He is familiar with the geology of the plant site and the site vicinity. His testimony is being offered to respond to those portions of the Rockford League of Women Voters' Contention 106 which assert that strain gauge tests should have been performed as part of the geologic and seismic investigation, and that there is insufficient information to determine whether the Plum River Fault is a capable fault.

Mr. Yonk first establishes his qualifications to testify regarding the geology of the Byron area. (pp. 1-2). He then describes the data (excavation reports and scientific literature) which was considered as a part of the geologic investigations, and in particular the investigations of faults in the Byron area. (pp. 2-3). Mr. Yonk continues by describing the manner in which the dates of last movement

Q5 What are your responsibilities with respect to the Byron Nuclear Power Plant?

A5 Originally, I was involved in the review and preparation of some portions of the FSAR pertaining to regional and site geology. Since then, I have been involved in assisting Commonwealth Edison Company during the course of the NRC Staff technical review of the Byron license application, and in reviewing and analyzing matters raised in contentions filed in the NRC operating license proceedings.

Q6 Are you familiar with the studies and investigations which were performed regarding the geology of the Byron site?

A6 Yes.

Q7 Can you briefly describe those studies?

A7 Basically, the studies consist of a review of the scientific literature covering the geology of the Byron environs, geologic mapping of the excavations at the Byron Plant and also a report of small displacement faults discovered at the site.

Q8 Who performed these studies?

A8 The preparation of the FSAR was performed by Dames & Moore and Sargent & Lundy. Dames and Moore is a geotechnical and environmental consulting firm. The mapping of the excavation was performed by Dames & Moore with Sargent & Lundy review in the field. The examination of the small faults found in the excavation was performed by both Dames & Moore and Sargent & Lundy.

TESTIMONY OF ALAN K. YONK ON CONTENTION 106

Q1 Please state your name.

A1 Alan K. Yonk

Q2 By whom are you employed?

A2 Sargent & Lundy Engineers

Q3 Briefly describe your educational and professional background and experience.

A3 I attended Northern Illinois University, majoring in geology. I was awarded a Bachelor of Science degree in 1969, and a Master of Science degree in 1971. I am a Senior Geologist at Sargent & Lundy. In that capacity I supervise geologic studies for both nuclear and fossil fuel power plants. A more detailed statement of my educational and work experience is attached to this testimony.

Q4 To which contention is this testimony addressed?

A4 The League of Women Voters Contention 106. In particular, that portion of Contention 106 which states that "due to the lack of reliable information regarding the cause 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." I will also address that portion of the contention which asserts it is not known whether the "recently discovered Plum River Fault is a capable fault."

of the small displacement faults found on site and the Plum River and Sandwich Faults, which are located in the vicinity of the site, were determined. (pp. 3-6). His conclusion is that the date of last movement was greater than 200,000 years ago. Mr. Yonk then addresses the criteria set forth in Appendix A to 10 C.F.R. Part 100 for determining whether a fault is capable, and provides the basis for his opinion that, under these criteria, the faults, including the Plum River Fault, are not capable faults. (pp. 6-8).

Finally, Mr. Yonk provides the basis for his opinion that it is not necessary to conduct strain guage tests near faults cutting basement rock. His reasons are threefold: (1) such tests are not required by the Commission's regulations and the investigations required by the regulations which were conducted provide a sufficient basis for concluding the faults are not capable; (2) it is questionable whether strain guage tests would provide any additional useful information; and (3) the intensity of the Byron design basis earthquake is greater than the intensity of any earthquake experienced in the area. (pp. 8-9). The final three pages of testimony describe the reasons underlying the selection of the Byron design basis earthquake.

In sum, Mr. Yonk's testimony refutes the League's contention that strain guage testing is necessary, and that the Plum River Fault may be a capable fault.

Q9 Please describe the geology of the Byron site.

A9 The Byron site is basically a rock site. The plant foundations extend into the upper bedrock units which are part of the Ordovician-age Galena Group dolomites. These dolomites are jointed and fractured in the upper formations of the Galena Group. Some solution activity has taken place among the joints with widening of the joints. Some of the joints have minor offsets, which technically qualifies them as faults. These faults were discovered during mapping of the excavation and upon further study it was determined that the maximum vertical offset on any fault was approximately six inches. The lateral extent of the longest small fault encountered in the excavation ranges from 1,000 to 1,800 feet. It was determined that the age of this faulting, based on Dames & Moore/Sargent & Lundy studies and consultation with the Illinois State Geological Survey, was at least pre-Illinoian in age or greater than 200,000 years before present.

