August 4, 1981

RELATED CORRESPONDENCE

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

AUG 5 1981
Office of the Secretary
Docketing & Service
Branch

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

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APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE TO BE HEARD (CONTENTION 7(a))

Pursuant to 10 C.F.R. § 2.749(a) Applicants state, in support of their Motion for Summary Disposition of Contention 7(a) in this proceeding, that there is no genuine issue to be heard with respect to the following material facts:

1. The dynamic loads imparted to the containment structures at the Susquehanna Steam Electric Station ("SSES") during blowdown are the hydrodynamic loads generated during steam discharge into the water pool used to condense steam within the SSES containment. In order to assess the ability of the containment structures at SSES to withstand the dynamic forces realized during blowdown, one must compare the hydrodynamic loads produced during a steam relief valve ("SRV") discharge and a loss-of-coolant accident ("LOCA") to the containment design capacity and test level. Affidavit of

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George R. Abrahamson in Support of Summary Disposition of Contention 7(a) ("Abrahamson Aff."), para. 3.

2. The primary containment at each of the SSES containment structures completely encloses the reactor vessel. It consists of a base mat, a hollow cylinder, a hollow cone, and a domed cap. The base mat is reinforced concrete 7 feet 9 inches thick and rests on slate-like siltstone. The cylinder and cone are reinforced concrete 6 feet thick; all the inner surface of the concrete is lined with teel plate 1/4 inch thick. The cap is steel plate, 1-1/2 inches thick, held in place by 80 bolts 2-3/4 inches in diameter. Abrahamson Aff., para. 4.

3. The containment is divided into two chambers by the horizontal diaphragm slab at the junction between the cylindrical and conical sections. The upper chamber is the drywell and the lower chamber is the suppression chamber or wetwell. The drywell contains the reactor vessel and associated piping, valves and equipment; the wetwell is filled to a depth of 24 feet with water used to condense steam. Steam can be discharged into the wetwell water pool by actuation of an SRV or by a LOCA. These are the events that produce hydrodynamic loads in the containment. Id., para. 5.

4. As a result of a 1972 event at the German Wurgassen boiling water reactor, dynamic loading conditions were identified which had not been fully considered in the design of the Mark II containment used at SSES. Since that time, extensive studies and tests (both generic and

SSES-specific) have been conducted to quantify those loads and design modifications have been implemented to assure that these loads can be accommodated by the SSES containments. Id., paras. 8-19.

SRV discharge loads.

5. There are 16 SRVs in the containment; each has a discharge line that extends downward from a main steam line at the top of the reactor vessel to the bottom of the water pool. Actuation of one or more SRVs results in steam discharge to the pool. Id., para. 6.

6. Each discharge line has a device at the discharge end to enhance steam condensation. These devices, called quenchers, have been specifically designed for SSES to minimize hydrodynamic loads. The SSES quencher design greatly enhances the water surface exposed to steam and thereby increases the rate of condensation and eliminates the types of loads encountered at Wurgassen. Id., para. 20.

7. Prior to SRV actuation, the steam discharge line contains air down to the water level. Upon SRV actuation, steam enters the line and compresses the air. As the water clears the discharge line, compressed air emerges into the pool (air clearing phase), followed by steam (condensation phase). Id., para. 21.

8. During air clearing, air enters the pool at a pressure substantially higher than the local hydrostatic

pressure and forms a bubble adjacent to the quencher. The excess pressure causes the bubble to expand, giving an outward velocity to the water. Due to the inertia of the water, the bubble expands beyond its equilibrium volume at the local hydrostatic pressure, and is eventually driven back again compressing the air in the bubble. Thus the bubble oscillates, producing a periodic pressure history. Id., para. 22.

9. To determine the pressure on the pool boundary, which is the hydrodynamic load on the containment, an extensive test program was undertaken by Pennsylvania Power & Light Co. ("PP&L") at Kraftwerk Union ("KWU"), the German firm with extensive experience in nuclear reactor steam discharge phenomena that designed the SSES quenchers. Tests were performed using an actual SSES steam relief valve, actual steam line diameters and line lengths, and an actual quencher. The tests simulated the simultaneous actuation of all sixteen SRVs, which is the case that gives the highest loads on the containment structure. Id., para. 23.

10. To permit calculations of containment response to proceed in parallel with the test program, KWU provided PP&L with an SRV load specification based on data taken by KWU in previous in-plant quencher tests. The load specification gives the pressure amplitude and distribution on the pool boundary, and the frequency range of the oscillations. The pressure measurements obtained in the SSES quencher tests verified the validity of the load specification. Id., para. 24.

11. The tests covered the range of reactor operating conditions. Tests were performed with the longest and shortest discharge lines, with different temperatures of the air in the discharge line (temperature affects the total air mass in the line), different water levels in the discharge line, vacuum breaker open and closed, various pool temperatures, various steam pressures, and different numbers of actuations. Id., para. 26.

12. The main data relating to hydrodynamic loads on the containment are the pressure measurements. The peak overpressures are of the order of 15 psig, and the main frequency about 6 Hz. Id., para. 29. The pressure amplitudes observed during condensation tests were small compared to those occurring during air clearing. Id., para. 30.

