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SUBJECT: Submits responses to questions re auxiliary feedwater sys tornado missile analysis submitted on 830829.

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Director of Nuclear Reactor Regulation
Attention: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing
United States Nuclear Regulatory Commission
Washington, DC 20555

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23
AUXILIARY FEEDWATER SYSTEM TORNADO MISSILE ANALYSIS

Dear Mr. Varga:

Carolina Power & Light Company (CP&L) has recently received questions from your staff concerning the Auxiliary Feedwater System (AFWS) Tornado Missile Analysis submitted on August 29, 1983 for the H. B. Robinson Steam Electric Plant Unit No. 2 (HBR2). The questions are listed below along with CP&L's response to each.

NRC Question No. 1

On page 2-1, second paragraph, the third sentence ("The feed to the . . .") does not have any verbs and is, therefore, not comprehensible in its present form.

CP&L Response

The word "surfaces" in the third sentence in the second paragraph on page 2-1 is used as a verb meaning to come to the surface. The sentence could be rewritten as follows:

"The feed to the turbine driven auxiliary feed pump enters the turbine building from underground in the vicinity of the pump and the feed to the motor driven auxiliary feed pumps enters the auxiliary building from underground in the vicinity of the motor driven auxiliary feedwater pumps."

NRC Question No. 2

In Section 4.1 ("Loss of Offsite Power and Failure of Emergency Power Sources") the probability of loss of offsite power is assumed to be equal to the estimated probability of 73 mph or higher winds striking the switchyard or the transmission lines. If only tornado winds are considered, the probability

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is estimated in the report to be about 1.9×10^{-4} per year. However, if nontornadic winds were considered this probability would be substantially higher (on the order of 4×10^{-2} per year -- see for example, estimates of extreme speeds at Greenville, SC, in Reference 1). The question is: why have nontornadic winds not been taken into consideration?

Reference 1: E. Simiu, M. Changery, and J. J. Filliben, Extreme Wind Speeds at 129 Stations in the Contiguous United States, Building Science Series 118, National Bureau of Standards, Washington, DC, March 1979.

CP&L Response

The study was conducted to perform an assessment of the effect of tornados on the availability of the auxiliary feedwater system, as requested by NRC. Consistent with NRC's request, Section 4.1 documents the simplified analysis that was performed to estimate the frequency of a loss of offsite power directly due to tornados. The purpose of the section was to show the relative contribution of loss of all AC power (initiated by tornado damage to the switchyard or transmission lines) to tornado induced unavailability of the AFS.

In addition, wind loadings for HBR2 are discussed in Section 3.3.1 of the updated Final Safety Analysis Report (FSAR). Carolina Power & Light Company believes that the tornado missile analysis submitted on August 29, 1983 and the analysis discussed in the FSAR demonstrate the acceptability of the AFWS considering high winds in the vicinity of HBR2.

NRC Question No. 3

On page 4-5 it is stated that the reliability of the AFWS was estimated as being less than 10^{-4} per demand given that onsite power is not lost. The authors of the report presumably mean that the probability of failure (rather than the reliability) has that estimated value. Is this a correct statement?

CP&L Response

The statement in the question is correct; 10^{-4} is the probability of failure on demand of the AFWS, not its reliability.

NRC Question No. 4

In Section 4.3.2 it is stated that, in the absence of any relevant information, the pump motors are assumed to experience damage only if wind speeds exceed about 158 mph. This reviewer feels that this assumption may not be warranted, since pump motors could be more sensitive to wind effects than a storage tank, say. The question is whether it is prudent to design the plant on the basis of this uncertain assumption. If, for example, the pumps were able to sustain only winds of about 130 mph or so, then the probability of loss of offsite power and damage to the service water pumps could be of the order of 10^{-4} (considering again nontornadic winds).

CP&L Response

Carolina Power & Light Company does not agree that pump motors would be more sensitive to wind effects than a storage tank. The service water pumps are National Electric Manufacturer's Association (NEMA) Class WP II, and therefore, are protected from the adverse effects of water impingement on the motor. The effect of wind loads on the relatively small (about 4 foot diameter and 8 foot high) well anchored and rugged (because of normal operating requirements) pump motors would be expected to be considerably less than on a storage tank. The study did, however, consider the possibility of a lower windspeed damage threshold for tornado winds in the sensitivity study (see Table 3 of the report submitted August 29, 1983). The study did not consider nontornadic winds, as discussed in response to Question 2 above. Carolina Power & Light Company believes that the assumptions made are acceptable.