Q10 What is meant by the term "fault dating"?

A10 Fault dating consists of examining and analyzing geologic structures and other data to determine the approximate date of last movement of a fault. Faults can be dated by one of two principal methods, absolute and relative age dating. One method of absolute age dating is based on radiometric studies of naturally occurring radioactive isotopes and their daughter

products. This method was considered for dating the Byron faults, but because proper mineralogy was not present at the Byron site to use radiometric dating, it was not utilized.

Q11 What method was used to date the faults at Byron?

A11 We used the relative age dating method. Basically, relative age dating consists of determining the age of a fault by examining the material which overlies the fault. If we know when the overlying material was deposited we can surmise the date of last movement of the fault. Specifically, the small displacement faults at Byron were dated by using regional interpretation of geologic history in Illinois and cross-cutting relationships of the faults. Dating by cross-cutting relationships is a method whereby the fault is traced upward through stratigraphically younger faulted rock to a point where the fault stops and is overlain by unfaulted rock or soil. The age of the fault is therefore older than the age of the unfaulted rock or soil and faulting occurred prior to the deposition of the unfaulted rock or soil.

Q12 Were you able to determine the date of last movement of the displacement faults at the Byron site?

A12 Yes. Studies on the small displacement faults found in the Byron excavation indicated that the faults were continuous to the top of the bedrock surface. However, they did not extend into the overlying soil units. The

age of these soil units was determined to be Illinoian or older. Illinoian soils were deposited approximately 200,000 years before the present. Therefore, the most recent movement of these faults occurred at least 200,000 years ago.

Q13 On what do you base your conclusion that the soil units overlying the displacement faults at Byron were at least Illinoian in age?

A13 The soils and faults were examined by members of the Illinois State Geological Survey, well recognized experts on Illinois geology. The exact formational unit was identified by members of the State Survey who determined that these soils are at least Illinoian in age.

Q14 Have the dates of the most recent movement on faults located in the vicinity of the Byron Plant also been ascertained?

A14 Yes, also by relative age dating. Faults identified in the plant's vicinity are the Plum River Fault Zone and the Sandwich Fault Zone. The best information indicates that the eastern end of the Plum River Fault Zone is approximately 5.3 miles northwest of the Byron site. The western limit of the Sandwich Fault Zone is approximately 6 miles southwest of the Byron site. These two fault zones have been studied by the Illinois State Geological Survey and a report has been issued by the Survey on each of these fault zones. The studies of

the Plum River Fault Zone are discussed in the Illinois State Geological Survey Circular 491 and the studies of the Sandwich Fault Zone are discussed in Illinois State Geological Survey Circular 505. The studies indicate that there is no evidence that the Plum River and Sandwich Fault Zones are connected.

Q15 Do these studies indicate the date of last movement of the Plum River Fault Zone and Sandwich Fault Zone?

A15 Yes. In both cases the date of last movement is prior to the deposition of Illinoian age soils with no evidence of displacement observed in the overlying soils. Thus, as with the small displacement faults on the Byron site, the last movement on these faults occurred at least 200,000 years ago.

Q16 Do you agree with the conclusions reported by the Illinois Geological Survey concerning the age of the Plum River and Sandwich Fault Zones?

A16 Yes. Based on my review of these reports, I believe these conclusions to be accurate.

Q17 Based on your review of the geologic mapping and fault investigations and the Illinois State Geological Survey circulars referred to earlier in your testimony, do you have an opinion whether there has been movement at or near the ground surface of the faults located on or near the Byron site at least once within the past 35,000 years?

A17 Yes. There is no evidence of any movement on these faults within the last 200,000 years let alone the last 35,000 years.

Q18 Do you have an opinion whether there has been any movement of a recurring nature with respect to these faults within the past 500,000 years?

A18 Yes. There is no evidence of any recurring movement on any of these faults within Pleistocene time. Pleistocene is dated to have started approximately one million years before present. Therefore, it is my opinion that there has been no movement of a recurring nature within the last 500,000 years.

Q19 Has there been any macro-seismicity instrumentally determined with records of sufficient precision which is directly related to any of the faults located on or near the Byron site?

A19 No, to my knowledge there is no instrumentally determined evidence of macro-seismicity associated with these faults.

Q20 To your knowledge are any of the faults located on or near the vicinity of the Byron site related to a capable fault such that movement on the capable fault could reasonably be expected to be accompanied by movement on the faults in the Byron site vicinity?

