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 D. W. JAMES
IN SUPPORT OF PARTIAL SUMMARY
DISPOSITION OF CONTENTION 11

County of San Francisco)
: ss
State of California)

D. W. James, being duly sworn according to law, deposes and says:

1. I am a Nuclear Engineering Supervisor for the San Francisco Power Division of Bechtel Power Corporation. My business address is Fifty Beale Street, San Francisco, California. I give this affidavit in support of Applicants' Motion for Summary Disposition of Contention 11 in this proceeding. 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 in this proceeding states:

> 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 10 CFR §§20.1 and 20.105(a), in that the Applicants have failed to provide adequately for safe onsite storage, for periods of up to 10 to 15 years, of spent fuel and low-level radioactive wastes.

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The purpose of this affidavit is to respond to that portion of Contention 11 which is addressed to safe onsite storage fo spent fuel. Specifically, the affidavit shows that the spent fuel storage facilities of the Susquehanna facilities can safely store spent fuel for periods at least as long as the duration of the operating licenses (i.e. through the year 2013). The capability of the spent fuel itself to be stored for this period of time is dealt with in the Affidavit of Clair Herrington in Support of Partial Summary Disposition of Contention 11.

3. At the Susquehanna facility (as at other nuclear power reactors) nuclear fuel which has been discharged from the reactor is stored in water-filled basins called spent fuel pools. The water provides both for heat removal and for radiation shielding.

4. Each of the Susquehanna units has its own spent fuel storage facility. This facility, located in the reactor building, consists of a water-filled reinforced concrete basin lined with stainless-steel, racks for storing the fuel, cranes and material handling equipment, a heat exchanger for cooling the water, a clean-up system for controlling water purity, and pumps to circulate the water. Both units share a common cask pit that accepts the spent fuel shipping casks and accommodates underwater fuel transfer from either unit through its respective transfer canal.

5. The pool walls are six foot thick reinforced concrete. The pools themselves are part of the reactor building structure and meet all the codes and standards for the reactor building. The pools are also designed for the same loads and loading conditions as the reactor building. All components of the spent fuel storage facilities are located within the reactor building. Final Safety Analysis Report (FSAR), §3.8.4.

Spent Fuel Pool Liner

6. Each spent fuel pool is lined with a stainless steel liner. The fuel pool liner is not load bearing; it is directly supported by a system of stiffeners and anchors embedded in the pool wall. The liner plates are welded to those embeds. The pool wall with its embeds and liner is designed to withstand all credible loading combinations resulting from natural phenomena and plant operation. Liner material is stainless steel to minimize corrosion formation and possible leakage. Experience with stainless steel in demineralized water service has not shown measurable corrosion. For design purposes a corrosion allowance of 0.0001 inch per year is made for the 1/4 inch thick liner. Therefore, liner corrosion over the lifetime of the plant is considered insignificant.

7. A leak detection system is provided to verify leak tightness following liner installation and during plant operation. Any leakage would be contained by a system of channels welded behind the liner weld joints which permit free gravity flow through isolation valves to a leak detection station. The liner is capable of withstanding a temperature of 212°F during an accident situation involving pool boiling. Liner repairs can be (and have been) made even when there is spent fuel in a pool.

Spent Fuel Pool Racks

8. The spent fuel racks are of all anodized aluminum, bolted construction and are attached to the pool walls through embeds and anchors. The neutron absorber material, Boral (a ceramic mixture of boron carbide and aluminum oxide), contained in the poison cans of the racks, is completely encapsulated in aluminum and, hence, is totally isolated from the pool water. Each poison can is pressure and vacuum leak-tested prior

to installation. Seismic restraints of welded stainless steel construction tying to the pool liner embeds are provided to enable the racks to withstand all credible loading combinations resulting from natural phenomena and plant operation. To reduce any galvanic corrosion, inconel pins are used between the wall seismic restraints and the racks. For the same purpose, the leveling screws of the racks butt against ABS plastic 1/ discs that are crimped into stainless steel pads.

9. These design features will prevent any significant degradation of the racks from water submersion, radiation, thermal, hydrodynamic, and seismic loading conditions over the 40 year design lifetime of the plant. Furthermore, test coupons consisting of actual poison can sections installed adjacent to the racks will permit verification of the long-term mechanical and material integrity of the poison cans over the plant lifetime.

