UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of

WISCONSIN PUBLIC SERVICE CORPORATION, ET AL.

(Kewaunee Nuclear Power Plant)

Docket No. 50-305
Amendment to License
No. DPR-43
(Increase Spent Fuel
Storage Capacity)

LICENSEES' RESPONSE TO
STATE OF WISCONSIN'S INTERROGATORIES

In response to the State's instructions, names of individuals and documents relied upon by licensees are set out in full as part of the Licensees' responses to intervenor's interrogatories previously filed in this proceeding, copy of which responses was served upon each party. Those lists are incorporated herein by reference.

Interrogatory 1

What is the probability that the radioactive releases from the Point Beach Nuclear Power Plant will combine with those from Kewaunee Nuclear Power Plant? What meteorological conditions would have to exist for the radioactive plumes from these two plants to come in contact with each other and intermingle? Please set forth the model which you base your estimate upon.

Response 1

As discussed in Section 3.2 of the Environmental Impact Evaluation submitted in support of the application for this proposed modification, the only increase in radioactive emission to the atmosphere due to the

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expanded spent fuel storage capacity, could be in the release of Kr-85. However, essentially all the Kr-85 that is going to be released will be released in the first few months. This is because the fuel decay heat decreases rapidly in the first few months (by a factor of about 100 in the first 90 days after shutdown) resulting in decreases in the fuel rod temperature and internal pressure, and consequently the release mechanism of fission products, including Kr-85. Thus the release of Kr-85 will not increase with the proposed expansion of the pool and there is no increase in radioactive emission to the atmosphere. Therefore, there will be no increase in the combined effect of Point Beach and Kewaunee Nuclear Power Plants.

The discussion in Section 3.2 of the Environmental Impact Evaluation, which indicates a potential increase, is highly conservative as it is based on the existence of a release mechanism (fuel rod pressure and temperature) throughout the entire storage period. This release mechanism is present only in the first few months of storage. If the existence of a release mechanism throughout the storage period were assumed, an upper bound of resulting releases due to increased storage could be calculated. Section 5.3.2 of the NRC Environmental Impact Appraisal addresses such a bounding calculation. These calculations do not represent real conditions, but provide great assurance that regulatory limits will not be exceeded.

Interrogatory 2

State the technical basis upon which you believe that the spent fuel stored in the pool will retain its integrity for the entire period of licensing.

Response 2

A detailed examination of Westinghouse designed fuel irradiated to burnup of 33,000 MWD/Te after 5 years of pond storage was reported by R. H. Flowers in testimony given at the Windscale Public Inquiry (Reference 1, page 10 and 11). This fuel, which had typical thin Fe rich deposits on the surface (Crud), was examined for corrosion, hydride segregation, metallurgical changes in cladding and surface oxide and was found to be normal in all respects to that expected at reactor discharge. Studies made by the Battelle Memorial Institute at Columbus, Ohio, on Westinghouse designed fuel after approximately 1 year of storage (Reference 2) confirmed excellent mechanical properties (strength and ductility) on fuel irradiated to approximately 25,000 MWD/Te. This latter burnings is well past the point where irradiation saturation damages occur. From this and other data available in the literature, it can be concluded that irradiated fuel properties are satisfactory and can be expected to change very little during long term storage.

Many experts (B. F. Warner, page 7, Reference 1; D. G. Boase and T. T. Vandergraaf, Reference 3, page 62; A. B. Johnson, Jr., Reference 4, page 61) agree that the corrosion rate of the Zircaloys, even at temperatures well above the maximum credible storage temperatures, is so low that many decades would be required to cause even a 10% metal loss.

A recent study sponsored by EPRI (Reference 6) illustrates that a minimum stress level is required before stress corrosion cracking due to iodine fission products will occur. A. B. Johnson (Reference 4, page A-5) shows that typical pre-pressurized PWR fuel hoop stresses under storage conditions are in the order of 4,000 - 8,000 psi (due to pre-pressurization fill gas and fission gas release) while the maximum credible pressure for the worst rod is 17,000 psi. Figure 5-14 of Reference 6, indicates that the

threshold level for stress corrosion on cracking at 357°C (670° F) is 29,000 psi. Considering the conservativeness of the temperature and stresses involved and the good experience observed in pool storage to date, it is entirely reasonable to project that internal stress corrosion failure will not limit fuel pool storage life for many decades, if ever.

The usage of high boron levels in the spent fuel pit is not viewed as a major difference of the overall pool chemistry as compared to pure water. An extensive study by Whyte (Reference 7, page 17) showed that boron at high levels (1,500 ppm) and high temperatures (600°F) had essentially no effect on Zircoloy-4 corrosion compared to pure water. Similarly, Dalgaard (Reference 8) showed that out-of-pile pure water kinetics accurately described in-reactor corrosion kinetics. There is even evidence that at higher temperatures (Reference 9 and 10) that boron can inhibit corrosion of Zircoloy. Whyte (Reference 7, page 28) also found no evidence that boron degraded the performance of the stainless steels and Inconel.

