12/8/78

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety And Licensing Board

In the Matter of	)	
CONSUMERS POWER COMPANY	)	Docket Nos. 50-329
(Midland Plant, Units 1 and 2)	)	50-330

MEMORANDUM OF CONSUMERS POWER COMPANY
REGARDING THE ENVIRONMENTAL EFFECTS OF RADON

By a Memorandum and Order dated November 6, 1978, the Nuclear Regulatory Commission (the "NRC" or the "Commission") requested that the parties to the construction permit proceedings involving the Midland Plant file memoranda with this Atomic Safety and Licensing Board ("Licensing Board") addressing questions related to the environmental effects of radon. This memorandum of Consumers Power Company ("Consumers Power" or "Licensee") is submitted in accordance with that Order.

The intricate chain of events which led the Midland Plant construction permit proceedings to their current stage has been set forth at length in other pleadings and will not be repeated here. The sole fact which is relevant for purposes of this memorandum is that, in April 1978, the NRC deleted the term encompassing the environmental effects of radon from the interim fuel cycle rule,

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Table S-3, 43 Fed. Reg. 15613 (1978). Thus, by the Commission's November 6 Order, this Licensing Board must consider the radon issue and determine whether the radon emissions in the uranium mining and milling process and resultant health effects are such as to tip the cost-benefit balance against continued construction of the Midland Plant. Consideration of the radon issue is necessary because there was a proceeding in this docket pending before the Commission when the radon term was deleted from Table S-3, notwithstanding the fact that the Supreme Court has upheld the grant of the construction permits for this nuclear facility in Vermont Yankee Nuclear Power Corporation v. NRDC, 98 S.Ct. 1197 (1978).

In assessing the radon question, the Commission directed this Licensing Board to structure its review in accordance with the lead case procedure adopted by the Atomic Safety and Licensing Appeal Board ("Appeal Board") in Philadelphia Electric Company (Peach Bottom Atomic Power Station, Units 2 and 3), ALAB-480, 7 NRC 796 (1978). Under the terms of the Commission's Order, the parties in this proceeding were to review the radon evidentiary record and decision in Duke Power Company (Perkins Nuclear Station, Units 1, 2 and 3), LBP-78-25, 8 NRC 87 (1978); parties could then make certain requests concerning supplementing or objecting to the Perkins record. Additionally, the parties were to brief two specific questions regarding the Perkins

decision and the effect of the radon question upon the cost-benefit balance for the Midland Plant. Consumers Power does not request that additional evidence be received on the radon question or that further hearings be held on the Perkins record; neither does Licensee have any objections to any aspect of the Perkins radon proceeding. Therefore, Consumers Power responds to the questions posed by the Commission.

I. THE PERKINS EVIDENTIARY RECORD SUPPORTS THE PERKINS DECISION REGARDING RADON

The first question to which the Commission solicited an answer was

> whether the Perkins evidentiary record supports the generic findings and conclusions of the Perkins Licensing Board respecting the amount of the radon emissions in the mining and milling process and resultant health effects. Order at 4.

Consumers Power believes that the Perkins decision regarding radon, described below, is more than adequately supported by the record adduced at that proceeding. To bear out this fact, the affidavit of an expert in this field, G. Hoyt Whipple, is attached. Dr. Whipple has reviewed the Perkins record and decision and concurs in the result reached by that Licensing Board.

What the Perkins Licensing Board did decide, after considering the amount of radon released from mining, the amount released from milling, and the health effects associated with radon, was that:

> 51. Based on the record available to this Board, we find that the best mechanism available to characterize the significance of the radon releases associated with the mining and milling of the nuclear fuel for the Perkins facility is to compare such releases with those associated with natural background. The increase in background associated with Perkins is so small compared with background and so small in comparison with the fluctuations in background, as to be completely undetectable. Under such a circumstance, the impact cannot be significant. 8 NRC at 100.

As a result, the Licensing Board concluded that radon releases and the resulting impacts were insignificant in striking the cost-benefit balance for the Perkins Nuclear Power Station. 8 NRC at 100, ¶52.

In his affidavit, Dr. Whipple reviews the evidentiary record related to each phase of the radon issue and expresses his agreement with the conclusions reached in the Perkins decision. Therefore, the specifics of that opinion will not be reiterated in this memorandum. Further support for the correctness of the Perkins decision, and of Dr. Whipple's review of that decision, can be found in the opinion of another Licensing Board which has similarly explored the radon issue, Public Service Company of Oklahoma (Black Fox Station, Units 1 and 2), LBP-78-26, 8 NRC 102 (1978). After holding hearings on the radon question, at which Dr. Whipple testified for the applicant, the Black Fox Licensing Board concluded that the environmental impact of radon emissions was "negligibly small" and had "no effect on the environmental cost-benefit balance." 8 NRC at 144, ¶125.

