3/30/79

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of PUBLIC SERVICE ELECTRIC & GAS COMPANY, et al. (Salem Nuclear Generating Station, Unit 1)	)	Docket No. 50-272

AFFIDAVIT OF JOHN R. WEEKS

I, John R. Weeks, being duly sworn, do state as follows:

I am employed by the Brookhaven National Laboratory, Department of Nuclear Energy, as Leader of the Corrosion Science Group. A statement of my professional qualifications is attached to this affidavit.

This affidavit addresses the following contentions:

Coleman Contentions

2. The Licensee has given inadequate consideration to the occurrence of accidental criticality due to the increased density or compaction of the spent fuel assemblies. Additional consideration of criticality is required due to the following:

A. deterioration of the neutron absorbtion material provided by the Boral plates located between the spent fuel bundles;

B. deterioration of the rack structure leading to failure of the rack and consequent dislodging of spent fuel bundles;

D. combinations of the above - as it relates to A & B.

In this affidavit, I will address only the anticipated deterioration of the neutron absorption and rack materials. Based on my personal knowledge and experience and on the discussions in section 2.4.1 of NRC Safety Evaluation Report, I do not anticipate these deteriorations to be significant. Therefore, I do not expect the criticality considerations to be significant.

A. No deterioration of the neutron absorption material is anticipated in the Salem spent fuel pool for the following reasons:

1. The Boral plates are in welded cavities, protecting them from environmental degradation.

2. Should water enter the Boral cavities, pitting corrosion due to galvanic action would be anticipated on the aluminum cladding on the Boral at various points where it contacts stainless steel. However, the boron carbide matrix would not dissolve. When pitting progressed into the Boral, the B_4C particles remained embedded in place in the aluminum oxide and hydroxide corrosion products, as described in the proprietary Exxon Report, XN-NS-TP-009.

3. Dissolution of the aluminum oxide and hydroxide corrosion products would not occur in the SFP coolant, since the solubility of these products has been shown to be a minimum at a pH of approximately 5.0, which is close to the pH anticipated in a SFP containing boric acid (4.5).

4. General corrosion (or uniform weight loss) of aluminum would be negligible in the Salem SFP, since the rate of corrosion of the aluminum is a minimum at a pH of approximately 5.0. In my review for the NRC (BNL-NUREG-23021), which I have appended, I estimated it to be less than 1.5×10^{-4} mils/day in neutral water at $125^{\circ}C$. Extrapolating this datum to a pH of 4.5-5.0 and to a temperature of $50^{\circ}C$ would reduce the rate by a factor of approximately 4, to approximately 4×10^{-5} mils/day, or 0.5 mils in 40 years.

B. No significant deterioration of the rack materials is anticipated in the Salem SFP for the following reasons:

1. The rack structure is fabricated of type 304 stainless steel, according to the ASME Boiler and Pressure Vessel Code, Section 3. (No credit is taken for the Boral in determining the strength of the rack structure).

2. Stainless steels are protected from general corrosion by a tenacious passivating film. Corrosion rates are too low to measure under SFP conditions.

3. Stress corrosion cracking of stainless steel where it is sensitized by welding and where total stresses are high is possible under SFP conditions. However, welded stainless steel SFP liners are used in all PWR's in the U.S. except Yankee-Rowe. They have been in service in a boric acid environment for periods up to 12 years, and no failures due to stress corrosion in this environment have yet been observed, as determined in a survey I made in 1978. Therefore, while it is not impossible that, at some time,stress corrosion may develop in the heat affected zones of the welds, especially where residual stresses from welding are high, this phenomenon would be rare and localized; therefore, it is highly unlikely that this phenomenon will produce sufficiently severe degradation to affect the structural integrity of the racks.

D. Since neither the racks nor the neutron absorption material are likely to undergo significant deterioration during the design life of the racks, as discussed above, I do not anticipate any problems arising from combinations of these factors.

> 6. The Licensee has given inadequate consideration to qualification and testing of Boral material in the environment of protracted association with spent nuclear fuel, in order to validate its continued properties for reactivity control and integrity.