13. For actuation of less than all 16 SRVs, the pressure measurements were adjusted for the larger area in the SSES pool to obtain the pool boundary pressures. Id., para. 31.

14. The pressure histories on the pool boundary were used as input to a computer model of the containment. The computer code calculations show that the SRV loads (pressure and frequency) on the pool boundary produce stresses in the containment floor and walls that are within the structures' design values. Id., paras. 31, 48.

15. A test program to measure loads on submerged structures for SRV discharge in the SSES pool was undertaken for PP&L by SRI International ("SRI"). SRI designed a device, called a bubble source, that simulates SRV air clearing. The source was calibrated in the same tank in which the SRV discharge tests using the SSES quencher were performed. The calibration consisted of matching the peak pressure and oscillation frequency of the bubble source to the values observed during SRV discharge. This assured that the submerged structure loads found by using the bubble source in the SSES pool would be the same as would result from SRV air clearing. Id., para. 33.

16. The tests performed in the SSES pool with the SRI bubble source confirm that the loads on the submerged structures are well below the design loads. Id., para. 34.

LOCA Loads

17. There are 87 downcomers that connect the drywell to the water pool. The downcomers are 24-inch diameter open pipes with a deflector shield on the top; the deflector shield does not restrict the flow of steam into the pipe. Id., para. 7.

18. Release of steam from the reactor is normally accomplished by actuating the SRVs so as to allow steam to enter the water pool through the discharge lines. A LOCA is an unscheduled flow of water or steam from the reactor into the

drywell, and then into the wetwell through the 87 downcomers. The cause of the opening through which the flow occurs is not defined, hence these are called "postulated breaks." Id., para. 36.

19. Of the postulated breaks, the one that produces th largest steam flow and hence the highest pressure in the SSES containment is a postulated double ended rupture of a 28-inch diameter recirculation line. Such a break results in rapid pressurization of the drywell. This is accompanied by a downward acceleration of the water in the downcomers, followed by discharge of air into the water at the downcomer exit plane and an upward motion of the water above that plane. The upward motion of the water continues until air breaks through the water layer; the water then falls back to rejoin the water below the downcomer exit plane. This phase is called "pool swell." Id., para. 37.

20. During and after pool swell, the flow through the downcomers decreases in air content and increases in steam content. The steam condenses as it contacts the water, and the air forms small bubbles that rise to the surface in the pool. The flow into the pool continues until the pressure in the drywell decreases to the water pressure at the downcomer exit plane. The phase following pool swell is called the "condensation phase." Id., para. 38.

21. Loads on the containment during pool swell were investigated by SI [illegible] the auspices of the Electric Power Research Institute (EPRI). In these tests, the critical load

on the containment is the differential pressure across the diaphragm slab. The critical loads occurred when the differential pressure on the diaphragm slab was maximum downward and upward. Analyses of the SSES containment show that the critical load stresses were within the allowable range. Id., para. 39.

22. As with the SRV discharge, a single cell approach was used to determine LOCA loads (pool swell and condensation). An apparatus was constructed that was prototypical of SSES (same downcomer size, same water depth, etc.) except that the pool area was 1/87 of the actual pool area. The single cell approach used results in the highest LOCA loads. Id., paras. 40, 41. Tests were performed with this apparatus by flowing into the drywell 1/87 of the flow that would result from a LOCA in the plant. This is the fraction that would flow through each of the 87 downcomers. Measurements were made of the pressures in the drywell, wetwell air space, and wetwell water space. These measurements gave the loads on the containment. Id., para. 41.

23. A total of 22 tests (11 test conditions, 2 tests each) were performed covering a range of pool temperatures, steam flows and break sizes, including the break size corresponding to the design basis accident, (i.e., the recirculation line ("RCL") break). Id., paras. 43, 44.

24. The pressure histories obtained for the wetwell air space and the drywell during an RCL break indicate that the wetwell pressure rises to 25.2 psig and the drywell pressure

rises to 37.7 psig. The RCL break produces the most rapid flow of steam into the drywell, and the drywell and wetwell pressures for the RCL break are greater than for smaller breaks. Id., para. 47.

Comparison of Hydrodynamic Loads with Containment Design Capacity and Test Level.

25. The design pressure for the SSES containment is 53 psig for both the wetwell and drywell. The SSES containment has already been tested by pressurizing it to 61 psig with air. These pressures are greatly in excess of the maximum pressure of 37.7 psig produced in an RCL break. Id., para. 49. It is also greatly in excess of the maximum pressure of about 15 psig from an SRV discharge. Id., para. 29.

26. The computer calculations and the experimental test results show that the SSES containment can withstand the hydrodynamic loads from both SRV discharges and LOCAs with ample safety margin. Id., paras. 48, 50. Therefore the SSES containment can withstand the dynamic forces realized during blowdown with ample safety margin. Id., para. 2.

Dated: August 4, 1981.

Respectfully submitted,

SHAW, PITTMAN, POTTS & TROWBRIDGE

Jay E. Silberg
Matias F. Travieso-Diaz

Counsel for Applicants

1800 M Street, N.W.
Washington, D. C. 20036
Telephone: (202) 822-1000