Spent Fuel Pool Cooling

10. The fuel pool water temperature is maintained below 125°F by normal and backup cooling systems. Normally, fuel pool cooling is provided by the Fuel Pool Cooling and Cleanup (FPCC) system. One FPCC system is provided for each spent fuel pool. The FPCC system is sized to cool the maximum normal heat load, which is the heat generated by the 2,840 fuel assemblies which could be placed in the spent fuel pool, assuming that all the fuel assemblies are discharged at the normal refueling rate. See FSAR Table 9.1-2a and 2b. The fuel pool cooling pumps circulate the pool water in a closed loop, taking suction from the skimmer surge tank through

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1/ABS plastic is copolymer of acrylonitrile, butadiene and styrene.

heat exchangers where the decay heat of the irradiated fuel is transferred to the service water system. A partial flow from the cooling loop is directed through filter demineralizers and returned with the bypass flow back to the pool. There are three, one-third capacity pumps and three, one-third capacity heat exchangers in each FPCC system. Early in the plant life, when the cooling requirements are lower, unneeded pumps and heat exchangers will be kept in reserve.

11. The Residual Heat Removal (RHR) system serves as backup to the FPCC system and is also used to carry the emergency heat load. The emergency heat load will occur when the fuel pool is filled to its maximum capacity of 2,840 fuel assemblies with the last discharge a full core unload (rather than the 1/4 core discharge in the maximum normal case). See FSAR Tables 9.1-2c and 2d.

12. One RHR pump out of the four RHR pumps and one RHR heat exchanger out of the two RHR heat exchangers will provide sufficient cooling for either the maximum normal or emergency heat load. The remaining RHR pumps and heat exchanger provide additional backup capability. The RHR system interties with the outlet line of the skimmer surge tank and discharges to the pool through two independent Seismic Category I lines.

Makeup Water System

13. In the highly unlikely event that both the FPCC system and its backups (the RHR system) are lost, the primary consequence would be to significantly increase the evaporative losses from the pool. This would occur as a result of pool boiling. (It should be noted that the "boiling" which would take place would be in the form of steam escaping from the

pool surface, rather than the type of violent bubbling commonly associated with that term). Using very conservative assumptions (such as no heat loss through conduction or evaporation), boiling in the pool would not begin until 25 hours after loss of all external cooling at the maximum normal heat load and 8 hours after cooling at the emergency heat load. During these time periods, one or more of the cooling systems could be isolated and repaired to restore cooling. Neither loss of external cooling nor pool boiling restricts accessibility to the cooling systems for repairs.

14. Even if the boiling occurs, fuel damage cannot take place so long as the fuel remains under water. (It should be noted that in a BWR, fuel when it is in the reactor is normally exposed to a boiling regime.) There are at least four independent sources of makeup water for evaporative losses, each one capable of providing water at a rate greater than the maximum boil-off rate. Makeup for evaporative losses is normally supplied from the Makeup Demineralizer System. Two independent, Seismic Category I backup sources of water are provided from the Emergency Service Water System. As further backup to these backup systems, makeup water to the pool can be provided through a fire hose on the refueling floor. Because the tops of the spent fuel are under twenty-three feet of water, the plant would have a long time in which to add makeup water before reaching a situation where damage to the fuel could occur. With the redundancies in cooling systems and makeup water sources, there is no conceivable way in which the spent fuel could be damaged due to failures in cooling or makeup systems.

15. It should be noted that the pools have no bottom drains or connections from which the water could be inadvertently drained. Check valves and siphon breakers are provided at the high points of supply lines to prevent siphoning of water from the pools. The manual valves for backup cooling or backup water supplies are in accessible areas in the reactor building. There is no credible mechanism for a sudden loss of water from the pools.

16. Fuel storage is essentially a passive system and requires little operator intervention. Alarms indicating a high pool water temperature, high or low water level in the pool, and high area radiation are provided in the control room.

17. The spent fuel pool including the spent fuel racks, the redundant fuel pool cooling system (RHR) and the redundant water makeup provisions, are designated Seismic Category I and, as such, are designed to withstand the Safe Shutdown Earthquake. They are therefore protected against any credible seismic event.

Criticality

18. The spent fuel racks are designed to assure that the spent fuel remains in a subcritical condition under both normal and abnormal storage conditions. The criticality analysis performed for the Susquehanna fuel pools uses a series of diffusion theory calculations for its principal mathematical model. The results of the reference case so calculated are further compared with the results of an independent calculation using the multi-group, multi-dimensional Monte Carlo Neutron Transport Code, Keno-IV, which has been bench-marked against actual critical experiments.