II. RADON EMISSIONS AND RESULTANT HEATH EFFECTS DO NOT TIP THE COST-BENEFIT BALANCE AGAINST THE MIDLAND PLANT

The second question posed by the Commission in its November 6 Order was

> whether radon emissions and resultant health effects are such as to tip the NEPA balance against continued construction of the Midland plant. Order at 4.

In view of what the Perkins and Black Fox Licensing Boards concluded with respect to the insignificance of the impacts of radon emissions, Consumers Power believes that the cost-benefit balance for the Midland Plant is barely altered, and certainly not tipped against continued construction of the nuclear facility, by consideration of the radon matter. Again, the affidavit of Dr. Whipple supports this position, for he states that the radon emissions from mining and milling from 1 AFR, as calculated by NRC Staff Witness Dr. Gotchy at the Perkins proceeding, add only an insignificant and probably immeasurable increment in radiation exposure and health effects to what occurs naturally because of background radon radiation. (Whipple Affidavit at ¶13). Additionally, it should be remembered that the numbers used at the Perkins hearing have an added degree of conservatism when applied to the Midland Plant case, for the Perkins Station consists of three units, each one 1280 MWe, while the Midland Plant has a total output of approximately 1622 MWe. The smaller nuclear facility will require less uranium

fuel, and thus, there will be fewer radon emissions and resultant health effects attributable to the Midland Plant.

The cost-benefit balance for the Midland Plant was last examined by the Appeal Board in its February 1978 opinion reviewing the decision of the Licensing Board not to suspend construction. Consumers Power Company (Midland Plant, Units 1 and 2), ALAB-458, 7 NRC 155 (1978). The Appeal Board took into account the environmental effects of the fuel cycle as set forth in the interim rule, (which included the now deleted term for radon), and concluded that those effects must be taken as insubstantial. 7 NRC at 164. In addition, the Perkins and Black Fox Licensing Boards have already determined that the effects of radon are insignificant in striking the environmental cost-benefit balances for their respective nuclear plants; thus, a consideration of the effects of radon in the Midland Plant cost-benefit balance will not tip that balance against continued construction of the nuclear facility. In fact, the impacts associated with radon emissions are so de minimis that the cost-benefit balance is altered at most imperceptibly.

This is especially true in view of the extensive margin of benefit over cost which the Midland Plant has been held to have. As the Appeal Board found in considering the effect of the increase in the monetary cost of the Midland Plant, it would not be easy to tip the cost-benefit balance against the nuclear facility.

> In short, once it has been determined that a generating facility is needed to meet real demand, that no environmentally preferable type of facility or site exists, and that all cost-beneficial environmentally protective auxiliary equipment has been employed, the final cost-benefit balance will almost always favor the plant, simply because the benefit of meeting real demand is enormous--and the adverse consequences of not meeting that demand are serious. ALAB-458, 7 NRC at 169 (footnotes omitted).

Because the cost-benefit balance for the Midland Plant so clearly favors the nuclear facility, even with the inclusion of the environmental effects of radon, it is not necessary to discuss alternative types of generating facilities. However, it should be noted that the Perkins and Black Fox Licensing Boards each considered the environmental impacts associated with the coal fuel cycle, compared with the impacts of the nuclear fuel cycle, including radon emissions, and concluded that the nuclear facilities were still environmentally preferable to coal plants. Perkins, 7 NRC at 100, ¶50; Black Fox, 8 NRC at 144, ¶125.

CONCLUSION

For the reasons set forth in this memorandum and in the attached Affidavit of Dr. Whipple, the Perkins decision is supported by the record of that proceeding, and the impacts from radon emissions do not tip the cost-benefit balance against continued construction of the Midland Plant.

Respectfully submitted,

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December 8, 1978

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety And Licensing Board

In the Matter of	)	
CONSUMERS POWER COMPANY	)	Docket Nos. 50-329 50-330
(Midland Plant, Units 1 and 2)	)	

AFFIDAVIT OF G. HOYT WHIPPLE

State of Michigan
County of Washtenaw

I, G. Hoyt Whipple, being first duly sworn, upon my oath certify that the statements contained in the attached pages are true and correct to the best of my knowledge and belief.

G. Hoyt Whipple

Subscribed and sworn to before me
this 4 th day of December 1978.

Bonnie J. Larson

Notary Public

My Commission Expires: July 13, 1982

BONNIE J. LARSON
Notary Public, Washtenaw County, Michigan
My Commission Expires July 13, 1982

1. I, G. Hoyt Whipple, am Professor of Radiological Health at the University of Michigan, School of Public Health. A statement of my professional qualifications is attached.