References:

1. Windscale Public Inquiry into British Nuclear Fuels, Ltd., application for planning permission to construct, at Windscale, a Thermal Oxide Reprocessing Plant (THORP). Testimony by B. F. Warner and R. H. Flowers. The inquiry ended November 4, 1977, after 100 days of evidence presentations.

2. L. M. Lowry, et al., "Mechanical Properties of Spent Fuel Cladding." Presented at Sixth Water Reactor Safety Research Information Meeting on November 6-9, 1978, Gaithersburg, Maryland.

3. D. G. Boase and T. T. Vandergraaf, "The Canadian Spent Fuel Storage Canister: Some Materials Aspects," Nuc. Tech., Vol. 32, January, 1977.

4. A. B. Johnson, Jr., "Behavior of Spent Nuclear Fuel in Water Pool Storage," BNWL-2256, September, 1977.

5. P. Cohen, "Water Coolant Technology of Power Reactors," ANS-USAEC Monograph, Gordon and Breach Science Publishers, 1969.

6. D. Cubicciotti and R. L. Jones, "EPRI-NASA Cooperative Project on Stress Corrosion Cracking of Zircaloys," EPRI NP-217, Project 455-1, Final Report, March, 1978.

7. D. D. Whyte, "A Long Term Corrosion Test of Reactor Structural Materials in a Chemical Shim," WCAP-3737, March, 1964.

8. S. D. Dalgaard, "Long Term Corrosion and Hydriding of Zircaloy-4 in Commercial Pressurized Reactors with Forced Convective Heat Transfer," Presented at the Electrochemical Society, Inc., May 2-7, 1978.

9. C. F. Britton, J. N. Wanklyn, "Inhibition of Boric Acid of the Oxidation of Zirconium in High Pressure Steam," J. Nucl. Mater, 5 (1962), pp. 326.

10. C. F. Britton, J. V. Arthurs, J. N. Wanklyn, "Further Studies on the Inhibition by Boric Acid on the Oxidation of Zirconium in High Pressure Steam," J. Nucl. Mater, 15 (1965), pp. 263.

11. Y. Solomon and J. Roesmer, "Measurement of Fuel Element Crud Deposits in Pressurized Water Reactors," Nuclear Technology, Vol. 29, May, 1976.

12. J. Roesmer and M. W. Roothan, "Estimation of Activity Inventories in Primary Circuits of Pressurized Water Reactors," Presented at the BNES Meeting at Bournmouth, England, October, 1977.

Interrogatory 3

Please state the average, median and maximum burnup of the spent fuel which will be stored in the fuel pool. How does the burnup of the fuel affect your estimate of long-term fuel integrity? Please be specific. Please state the names of all technical studies and/or experiments with which you are familiar, whether completed or ongoing, which assess the integrity over a forty-year period of spent fuel having a burnup as high as that of the spent fuel with the maximum burnup expected to be placed within the Point Beach spent fuel pool.

Response 3

See response to Interrogatory 1.

Interrogatory 4

How will the integrity of the fuel rods in the spent fuel pool be monitored?

Response 4

The integrity of the fuel is monitored by a spent fuel pool water monitoring program. This combined with radiation monitors installed to monitor all releases from the plant would verify the integrity of the fuel rods.

Samples of spent fuel pool water are analyzed for isotopic content. The existence of activated corrosion products is expected in the spent fuel pool along with low concentrations of fission products. Large changes in fission product concentration in the spent fuel pool water would result from significant deterioration of fuel cladding. The monitoring of the water thereby provides monitoring of the clad integrity.

AFFIDAVIT

STATE OF WISCONSIN)
BROWN COUNTY) ss

E. W. James, first being duly sworn on oath, states as follows:

1. I am Senior Vice President, Power Supply & Engineering of Wisconsin Public Service Corporation, Licensee herein and make this affidavit on its behalf being duly authorized so to do.

2. The attached Responses to Interrogatories are true and correct to the best of my knowledge and are based on such information as is available to Wisconsin Public Service Corporation.

Dated this 19th day of December, 1978.

E. W. James

Subscribed and sworn to before me
this 19th day of December, 1978

Notary Public

My Commission: 9-13-79

SERVICE LIST

Robert M. Lazo, Esq.
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

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

Dr. Oscar H. Paris, Member
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Mr. William Cordaro
1412 New York Avenue
Manitowoc, WI 54220

Mrs. Wend Schaefer
3741 Koehler Drive
Sheboygan, WI 53081

Ms. Mary Lou Jacobi
Lakeshore Citizens for Safe Energy
932 N. 5th Street
Manitowic, WI 54220

Patrick Walsh, Esq.
Department of Justice
114 East State Capitol
Madison, WI 53702

William J. Olmstead, Esq.
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

AFFIDAVIT OF SERVICE

Donald C. Hintz, first being duly sworn on oath states that service of copies of the attached Responses to Intervenors' Interrogatories was made upon the persons listed in the attached Service List by placing the copies in the United States mails prepaid addressed as indicated.

Donald C. Hintz

Subscribed and sworn to before me this 19th day of December, 1978

Notary Public

My Commission: 9-13-79