NRC Question No. 5

This reviewer is not aware that 10^{-4} per year is now an acceptable probability of core melt. Is this indeed the case?

CP&L Response

The report did not state that 10^{-4} is an acceptable value for the annual frequency of core melt, only that it is a design objective proposed in NUREG-0880. The purpose of this statement was to show that the best estimate for tornado induced unavailability of the AFWS produces a number much smaller than this proposed design objective.

NRC Question No. 6

In this reviewer's opinion, the estimated probabilities of tornado damage based on the DAPPLE index underestimate the actual probabilities. This is so because the DAPPLE index does not include corrections for (a) the possibly poor estimation of the tornado intensity on the basis of observed damage, and (b) the possible absence of objects (such as buildings, signs, and so forth) in the path of the tornado zones where wind speeds are highest. This opinion was confirmed in recent conversations with Drs. Abbey and Twisdale. Why does the report not make allowance for such corrections?

CP&L Response

We agree that there is a potential for nonconservatism in the estimates of damage frequencies using either the DAPPLE (damage-area-per-path-length) index method or using National Severe Storms Forecast Center (NSSFC) data due to classification errors or the possibility that a tornado might strike in an area where there was little to damage. Our belief was that any nonconservatism would not be large in the range of wind speeds of interest. In order to confirm this, the calculation has been repeated using a different approach.

In NUREG/CR-2944, "Tornado Damage Risk Assessment," Reinhold and Ellingwood have evaluated several proposed models for predicting tornado windspeed frequencies and have recommended a model, the results of which for a structure 150 feet wide are given in Figure 15 of their report. The results of a point target, which is what was used in our report, would give lower frequencies by a factor of between 1.2 and 1.5 (Twisdale and Dann, "Probabilistic Analysis of Tornado Wind Risks," Journal of Structural Engineering, Vol. 109, No. 2, February 1983).

The model used by Reinhold and Ellingwood has taken into account random encounter errors and misclassification errors. Their results for the frequencies of windspeeds equaling or exceeding F2, F3, and F4 categories are given in line 1 of Table 1 (attached). The appropriate frequencies are those from tornado Region 1 (WASH-1300) since this is the region in which the Robinson plant is located. The occurrence rate of tornados in Region 1 is much higher than the local occurrence rate at the site. From Table 3 of Reinhold and Ellingwood, the unadjusted Region 1 rate is 3.089×10^{-4} per year as compared to a local value of 0.587×10^{-4} per year from NUS-4396 "The Effect of Tornados on the Availability of the Auxiliary Feedwater System at H. B. Robinson Unit 2," revised August 1983. (Note that the occurrence rate unadjusted for reporting trends has been used to compare with the 0.587×10^{-4} per year which is also an unadjusted occurrence rate). Line 2 of Table 1 gives the frequencies in line 1, adjusted by the ratio 0.587/3.089 to allow for this variation in occurrence rate. The last line in Table 1 gives the estimates of equaling or exceeding F2, F3, and F4 categories from NUS-4396. Comparison of the last two lines indicates that the Reinhold and Ellingwood results (uncorrected for target size) give results that are a factor less than 2 higher for windspeeds F2, a factor of approximately 2.5 higher for windspeeds F3, and a factor of 5 higher for windspeed F4. This implies if we were to use the Reinhold and Ellingwood method, the estimate for the unavailability of the AFWS from tornado strike would increase to 4.5×10^{-6} per year (rather than 1.8×10^{-6}). In view of the approximate nature of the analysis and the conservative damage assumptions, this increase is not considered significant.

If you have any further questions on this subject, please contact Mr. David Stadler at (919) 836-6739.

Yours very truly,

S. R. Zimmerman
Manager
Nuclear Licensing Section

ONH/ccc (99430NH)
Attachment

cc: Mr. J. P. O'Reilly (NRC-RII)
Mr. G. Requa (NRC)
Mr. Steve Weise (NRC-HBR)

Table 1

Annual Frequency of Equaling or Exceeding
F Scale Windspeed

Windspeed Case	$F \geq 2$	$F \geq 3$	$F \geq 4$
NRC Tornado Region I (WASH 1300)	7×10^{-5}	2×10^{-5}	4.5×10^{-6}
Adjusted to Local Rate	1.3×10^{-5}	3.8×10^{-6}	8.5×10^{-7}
NUS-4396	8.0×10^{-6}	1.55×10^{-6}	1.68×10^{-7}