2. I have reviewed the record of that portion of the Perkins hearing which deals with the effects of the release of radon-222 as a result of the mining, milling and storage of mine tailings of uranium required to fuel a nuclear reactor. Hereafter, I shall refer to these issues as "radon issues". I have also reviewed the Partial Initial Decision of the Atomic Safety and Licensing Board in Perkins dated July 14, 1978. In addition,I participated in the hearings with respect to radon issues conducted by an Atomic Safety and Licensing Board in connection with the application of Public Service Company of Oklahoma and others for construction permits for the Black Fox Station. Some of the NRC Staff witnesses at the Perkins and Black Fox hearings were the same (Mr. Wilde, Mr. Magno and Dr. Gotchy). In addition to the witnesses who testified at the Perkins hearing, Dr. Robert Pohl, a physicist, and Dr. Stanley Ferguson, an M.D. employed by the Colorado State Department of Health, testified at the Black Fox hearings on behalf of Intervenors in that proceeding. The substance of Dr. Pohl's testimony was that the health effects of incremental releases of radon should be considered world-wide, rather than limited to the United States and that such health effects

should be calculated essentially to infinity, rather than being limited to 1000 years. The substance of Dr. Ferguson's testimony was that the use of tailings from uranium mines as construction fill might lead to an increase in health hazards to individuals living in proximity to the fill. The following statements are based on my review of the Perkins record and my participation in the Black Fox hearing.

RADON EMISSION RATES

3. The release of radon from mines, mills and the mill tailings piles was considered in some detail in both proceedings. The following paragraphs summarize my understanding of the evidence considered and the conclusions reached in the course of the Perkins hearing. There was little, if any, evidence tending to contradict the conclusions reached. Nothing which occurred at the Black Fox hearing casts any doubt on the conclusions reached at the Perkins hearing.

MINING

4. Mr. Wilde at page 5 of his affidavit estimates the emission of radon from an underground mine to be 4060 Ci per Annual Fuel Requirement (AFR).* Nothing in the hearing calls

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* The terms AFR and RRY (reference reactor year) are used interchangeably throughout the Perkins and Black Fox records and are essentially the same. They refer to the fuel requirement of one 1000 MWe light water reactor operating at an 80% capacity factor for one year.

this figure of 4060 Ci per AFR into question. Estimates for the radon emission from open-pit mines were made by Wilde and Goldman in the course of the hearing and these estimates are summarized by the Board in its Partial Initial Decision, paragraph 15, as being about 4000 Ci per AFR over a 20-year period. I find the Board's summary reasonable and agree with its conclusion that some 4000 Ci per AFR is released by either form of mining.

MILLING

5. Mr. Magno, at pages 2 and 3 of his affidavit, estimates the radon release from milling to be about 30 Ci per AFR. The record reveals no serious disagreement with this estimate. I find it reasonable.

MILL TAILINGS PILE

6. Mr. Magno, at pages 2 through 4 of his affidavit, estimates the radon emission of an active tailings pile to be 750 Ci per AFR over a period of 26 years. At page 6 of his affidavit, Mr. Magno estimates the radon emission from a tailings pile during the 5-year period between the end of active milling until stabilization to be 350 Ci per AFR. Mr. Magno estimates the emission rate of a dry, unstabilized tailings pile as about 110 Ci per AFR per year (Magno affidavit at page 10, paragraph 9), and of a stabilized pile as less than 1 Ci per AFR per year (Magno affidavit at pages 6 and 7, paragraph 7). No serious contradiction of any of these estimates took place during the hearing and I find them reasonable.

7. Dr. Gotchy, at page 4 of his affidavit, chooses to use the estimates of Mr. Magno for release from mill tailings piles in the following way: 1 Ci per year per AFR for the first hundred years after stabilization, 10 Ci per year per AFR for the next 400 years, and 100 Ci per year per AFR after 500 years. This treatment assumes that the tailings pile returns to the unstabilized state in 500 years. The only criticism of Dr. Gotchy's choice was that it is on the conservative side. I concur.

TOTAL RADON RELEASE

8. The following table gives my summation of the radon releases from mining, milling, and the tailings pile according to the estimates discussed above.

Period, years	Ci of Radon per AFR
0 - 20	5,150
0 - 100	8,230
0 - 500	12,230
0 - 1,000	62,230
0 - 10,000	962,230

9. The figures tabulated above may be compared to the amounts from naturally occurring background radiation. Radon emission totals some hundred million curies per year from soil in the contiguous United States. (Gotchy Affidavit at page 14).

