November 25, 1985

Docket No.: 50-245

Mr. J. F. Opeka, Senior Vice President
Nuclear Engineering and Operations
Northeast Nuclear Energy Company
Post Office Box 270
Hartford, Connecticut 06141-0270

Dear Mr. Opeka:

SUBJECT: INTEGRATED PLANT SAFETY ASSESSMENT REPORT SECTION 4.4, WIND AND TORNADO LOADINGS, SECTION 4.7, TORNADO MISSILES - MILLSTONE UNIT 1

Enclosed is the staff's Safety Evaluation Report for Sections 4.4 (Wind and Tornado Loadings) and 4.7 (Tornado Missiles) of the Integrated Plant Safety Assessment Report (IPSAR) for Millstone Unit 1 (NUREG-0824). Those sections of the IPSAR identified structures and components which were unable to adequately resist the effects of tornado winds and missiles.

The staff concludes that your proposal to provide a connection to the city water system and make-up pump to the isolation condenser will provide reasonable assurance that hot shutdown can be achieved and maintained until arrangements can be made to achieve cold shutdown. The staff also concludes that this modification, combined with the present capacity of structures and components at Millstone 1, are sufficient such that no further modifications are warranted.

These conclusions are dependent on confirmation of the capacity of the anchor bolts on the condensate storage tank (CST) and firewater tanks to assure that they provide substantial resistance against failure. The CST and firewater tanks provide two of three sources of make-up to the isolation condenser, which is being relied upon as a protected method of achieving hot shutdown; thus, the potential for failure of the CST and firewater tanks should be minimized. Confirmation of the capacities of these anchor bolts and issues related to load combinations will be addressed under Topic 1.19, Integrated Structural Analysis, in the Integrated Safety Assessment Program (ISAP).

Sincerely

Original Signed By
Chris Grimes

Christopher Grimes, Director
Integrated Safety Assessment Project Directorate
Division of PWR Licensing - B

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Docket No.: 50-245
LS05-85-

Mr. J. F. Opeka, Senior Vice President
Nuclear Engineering and Operations
Northeast Nuclear Energy Company
Post Office Box 270
Hartford, Connecticut 06141-0270

Dear Mr. Opeka:

SUBJECT: INTEGRATED PLANT SAFETY ASSESSMENT REPORT SECTION 4.4, WIND AND TORNADO LOADINGS, SECTION 4.7, TORNADO MISSILES - MILLSTONE UNIT 1

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Sincerely

John A. Zwolinski, Chief
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Enclosure

SAFETY EVALUATION BY
THE OFFICE OF NUCLEAR REACTOR REGULATION
MILLSTONE UNIT 1
INTEGRATED PLANT SAFETY ASSESSMENT REPORT (IPSAR)
SECTION 4.4, WIND AND TORNADO LOADINGS
SECTION 4.7, TORNADO MISSILES
DOCKET NO.: 50-245

I. INTRODUCTION

The Integrated Plant Safety Assessment Report (IPSAR) for Millstone 1 (NUREG-0824, Ref. 1), issued in February 1983, identified in Section 4.4 six areas of the plant that could not adequately resist the site specific windspeeds identified in SEP Topic II-2.A or for which additional information from the licensee was necessary. The licensee agreed to review the staff's analyses and address each of the six items as part of an overall structural review of the Millstone 1 facility that would also address concerns discussed in IPSAR Sections 4.1 Flooding Potential and Protection Requirements, 4.2 Settlement of Foundations and Buried Equipment, 4.5 Effects of High Water Level on Structures, 4.7 Tornado Missiles, 4.11 Seismic Design Considerations, and 4.12 Design Codes, Design Criteria and Load Combinations. The six areas identified in the IPSAR relating to wind and tornadoes are: (1) reactor building steel structure above the operating floor, (2) ventilation stack (chimney), (3) effects of failure of non-qualified structures, (4) components not enclosed in qualified structures, (5) roofs, and (6) load combinations.

Input to Section 4.4 of the IPSAR was provided by the staff's final Safety Evaluation Report (SER) dated September 30, 1982, (Ref. 2). The items identified in the IPSAR were addressed by the licensee in letters dated February 2, 1984 (Ref. 3), March 16, 1984 (Ref. 4), October 7, 1983 (Ref. 5), and December 3, 1982 (Ref. 6).

Section 4.7 of the IPSAR similarly concluded that a number of safety-related components are inadequately protected from tornado missiles and, therefore, that the licensee should provide protection for sufficient systems and components to ensure the ability to safely shutdown (i.e., achieve hot shutdown) following a tornado strike. The licensee responded to this aspect of the wind and tornado loadings in a letter dated December 2, 1983 (Ref. 7).

