7/17/81

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
PENNSYLVANIA POWER & LIGHT COMPANY	)	Docket Nos. 50-387
and	)	50-388
ALLEGHENY ELECTRIC COOPERATIVE INC.	)	
(Susquehanna Steam Electric Station, Units 1 and 2)	)	

AFFIDAVIT OF CLAIR C. HERRINGTON
IN SUPPORT OF PARTIAL SUMMARY DISPOSITION
OF CONTENTION 11

County of Santa Clara)
: ss.
State of California)

Clair C. Herrington, being duly sworn according to law, deposes and says:

1. I am Licensing and Safety Manager, Spent Fuel Services Operation, General Electric Company ("GE") and give this affidavit in support of Applicants' Motion For Partial Summary Disposition of Contention 11. I have personal knowledge of the matters set forth herein and believe them to be true and correct. A summary of my professional qualifications and experience is attached as Exhibit "A" hereto.

2. Contention 11 states that "The proposed project creates an unreasonable risk of harm to the health and safety of petitioners and their private property, and violates the Commission's standards for protection against radiation in 10CFR§20.1 and §20.105(a), in that the Applicants have failed to provide adequately for safe on-site storage, for periods of up to 10 to 15 years, of spent fuel and low-level radioactive wastes." The purpose of this affidavit is to respond to that portion of Contention 11 dealing with spent fuel storage, and specifically

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with the ability of the spent fuel itself to be safely stored for periods at least as long as the duration of the Susquehanna operating licenses (i.e., the year 2013).

3. The technical principles for meeting the functional and regulatory requirements of a spent fuel storage system are straightforward and proven by over 30 years of favorable experience in operation and control of such storage facilities. Since there have been no indications of storage problems, either theoretical or actual, major development and test programs are not required to provide safe storage capabilities, although ongoing development is proceeding to further improve storage efficiencies. Indeed, after their review of storage of spent fuel for extended periods of time, the Advisory Committee on Reactor Safeguards (ACRS) has stated its belief that the issues and concerns about storage of spent fuel have been adequately addressed and that safe interim storage well beyond 30 years can be provided should it be required.[1]

4. Spent fuel in storage is best characterized by its inactivity. There is little stored energy in the fuel system to act as a driving force. Without a driving force there is no mechanism for fission product release from the stored spent fuel. After fuel is discharged from the reactor to the fuel pool, it continues to generate heat from the decay of fission products, however, the amount of decay heat generated decreases continuously. The initial decrease is very rapid because many of the short half-life nuclides are totally expended in the early cooling period. Each assembly's radioactive decay power output is reduced by about 97% within one month after shutdown.[2] The overall result is that the heat generation rate diminishes and therefore the margin of safety for the storage system increases with time in storage. After only a few weeks of pool cooling, the surface cladding temperature is only about 10°C above the bulk water temperature in the pool (30°-60°C) compared to a cladding temperature of 290°-400°C while the fuel is in the reactor.[3] In short, the storage system is a benign environment, particularly in comparison with the pre-storage power generation environment.

5. The influence of the large volume of water in a water basin system provides a moderating environment that precludes rapid change of storage conditions. The large volumes of water assure that

any credible failures in the cooling system would only result in slow temperature increases.

6. The spent fuel in storage in a water basin is readily accessible for visual monitoring, if such observations should be desired. This enables the examination for defects as the fuel is brought in for storage; the further examination for defects or review of known defects at later dates; and the final observation as spent fuel is moved for shipment. Visual monitoring of the fuel in storage may also detect escaping gas bubbles, and the accessibility permits sampling escaping gas or the water around a suspected "leaker". Radiation levels of the pool water are monitored frequently. Concentrations of airborne radioactive materials above the pool are monitored continuously.

7. If some presently unidentified mechanism should arise that could allow radioactive material to escape from the spent fuel storage system, its genesis can be expected to be gradual. Such low energy systems do not undergo rapid changes. Available instrumentation and monitoring programs assure that adequate time would be available for identification and development of remedial action without subjecting plant personnel or the public to significant risk.

8. The Zircaloy cladding surrounding the fuel pellets is an important containment barrier that helps to keep the fission products within the fuel separated from the biosphere. Zircaloy-clad fuel has been stored satisfactorily in pools for over twenty years. This is as expected since the cladding has been designed to endure several years of the much more corrosive conditions of reactor operations where one year of reactor exposure is equivalent to many years of pool storage exposure. The amount of corrosion for Zircaloy cladding in pool storage extrapolated to 100 years is 0.3 to 0.5 microns (0.037 to 0.062% of the initial Susquehanna cladding thickness). Other degradation mechanisms such as hydriding, fission product attack, helium embrittlement, oxidation, radiation, galvanic effects and pitting corrosion, have also been examined. Assessments by four different investigators have identified no mechanisms that can be regarded as a substantial threat to fuel cladding integrity.[4]

9. The uranium oxide ceramic fuel pellets themselves provide a remarkably efficient barrier to the leaching of radioactive material into basin water. The pellets are virtually inert to pool water and

there has been no observable physical degradation in several years of exposure of bare pellets to basin water.[5] This property enhances the containment of the fission products by minimizing the impact of a potential defect in the fuel cladding.

