

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
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

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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 Intervenor 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

* 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.

<u>Period, years</u>	<u>Ci of Radon per AFR</u>
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 radiation 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 Intervenor's 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:

Marshal E. Miller, Esq.
Chairman
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Board Panel
U.S. Nuclear Regulatory Comm.
Washington, D.C. 20555

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December 8, 1978