Docket No. 50-354

DEC 12 1984

Mr. R. L. Mittl, General Manager
Nuclear Assurance and Regulation
Public Service Electric & Gas Company
80 Park Plaza, T22A
Newark, New Jersey 07101

Dear Mr. Mittl:

SUBJECT: MISSILES GENERATED BY NATURAL PHENOMENA

The staff has reviewed your submittal dated September 17, 1984, concerning missiles generated by natural phenomena (flooding) and the protection of safety - related structures, systems and components from these missiles. Based on this review the staff has generated the enclosed list of comments. Please be prepared to discuss these comments at the previously arranged December 18, 1984 meeting.

Sincerely,

Original signed by:

A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing

Enclosure:
As stated

cc: See next page

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PROTECTION FROM MISSILES GENERATED BY NATURAL PHENOMENA
HOPE CREEK GENERATING STATION

1. Your analysis of waterborne missiles has been limited to the hurricane flooding event. a) Using the combined event criteria cited in ANS 2.8-1981, provide your detailed analysis of the water levels associated with the Probable Maximum Flood (PMF) on the Delaware River at the Hope Creek Plant. Use appropriate hydrologic models which input the 10% excedence high tide and the PMF hydrograph as the upstream input condition. b) Using the combined event criteria, provide your analysis of the water levels at the plant site associated with the seismic dam failure combined with the one-half PMF event on the entire river basin and the 10% excedence high tide at the plant site.

2. Discuss the impact of waterborne missiles, derived from upstream industrial areas as a result of these flooding events, on safety-related structures including the waterproof doors.

3. Discuss the ability of the service water intake structure to resist the impact of waterborne missiles (boats, barges, etc.) from upstream sources.

4. Discuss the ability of exterior doors in safety-related structures to withstand the impact of a spectrum of waterborne missiles and identify the limit of the doors to resist the impact of the missile spectrum.

5. Provide the uncertainty associated with the extrapolation of an 11-year data base to represent return periods of up to 200 years,particularly in the developmentof a relationship between extreme wind speed and wind direction.

6. Provide further justification of the use of the "Fisher-Tippett Type 2" distribution when other analyses of extreme winds (e.g. NUREG/CR-2639, "Historical Extreme Winds for the United States-Atlantic and Gulf of Mexico Coastlines") suggest use of a mixed distribution, with all Type I distribution fitting non-tropical storms and the Weibull distribution fitting tropical storms.

7. The statement is made on page 2 that "the particularly open exposure of this site is not adequately duplicated at any of the National Weather Service (NWS) stations in the region," implying that extreme wind speeds at the site may be higher than at the NWS stations. Provide a discussion of the exposure of NWS stations in the region, particularly at Wilmington, DL, and provide comparable estimates of extreme winds at the NWS stations for return periodis of 20, 50, 100, and 200 years as in Table 2.

8. Typically, extreme winds are represented by the fastest mile windspeed. Provide a comparison of fastest mile wind speeds for return periods of 20, 50, 100, and 200 years between regional NWS stations and the site.

9. Sustained winds with durations of 10 minutes are often examined to determine wave action, run-up and surges. Provide additional discussion and justification for use of 1-hour and 6-hour averages of wind speed for consideration of the effects of winds on riverborne missiles at Hope Creek.

10. The attempt to quantify the probability of occurrence of a probable maximum hurricane (PMH) with a trajectory west of Artificial Island appears somewhat misguided, considering the deterministic deviation of the PMH parameters and the considerable uncertainties associated with hurricane trajectories prior to 1871. Provide additional discussion of the relationship of the PMH to trajectory, considering in particular the number of hurricanes which have or appear to have passed west of Artifical Island since 1683 (about 6?) and that none of the observed hurricanes approached the intensity of the PMH.

11. The relationship between wind speed magnitude, direction, and duration appears crucial for this analysis. Although relationships between fastest mile wind speeds and sustained winds for 1-minute or 10-minute periods are available, the relationship between the direction of sustained winds is not well-established. Provide additional discussion of the relationship of extreme wind speeds to wind direction in the context of riverborne missiles at Hope Creek.

12. Provide the details of your analysis performed to evaluate effects on power block structures and the intake structure due to the impact of the waterborne missile. These details should include, at least, the following:

    a. Assumptions, Basis and Results
    b. Criteria used in evaluations
    c. Evaluation of local effects, including spalling of concrete on inside faces, potential impact on the safety-related equipments nearby, and leakage potential
    d. Overall effect of the waterborne missile on the structural elements and doors, and boundary mechanics by which the impact forces are transmitted from the door to the structure
    e. Overall stability of intake structure
    f. Any high frequency vibration effects on the attached equipment

13. For those structures and doors which may leak or fail or generate secondary missiles, provide the results of any analysis of the effects of the secondary missiles and flooding on safety-related systems and components. Credit for any mitigating action can only be taken for safety-related, Class 1E powered structures, systems, and components.

14. On pg. 5 of the ADL Report it is stated that grade level is approximately 14 ft above Mean Low Water Level. In Table 2, footnote 4, p. 7, it is stated that an increased water depth of 12 ft over Mean Low Water results in a water level which is about 3 ft below plant grade (rather than 2 ft, as would result from the statement on p. 5 of the ADL Report). Is there a reason for the difference between the statement in p. 5 and Table 2?