A20 Based on my knowledge of geologic structures in northern Illinois, and my review of the studies and reports regarding faults in the Byron area, I conclude that no fault on the Byron site or in the vicinity of the Byron site has any structural relationship to any capable fault. Indeed, since there is no known Pleistocene faulting known in northern Illinois, there are no

capable faults on which movement could reasonably be expected to cause movement on the faults in the Byron area.

Q21 Getting to Contention 106, the League of Women Voters asserts that strain gauge tests should be performed on faults located in northern Illinois which cut basement rock. In your opinion, is it necessary to conduct such tests?

A21 No, for three reasons. First, the NRC regulations, specifically Appendix A to 10 CFR Part 100, require that the faults in the Byron area be studied to determine whether they are capable faults. This has been done, and based upon the excavations and studies, discussed earlier in my testimony, the evidence is basically irrefutable that the faults in question are noncapable. Commonwealth Edison has clearly complied with the regulatory requirements, and there is simply no practical justification for requiring additional tests, as requested by the League.

Additionally, I do not believe that the information which would result from the very significant effort which would be involved in performing strain guage tests near faults cutting basement rock would be of substantial benefit. In the area in question, the top of the basement rock is at least 3,500 feet below the earth's surface. It is highly questionable whether the faults which the League would have stress tested could be located. Moreover, even if they were located, and

the relative stresses were measured it is unlikely that the information would be of substantial assistance in predicting where or when along the fault, some of which run tens of miles, an earthquake could occur. Therefore, for the purpose of determining the seismic suitability of the Byron site, the information gathered could well be useless.

Finally, and most significantly, because of the very uncertainty of the causes of earthquakes in the northern Illinois region to which the League refers in Contention 106, the Byron Station is designed to withstand the consequences of an earthquake greater in magnitude than any earthquake ever known to have been experienced in the area. Thus, the question of whether further testing and analysis of faults, beyond what is required by the NRC's regulations, should be required is basically irrelevant. Simply put, the plant is designed to withstand an earthquake which is greater than any which could reasonably be experienced in the area, irrespective of what might cause such an earthquake.

Q22 What is the intensity of the earthquake selected for the design of the Byron Station?

A22 The theoretical earthquake selected has an intensity of VIII on the Modified Mercalli scale.

Q23 Why was such an earthquake selected?

A23 Because the faults in the Byron area are not capable

faults, we considered the intensities of earthquakes which have been experienced in the Byron region, and determined that the controlling earthquake for Byron was the 1937 Anna, Ohio MM VII-VIII earthquake. Since an MM VII earthquake has been experienced in the northern Illinois area, the NRC Staff required that the Byron design basis earthquake be an MM VIII earthquake. This value is conservative since the greatest recorded earthquake in the 200 mile area surrounding Byron is the 1909 MM VII earthquake which occurred near Beloit, Wisconsin.

Q24 What is the most recent earthquake which occurred closest to the plant site?

A24 The most recent earthquake which occurred closest to the plant site was the 1972 northern Illinois earthquake which occurred near the town of Amboy, Illinois in Lee County.

Q25 What was the intensity of that earthquake?

A25 The epicentral intensity of this earthquake was a Modified Mercalli VI. The felt intensity at the Byron site based on isoseismal maps was a Modified Mercalli V.

Q26 Do you know what the stress orientation and causative mechanisms were which are associated with this earthquake?

A26 Studies done by Herrmann, a well recognized seismologist from St. Louis University, in 1979 using P wave first motion together with amplitude and phase data from long

period Love and Rayleigh waves indicate that the least principal horizontal stress orientation was N 51° W and the stress regime was strike slip movement. The epicentral depth of this earthquake was between 15 kilometers or 9 miles, and 6 kilometers or 3.6 miles, which places the movement on the strike slip fault well within the Precambrian rock sequence. One of Herrmann's conclusions based on this data was that the northern Illinois earthquake did not correlate with Paleozoic features. This indicates that both the Plum River and Sandwich Fault Zones as well as the small displacement features found at the Byron site are unrelated to the causal mechanisms of the 1972 northern Illinois earthquake.

ATTACHMENT A

PROFESSIONAL QUALIFICATIONS OF ALAN K. YONK

Employment: November 1973 to present

Sargent & Lundy, Chicago, Illinois
Position: Staff Geologist from November, 1973 to October, 1976. Promoted to Senior Geologist in 1976.
Responsibilities: Supervision of geological evaluations of power plant sites to assure technical quality of work performed and coordination of work schedule.