II. EVALUATION

Under SEP Topic II-2.A, "Severe Weather Phenomena", the staff provided the site-specific tornado and straight wind hazard function considered appropriate for the Millstone 1 site. The curve provides the probability of exceeding a threshold windspeed in one year versus windspeed. An analysis was performed by Dr. McDonald under contract to the staff. As discussed in Topic II-2.A and in the IPSAR, the McDonald curve corresponding to the 95% confidence limit would be used by the staff to assess the tornado hazard at Millstone 1.

More recently, the staff completed an independent assessment of the tornado hazard conducted in the same manner that is currently used in licensing. The results are superimposed on the McDonald curve in Attachment 1. As can be seen, the NRR estimate is very close to the upper 95th percentile estimate developed by McDonald that was previously supplied to the licensee under SEP Topic II-2.A. Because of the good agreement in analyses results, conclusions presented in this evaluation can be considered to be based on either the NRR estimate or McDonald's upper 95th percentile estimate; i.e. the probability per year of exceeding the windspeeds listed in this evaluation.

The Franklin Research Center, under contract to the staff, provided assistance in the review of the licensee's structural capacity analyses. Details of FRC's review are given in a Technical Evaluation Report (TER) provided as Attachment 2 to this SER.

Although structural capacities for selected structures been calculated by the licensee, the underlying purpose of the review performed by the licensee was to assure that safe hot shutdown could be accomplished and maintained for a sufficient amount of time until arrangements can be made to proceed to cold shutdown. To this end, the licensee has relied upon the isolation condenser. Use of the isolation condenser would permit a stable, hot shutdown to be achieved and maintained as long as make-up water and a method of supplying the make-up to the isolation condenser are available.

With hot shutdown as the overriding goal, failure consequences of some structures were not investigated fully or were only investigated to determine whether their failure could affect shutdown via the isolation condenser.

The isolation condenser is located in the reactor building, one level below the operating floor. It removes heat from the reactor coolant system via natural circulation as reactor coolant (steam condenses to water) flows through the tubes of the isolation condenser. The system is initiated by opening a normally closed valve in the return condenser line using dc or manual power. Water to the shell side of the isolation condenser is provided by the firewater tanks, the condensate storage tank (CST), or the city water system. The CST and firewater tanks, and their associated pumps, however, are not protected from tornado missiles (the CST has been analyzed for tornado winds; see item D below). In response to the tornado missile topic, the licensee has committed to tie into the city water system in order to provide a protected source of make-up to the isolation condenser should the CST and firewater tanks both be damaged by tornado effects. Use of water in the CST and firewater tanks, if available, would permit hot shutdown to be maintained on the order of a few days while use of the city water system would permit hot shutdown to be maintained even longer. In addition to tying into the city water system, the licensee will provide a diesel driven pump to supply this water to the isolation condenser. This pump will be protected from tornado effects.

In the following evaluation, capacities calculated by the staff usually represent the speed at which the acceptance criteria for extreme external events as stated in the Standard Review Plan for selected structural elements are exceeded. The staff has performed limited investigations into structural capacities after some members have failed; however, detailed incremental, non-linear analyses were not performed by either the licensee or the staff for entire structural systems, consistent with the hot shutdown approach proposed by the licensee.

A. Reactor Building Above the Operating Floor (IPSAR 4.4.1)

In the IPSAR, the licensee agreed to analyze the reactor building for tornadic wind loads in response to the staff's SER, which concluded that the capacity of this structure does not meet the required capacity necessary to resist site specific wind loads. After performing the analyses, the licensee concluded that this structure is capable of withstanding a 245 mph tornadic wind. The licensee has concluded that no modifications are warranted because a 245 mph wind corresponds to a probability of exceedence of about $1x10^{-6}$/year, which is sufficiently low.

The reactor building above the operating floor is substantially a box structure approximately 140 feet x 106 feet x 42 feet high. The walls are 12-inch thick reinforced concrete with #5 bars @ 6" running horizontally and #4 bars @18" running vertically with steel columns constructed integrally with the wall. The roof consists of built-up roof decking supported by steel beams running north-south and east-west. The east-west beams span 106 feet between columns and are large girders approximately 5 feet deep. The north-south beams consists of W14x30 sections which run between the girders along column lines and M14x17.2 purlins which run between the girders in between north-south column lines. Some diagonal bracing exists in the roof between selected column lines in both the east-west and north-south directions. The lateral load resisting system relies on the concrete walls and steel columns with the roof acting as a diaphragm to distribute the load to the walls.