Boral material has been exposed in water for periods up to 20 years without any significant deterioration. I recently prepared a review of the subject, BNL-NUREG-25582, which I have appended to this affidavit. In a boric acid environment, I would anticipate no significant degradation of the Boral material. Should spent fuel pool coolant containing boric acid enter the cavity in the racks containing the Boral, an initial corrosion of aluminum would occur, producing some hydrogen. The Licensee has documented actions it would take (semi-remote tooling will be used to provide vent holes) should this occur, since the hydrogen pressure so generated is capable of bulging the stainless steel can. However, the production of this hydrogen would not lead to significant deterioration of the Boral. After exposure to water, aluminum passivates within a week and essentially no further general corrosion of the aluminum will occur. It is possible, of course, that pitting corrosion would continue at points where the aluminum is in contact with the stainless steel in this environment. This pitting, however, even if it should penetrate the aluminum clad on the Boral, should not lead to massive loss of boron carbide as the boron carbide particles are highly inert in this environment.

Association with the fuel should not lead to significant deterioration of the Boral. The primary radiation from this fuel that would reach the Boral is γ radiation from the fission products. γ radiation has little or no effect on the properties of metals or cermets of the B_4C/Al type. Neutron fluxes, which can lead to loss in the ability of the Boral to control reactivity, are extremely low in a SFP; maximum integrated fluxes from delayed neutrons of approximately 10^9 n/cm^2 in 40 years have been estimated for a SFP. This value is negligible compared to the approximately 4×10^{21} boron^{10} atoms/cm^2 of plate, available to absorb these neutrons.

I, therefore, believe that the Boral material will continue to maintain its properties of reactivity control throughout the forty year design life of the Salem Fuel Pool.

The above statements are true and accurate to the best of my knowledge.

John R. Weeks

John R. Weeks

Sworn before me this 29th

day of MARCH 1979

Donald J. Robbins

Notary Public

STATE OF NEW YORK
SUFFOLK County

DONALD J. ROBBINS
Notary Public, State of New York
No. 52-8591995
Qualified in Suffolk County
Commission Expires March 30, 1980

PROFESSIONAL QUALIFICATIONS

OF

JOHN R. WEEKS

I am currently a metallurgist at Brookhaven National Laboratory, (BNL), where I have been employed since 1953. My present title is Leader, Corrosion Science Group, in the Department of Nuclear Energy. My current responsibilities include experimental investigations on the mechanisms of stress corrosion cracking and pitting corrosion of stainless steels and Inconel, and providing technical assistance to the U.S. Nuclear Regulatory Commission (NRC) in the area of corrosion and coolant chemistry in light water reactors. I am a participating consultant on the NRC Pipe Crack Study Group. I also am Chairman of the BNL Reactor and Critical Experiments Safety Committee, and represent the Department of Nuclear Energy on the BNL Council.

Since joining Brookhaven I have performed and supervised research on materials behavior in both liquid metal and water cooled reactors. From 1970 to 1972 I headed Brookhaven's program on liquid sodium technology. I have been materials advisor to the Reactor Division at BNL since 1959. I was keynote lecturer in 1966 at the International Atomic Energy Agency Symposium on Alkali Metal Coolants, and served in 1967-1969 as a U.S. delegate at the US-UK information exchanges on corrosion of reactor materials. I was a consultant to Aerojet General on the SNAP-8 project.

I was an adjunct associate professor of materials science at SUNY - Stony Brook in 1962-1963, and am currently an adjunct professor of Metallurgy and Nuclear Engineering at the Polytechnic Institute of New York. From 1972 to 1974 I was on assignment to the U.S. Atomic Energy Commission as a senior metallurgist in the Materials Engineering Branch, Directorate of Licensing. In 1974-1975, I served on the AEC (later NRC) Task Force investigating the causes of the stress corrosion problems in BWR piping.

My academic qualifications include a Met. E. degree from the Colorado School of Mines in 1949, a M.S. in 1950, and a Ph.D. in 1953 in Metallurgy from the University of Utah. I am a member of the American Society for Metals, for which I have been Chairman of the Long Island chapter, the Metallurgical Society of AIME, for which I have served as Chairman of the Nuclear Metallurgy Committee, and the American Nuclear Society. I am the author or co-author of approximately sixty-five publications in the areas of my research.