15. It appears implicit in the estimate of the kinetic energy per unit area for a large recreational boat hitting a structure (p. 16) that the impact area is 100 square ft. Explain why the impact areas could not be significantly smaller than 100 square ft.

16. Explain why the chances of an unmanned vessel approaching within 10 miles of Hope Creek without a prior grounding are estimated on p. 44, Appendix C of the ADL Report, to be less than 10 percent.

17. It is assumed in the ADL Report (p. 45) that the probability per mile of simultaneous loss of power and steering is 10E5 per mile. This estimate is based on historical data contained in References 1 and 7. Does this historical data pertain to severe storm conditions? If not, are the estimates independent of whether storm conditions are present?

18. Explain why, once power and steering are lost, the vessel is more likely to head towards the target (rather than equally likely to move in any direction), by a factor of about 10 for the water intake structure and by a factor of about 100 for entering the Hope Creek site (see p. 47 of the ADL Report).

19. The probabilities of strike by a non-self-propelled vessel already within ten miles of Hope Creek striking the intake water structure are stated on p. 48 of the ADL Report to be 1.2 x 10E5 per vessel for the intake structure and 3.1 x 10E3 per vessel for the Hope Creek site. Were the same multiplication factors of 10 and 100 used in these estimates as in the estimate discussed in Question 410.132.

20. In any given storm, wind speeds over water are higher than wind speeds over ground. It appears this was not taken into account in the estimate of annual probabilities of extreme six-hour wind speeds at 33 ft elevation. Is this the case. If so, why?

21. In the July 1984 MES Report it is stated that the probability of occurrence in any one year of a "probable maximum hurricane," H(max), having a direction of motion, D, capable of causing a very large tidal surge can be obtained as follows:

$$P(H(max),D) = P(H(max))\ P(D) \quad (1)$$

where P(H(max)) = probability of occurrence in any one year of a probable maximum hurricane regardless of trajectory, and P(D) = probability of occurrence in any one year of a storm having the direction of motion D. It is estimated in the above-mentioned Report that P(H(max)) approximately equals 1000 per year. It is further estimated in the Report that P(D) approximately equals 100 per year, the justification for that estimate being that only one storm in 100 years was sufficiently strong and had the direction of motion needed to cause a significant tidal surge.

Actually, P(D) should represent the ratio of the number of storms having a direction of motion D to the total number of storms, regardless of their direction. For the area and time frame considered, it would follow from the report that this ratio is about 5/39 (p. 9). If the ratio 5/39 were used in equation 1 above, rather than the ratio 1/100, the estimated probability P(H(max), D) would increase by an order of magnitude, i.e., it would be about 10E-4 per year, rather than 10E-5 per year as estimated in the MES report.

To summarize, it appears that the MES Report uses, in lieu of P(D), a joint probability P(V,D), where V is a relatively large wind speed such that P(V,D) approximately equal to 100 per year. An explanation is requested concerning this matter.

22. It is stated in the August 1984 MES Report (p. 4) that the NBS BSS-124 document "is based on actual hurricane climatology and statistics only insofar as the frequency of occurrence of hurricanes in various locations is concerned." Actually, NBS BSS-124 also uses statistics based on climatological data concerning the pressure difference between center and periphery of storms, radius of maximum wind speeds, speed of translation of storm, and direction of storm translation (see pp. 3 and 4 of NBS BSS 124). The MES report should be corrected to reflect this information.

23. In Table 1 of the August 1984 MES Report, were any of the storms of the thunderstorm type? This question is asked because, if indeed some of those storms were of that type, then the ratios FM/1H and FM/6H would be too high to be possibly representative of hurricane winds.

24. Page 7 of the August 1984 MES Report reproduces estimates of directional fastest-mile wind speeds from the NBS BSS-124 Report. However, the estimates of NBS BSS-124 pertains to winds blowing from a 360°/16 = 22.5° sector, rather than from the 79°-170° sector. Using data on which the NBS BSS-124 report is based (which are available on tape at NBS), the fastest-mile wind speeds at 33 feet over ground is estimated as 36 mph, 73 mph, and 85 mph for the 10-yr, 50-yr, and 100-yr means recurrence intervals, respectively, rather than 25 mph, 57 mph, and 70 mph, as indicated on p. 7 of the August 1984 MES Report.

25. Page 4 of the Arthur D. Little, Inc., report "An Analysis of the Likelihood of Waterborne Traffic and other Floating Objects on the Delaware River Impacting the Hope Creek Generating Station in Severe Storms"-revised report dated September 1984, lists a number of floating objects such as utility poles, houses, automobiles, fuel tanks and trees which were analyzed for potential damage to metal doors in the power block.

In view of the location of rail lines and chemical industries at relatively low grade elevations up stream from the reactor site, indicate if empty railroad tank cars and industrial chemical storage and or processing tanks should also be included in the flood missile spectrum. Indicate the size (and mass) of these tanks as compared with the size of the power block doors and hatches.