To ensure that the analysis followed a conservative approach and conformed to the generic guidelines for criticality safety analysis, the following assumptions were made:

a. A uniform 3.25 percent by weight of U-235 distribution in an 8 x 8 assembly.

b. Fresh fuel, no burnable poison.

c. Minor structural members replaced by water.

d. Fresh water at 68°F (reactivity decreases with increasing water temperature).

e. Fuel assemblies are channeled and centered within the storage cavity (channeled fuel is more reactive).

f. An infinite array of storage fuel was assumed. All of these assumptions are more conservative than the situation that will actually exist in the spent fuel pool.

19. The effects on reactivity of various uncertainties and variables such as water temperature, void effect, Boral width, channel effect and spacing sensitivity were also evaluated. The analysis shows that for any conceivable condition, the multiplication factor (Keff) is maintained below 0.95. This includes the worst case postulation of a dropped fuel element.

<u>Aircraft, Spacecraft and Meteors</u>

20. There is no significant aircraft traffic in the plant area. FSAR §2.2.2. The probability of an aircraft striking the Susquehanna facility and resulting in a potential nuclear safety hazard has been

calculated to be less than one chance in ten million. FSAR §3.5.1.6. The likelihood of such an accident affecting the spent fuel pool itself is even smaller. The probability of spacecraft and meteors impacting the spent fuel pool is negligible.

21. For all of the reasons set forth above, I conclude that the spent fuel storage facilities at the Susquehanna facilities can safely store spent fuel for at least the duration of the operating licenses.

D. W. James

D. W. JAMES

Subscribed and sworn before me this 17 day of July, 1981.

Betty L. Vasil

Notary Public

BETTY L. VASIL
NOTARY PUBLIC-CALIFORNIA
CITY AND COUNTY OF
SAN FRANCISCO
My Commission Expires May 25, 1984

EXHIBIT A

D. W. JAMES

NUCLEAR ENGINEERING SUPERVISOR FOR SAN FRANCISCO POWER DIVISION OF BECHTEL POWER CORPORATION

EDUCATION:

Bachelor of Chemical Engineering, University of Minnesota, 1968

Master of Science in Nuclear Engineering, Purdue University, 1970

SUMMARY:

Mr. James has eleven years of experience in nuclear safety design and engineering in nuclear power stations. In his current position, Mr. James is the supervisor of the Radiological Assessment Group which includes the Radiological Dose Assessment Group and the Radwaste System Design Group. In this capacity he is responsible for the overall supervision and direction of all radioactive waste treatment system design for the San Francisco Power Division. His activities include studies of alternate liquid radwaste treatment methods, alternate solidification systems, available volume reduction processes including calcination and incineration, system capital and operating costs, waste generation rates from operation and decommissioning, and design features to reduce operator exposure.

The Dose Assessment Group, which is under Mr. James' supervision, is responsible for all dose analysis work for nuclear power plant projects. This work includes dose analyses and application of meteorological models for normal and accident conditions, design review of safety systems designed to mitigate activity releases, and development of criteria for radiological monitoring systems. Mr. James is responsible for the development and maintenance of the computer codes used for dose assessment by all Bechtel offices. Under his supervision, studies of fuel pool boiling and the radiological consequences of heavy load drop accidents in the spent fuel pool are performed by Bechtel SFPD.

Prior to his current position, Mr. James has held nuclear engineering positions of increasing responsibilities on Bechtel projects in the U.S. and Spain. Most recently, Mr. James spent two years in Madrid, Spain as Nuclear Advisor on "Central Nuclear de Vandellos". Prior to that, Mr. James served as Nuclear Group Leader for three years on the Skagit Nuclear Power Project.

D. W. JAMES (Continued)

SUMMARY: In both positions, Mr. James held supervisory responsibilities relating to the full range of nuclear design activities, including detailed design of radioactive waste treatment systems and the fuel pool cooling and cleanup systems, specification and procurement of spent fuel racks including high density fuel racks on the Skagit projects, coordination of special safety system criteria such as for leakage detection, seismic, separation and other environmental criteria stemming from NRC licensing requirements.

PROFESSIONAL ASSOCIATIONS: Registered Professional Nuclear Engineer, State of California (No. 871)

Registered Professional Engineer, Chemical, State of Minnesota (No. 10771)

Member, American Nuclear Society