10. Encapsulation has been considered as a means of isolating defective or failed fuel in basin storage. The impact of fuel rod failures during storage, however, has been found to be relatively slight.[6] Release of leachable radioactive material to the basin water is constrained by the limited exposure of the sintered ceramic UO_2 surface and by the extreme insolubility of the UO_2. Thus, encapsulation has not been deemed necessary at most fuel storage facilities even where known failed fuel is in storage. However, encapsulation is routinely used in Canada for the storage of defective fuel and can be used in the event that severe degradation of the fuel assemblies should occur.[7]

11. The experience with extended storage of spent fuel has been excellent. Assemblies have been stored for a period of some twenty years, with no apparent degradation due to storage. Some Zircaloy clad PWR fuel has been in water basin storage since 1959. In addition, at least nine Zircaloy-clad fuel bundles from the Canadian NPD reactor have been in water storage since 1962 and eight bundles loaded in the NPD reactor in 1963 are still incore and intact (1978).[8]

12. The favorable performance of spent fuel stored in water basins has been confirmed by observation and analysis. No degradation has been observed in commercial power reactor fuel. This is based upon a survey of basin operators representing some 20 U.S. pools.[9] Canadian experience, including occasional examination during 17 years of storage, has indicated no evidence of significant corrosion or other chemical degradation.[10] Even where the uranium oxide pellets were exposed to pool water as a result of prior fuel assembly damage, the pellets have been relatively inert to pool water, a conclusion also demonstrated in laboratory studies.[11]

13. Further experience concerning the ability of spent fuel to withstand extended water basin storage includes metallurgical examination of Canadian Zircaloy clad fuel after 11 years of pool storage, metallurgical examination of Zircaloy clad PWR and BWR high burn-up fuel after five and six years in pool storage, return of Canadian fuel bundles to a

reactor after 10 years of pool storage, and periodic hot cell examination of high burn-up PWR and BWR bundles over 6 years of pool storage at the WAK Fuel Reprocessing Plant in Germany. Favorable experience in other countries with Zircaloy clad fuel includes United Kingdom, 13 years; Belgium, 12 years; Japan, 11 years; Norway, 11 years; West Germany, 9 years; and Sweden, 7 years.[12]

14. From the preceeding discussions, it is clear that spent fuel can be safely stored in water filled pools on site for periods well beyond the 10 to 15 years cited in this contention. The Zircaloy clad fuel to be used at Susquehanna can safely be stored in the spent fuel pools beyond the expiration of the operating license in 2013.

Clair C. Herrington

CLAIR C. HERRINGTON

Sworn to and subscribed before me this 17 day of July 1981.

OFFICIAL SEAL
KAREN A. DUNBAR
NOTARY PUBLIC — CALIFORNIA
Santa Clara County
My Commission Expires Dec. 6, 1983

Karen A. Dunbar

NOTARY PUBLIC

REFERENCES

1. Letter from Plesset, M., Chairman ACRS to Ahearne, John, Chairman NRC, Subject: Waste Confidence Rulemaking, Storage and Disposal of Nuclear Waste. December 10,1980

2. U. S. Nuclear Regulatory Commission, "Final Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel," NUREG-0575, August 1979, Volume 1, Page 2-2.

3. Johnson, A. B., Jr., "Spent Fuel Storage Experience," Nuclear Technology, (Volume 43, mid-April 1979), Page 167.

4. Johnson (Reference 3), Page 171.

5. Johnson, A.B., Jr., "Behavior of Spent Nuclear Fuel in Water Pool Storage," BNWL-2256 (UC-70), Battelle Pacific Northwest Laboratories, September 1977. Pages 17 and 19.

6. Johnson (Reference 5), Page 18.

7. Johnson (Reference 3), Page 170.

8. Mayman, S.A., "Canadian Experience With Wet and Dry Fuel Storage Concepts," AECL-6191. Whiteshell Nuclear Research Establishment, July 1978. Pages 3 and 5.

9. Johnson (Reference 5), Page 17.

10. Johnson (Reference 5), Page 17.

11. Johnson (Reference 5), Page 17 and 19.

12. Hunt, C. E. L., J. C. Wood and A. S. Bain, "Long Term Storage of Fuel in Water," AECL-6577, Chalk River Nuclear Laboratories, June 1979, Page 1.

EXHIBIT A

CLAIR C. HERRINGTON

Manager - Licensing and Safety
Licensing and Transportation
Spent Fuel Services Operation

EDUCATION:

Chemistry, 1949-51, Reed College, Portland, Oregon

Engineering, 1955-57, Portland State College, Portland, Oregon

B.S. Ch.E., Chemical Engineering, 1958-59, Oregon State College, Corvallis, Oregon

SUMMARY:

Nineteen years in the nuclear field including reactor, fuel reprocessing and fuel storage experience. Responsibilities encompass process engineering and management in the areas of operations, process engineering and licensing.

PROFESSIONAL EXPERIENCE:

Eighteen years, General Electric Company, Process Control Engineer, Reactor Supervisor, Production Development Engineer, Process Engineering Manager, and Licensing and Safety Manager.

Activities include developing high volume production facilities from a lab-scale precursor; developing personnel training and certification program for reprocessing; developing test and operating plans and procedures and managing the licensing of spent fuel storage systems.

One year, General Electric Company, Methods Planner in plastic forming and electroplating.

Three years, General Electric Company, Manufacturing Management Training Program, rotational assignments including materials analyses, quality control, manufacturing engineering and process planning.

Senior Reactor Operator and Remote Reprocessing Operator Licenses.