I have been responsible for the planning and administration of geotechnical investigations during the site investigations, construction, and post-construction phases for nuclear and fossil fueled power plants. My duties have included supervision and coordinating the preparation of the geological aspects for siting reports, environmental reports, PSAR's and FSAR's; preparation of responses to NRC licensing questions of PSAR's and FSAR's; participation in licensing hearings for a nuclear power plant design criteria and specifications. I have evaluated soil and sedimentary, metamorphic, and igneous rock types from a standpoint of construction suitability and economic value. I have also evaluated rock for construction purposes on the basis on the rock quality designation method. I have also advised engineers and project management on geological matters. Other facets of my activities include direct contact with clients and consultants.

In addition to the geotechnical investigations for nuclear and fossil fueled power plants, I have also been responsible for the geological aspects of evaluation, exploration, and design of a compressed air energy storage peaking plant.

June, 1971 to May, 1974

Lindgren Exploration Company, Wayzata, Minnesota
Position: Geologist
Responsibilities: Geological and geochemical exploration for base metals in the southeastern United States, concentrating on the geology of the Piedmont: Duties as a geologist were geochemical and geologic scouting, detailed soil and stream sediment geochemical sampling, geochemical interpretation, geologic mapping and interpretation, and some geophysical scouting and interpretation. Assisted in initiating feasibility studies for industrial minerals in the upper Midwest region.

June, 1969 to September, 1969
Lindgren Exploration Company, Wayzata, Minnesota
Position: Summer Staff Geologist
Responsibilities: Geological and geochemical exploration for base metals in the Boulder Batholith region of Montana. Duties were geochemical and geologic scouting, stream sediment geochemical sampling, and geochemical interpretation.

Education:

Bachelor of Science, January, 1969
Northern Illinois University, DeKalb, Illinois
Major: Geology
Minor: Mathematics

Master of Science, June, 1971
Northern Illinois University, DeKalb, Illinois
Major: Geology
Special Interest: Economic Geology

Compressed Air Energy Short Course,
June, 1977, given by Professors
D. L. Katz and E. R. Lady of
University of Michigan

Applied Hydrogeology
University of Illinois - Chicago Circle
Spring, 1981

Publications and Papers Presented:

"A Re-assessment of the Upper Mississippi Valley Lead Isotope Date,: with J. R. Richards and C. W. Keighin; Mineral. Deposita, Vol. 7, 1972.

Karst Development in Silurian and Ordovician Carbonates in SE Jefferson Co., Indiana with A. C. Funk and D. L. Siefken, presented at GSA Annual North-Central section meeting in Bloomington, Indiana, April 10-11, 1980.

Selected Design & Construction Projects Performed by Alan K. Yonk at Sargent & Lundy

Operating Company	Station - Unit	Assignment
Public Service Indiana	Compressed Air Energy Storage	Project Geologist responsible for site evaluation; exploration planning; and well and well-field design.
Commonwealth Edison Co.	Braidwood 1&2 Byron 1&2	Supervision of the preparation of the geology portions to the FSAR and ER.
Commonwealth Edison Co.	Quad Cities 3&4	Supervision and planning for site exploration program. Evaluation of rock quality for construction purposes.
Commonwealth Edison Co.	Byron 1&2	Presentation of groundwater data to NRC and supervision of groundwater monitoring program.
Commonwealth Edison Co.	Braidwood 1&2 Byron 1&2 LaSalle 1&2 Quad Cities 1&2	Evaluation of riprap sources for slope protection.
Illinois Power Co.	Clinton 1	Supervision of FSAR preparation (geotechnical portions). Evaluation of riprap sources for slope protection.
Public Service Indiana	Gibson-Lake	Monitoring of lake for potential seepage and sources of seepage. Evaluations of groundwater monitoring program.
Public Service Indiana	Marble Hill 1&2	Resident Geologist responsible for supervision of Sargent & Lundy field personnel and drilling and geophysical subcontractors involved in site mapping and exploration. Responsible for preparation of groundwater and geologic portions of PSAR and ER. Presentation of material to NRC during licensing meetings.

Site Studies

Operating Company	Assignment
Arizona Public Service Co.	Evaluation of potential sites for development of fossil plants.
Iowa-Illinois Gas & Electri Co.	Site development study including planning of site exploration program.
Kentucky Utilities Co.	Evaluation of potential sites for development of fossil and nuclear plants.
Public Service Indiana	Evaluation of potential sites for development of fossil and nuclear plants.
Southwestern Electric Power Co.	Evaluation of potential Texas sites for development of fossil plant.