POPULATION DOSES

10. Dr. Gotchy has calculated the population radiation doses produced by the radon emissions. The method and assumptions used for these calculations are given at pages 2 and 3 of his affidavit. Neither the methods nor the results of the calculations were called into question during the hearing and I find them reasonable.

POTENTIAL FATALITIES

11. Dr. Gotchy, at pages 7-10 of his affidavit, uses radition risk coefficients from WASH-1400 and GESMO (NUREG-0002) to convert the calculated doses to cancer fatalities and genetic damage. These coefficients have been derived from the absolute risk model of the 1972 BEIR report. Most informed opinion regards these coefficients as over-estimating the actual risk at the very low doses dealt with in this case. Two recent reviews of this situation tend to lead to coefficients as low, or lower than those used by Dr. Gotchy (United Nations Scientific Committee on the Effects of Atomic Radiation, Sources and Effects of Ionizing Radiation, United Nations, 1977, pages 9, 413, 414; and Recommendations of the International Commission on Radiological Protection, ICRP Publication No. 26, 1977, pages 10, 11, 12).

12. The Board in its Partial Initial Decision, paragraph 38, notes that Gotchy's calculations can be reduced to

2×10^{-5} calculated deaths per curie of radon released. The United Nations Scientific Committee on the Effects of Atomic Radiation, Sources and Effects of Ionizing Radiation, United Nations, 1977, gives estimates on a global basis which come out to a figure of 1.7×10^{-5} deaths per curie of radon emitted from the earth's surface. The agreement of these two figures supports the reasonableness of Dr. Gotchy's calculations.

CONCLUSION

13. Dr. Gotchy summarizes his affidavit in Table 8, where he calculates that the radon from 1 AFR will add .0001 percent population radiation dose to the population dose resulting from radon naturally occurring as background radiation in the United States within any period up to 10,000 years. Assuming a linear relationship between radiation dose and health effects, the same increment of adverse health effects, that is, an increase in mortality and genetic defects of .0001 percent, may be calculated. This is truly an insignificant and probably immeasurable increment in radiation exposure and health effects. No evidence presented at either the Perkins or Black Fox hearings changes that conclusion, even if one accepts the somewhat greater doses postulated by Intervenors' witnesses in those proceedings.

EDUCATIONAL AND PROFESSIONAL QUALIFICATIONS

G. HOYT WHIPPLE
PROFESSOR OF RADIOLOGICAL HEALTH
UNIVERSITY OF MICHIGAN, ANN ARBOR

My name is G. Hoyt Whipple. I am Professor of Radiological Health in the Department of Environmental and Industrial Health, School of Public Health, University of Michigan, Ann Arbor, Michigan. In this capacity I am responsible for the graduate teaching and research in radiation protection.

I hold of Bachelor's Degree in chemistry from Wesleyan University in Connecticut, and a Ph.D. Degree in biophysics from the University of Rochester.

After graduating from Wesleyan University in 1939, I entered the Massachusetts Institute of Technology as a graduate student in physics. I joined the Division of Industrial Cooperation of the Massachusetts Institute of Technology as a staff member in 1942. From 1942 until 1947, in this position, I was engaged in research and development on several military projects, including Loran, dehydration of food, and aerial bomb fuzes.

In 1947, I accepted a position in the Health Instruments Division of the Hanford Works, General Electric Company in Richland, Washington. For three years I was in charge of a small group devoted to special problems in radiation protection.

In 1953, I was offered an opportunity to complete my Ph.D. by the University of Rochester Atomic Energy Project. In the course of seven years at this institution I taught courses offered to the AEC Fellows in Health Physics, conducted research in radiation dosimetry and radiation biology, and attained the rank of assistant professor in radiation biology.

In 1957, I was offered the opportunity to establish a graduate program in radiological health at the University of Michigan. The initial appointment was as associate professor, and in 1960 was changed to full professor. In this position, which I continue to hold, I have been responsible for the masters and doctoral radiological health programs at the School of Public Health.

I have been certified by the American Board of Health Physics, and by the American Board of Industrial Hygiene in the radiological aspects of industrial hygiene. I am a member of the Health Physics Society, and the American Industrial Hygiene Association.

From time to time I have served as a consultant to the Atomic Energy Commission, the Department of Defense, the State Department, the International Atomic Energy Agency, the World Health Organization, and a variety of private industries, primarily electric utilities.

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CERTIFICATE OF SERVICE

I hereby certify that copies of the attached "MEMORANDUM OF CONSUMERS POWER COMPANY REGARDING THE ENVIRONMENTAL EFFECTS OF RADON" and "AFFIDAVIT OF G. HOYT WHIPPLE" in the above-captioned proceeding, have been served on the following parties by United States Mail, first-class postage prepaid, this 8th day of December, 1978:

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