Based on the analyses presented in Attachment 2, the staff concludes that the limiting structural capacities for the reactor building above the operating floor (i.e., enclosure structure) are as follows:

The simply supported beam model of the wall relies on the resistance of the roof steel. The roof steel wind-speed limits for dynamic pressure are:

M 14x17.2 Roof purlin	114 mph
W 14x30 Roof Beam	171 mph
Roof deck welds	180 mph

For intact roof steel, the load transfer and suction on the downstream wall will cause this component to have a limiting wind-speed of 120 mph.

The capacities presented above are for tornado dynamic (velocity) pressure caused by windflow around a structure and not for differential pressure due to tornado pressure drop. The capacities for roof purlins and roof beams are overestimated because the contribution of differential pressure loads to the dynamic pressure loads were not included.

The primary reason for the differences in capacities of the roof purlins and beams calculated by the staff and the licensee is due to structural modelling. The licensee has assumed that the roof deck "blows off" and relieves the lateral loads on the roof steel, thus permitting it to resist a higher axial load and assist in the lateral resistance of the wall. Calculations performed by the staff using information provided in the Millstone 1 FSAR, indicate that the roof deck can resist a dynamic pressure corresponding to 180 mph and that the roof purlins will fail at a lower windspeed. Therefore, the assumption that the roof steel will be available to assist the walls in resisting lateral loads based on the assumption that the roof deck blows off is questionable.

The structure was not investigated for differential pressure by the licensee. Differential pressure would have a similar effect on the roof as the dynamic pressure, in that it will apply an upward force on the roof steel and decrease its capacity to resist lateral forces from the dynamic pressure. The staff has previously examined the structure for differential pressure and presented the results in the staff's SER dated September 30, 1982.

Additionally, upstream and downstream pressure on the walls and columns were not considered by the licensee in conjunction with the roof and floor reactions.

A summary of the limiting capacities determined by the staff in terms of windspeed, the associated probabilities of exceedence and the cause, namely dynamic or differential pressure, in Table 1.

Table 1

Summary of Limiting Structural Capacities for Tornado Winds

Element	Windspeed	Cause	Approximate Probability of Exceedance/yr
M 14x17.2 Roof Purlins	75	differential	1×10^{-4}
	114	dynamic	8×10^{-5}
W 14x30 Roof Beams	150	differential	3×10^{-5}
	171	dynamic	1×10^{-5}
Roof deck welds	107	differential	8×10^{-5}
	180	dynamic	8×10^{-6}
North and South Wall	95	differential	7×10^{-5}
columns (assuming roof is available to assist in resisting lateral loads)	120	dynamic	7×10^{-5}

Velocities given above for differential pressure were calculated using the cyclostrophic equation. The velocities are the tangential velocities based on the rotational component only. Total tornado tangential velocity is found by adding the translational component to the rotational component. Since the probabilities of exceedence given in attachment 1 are for total velocity, the translational component must be added to the above rotational component in order to determine the corresponding probability of exceedence. The relationship between rotational and translational velocities can vary; however, the ratio assumed here is $V_R/V_{TOTAL}=.8$; $V_R+V_T=V_{TOTAL}$. $V_R/V_{TOTAL}=.8$ based on the values given in Regulatory Guide 1.76.

The concern related to the reactor building enclosure structure is that collapse of this structure may endanger the spent fuel pool, structures and components adjacent to the reactor building, or safety -related equipment located below the operating floor of the reactor building. No equipment necessary to achieve safe shutdown is located above the operating floor; damage to safe shutdown equipment, such as the isolation condenser located a floor below the operating floor could occur if falling debris penetrates the operating floor. The isolation condenser is being relied upon as the primary method of shutdown if other structures and components necessary for safe shutdown are damaged by tornado effects.

The walls and the roof of the enclosure structure are inter-related in establishing the capacity of the entire structure; if the roof capacity decreases, the lateral load resisting capability of the entire structure is reduced. As a result, the staff is not concerned with items such as roof deck welds or roof purlins per se; rather, the staff is only concerned with these items to the extent that their failure affects the entire structural system.

The staff analyzed the north-south direction since it appeared to be weaker than the east-west direction. Member capacities and associated windspeeds obtained are presented in Table 1; however, these capacities should be viewed in the context of the entire structural system. For example, a purlin failure will not lead to structural collapse. The staff found that the purlins failed first. The purlins, however, may still provide some axial resistance even after they have buckled. Failure of the purlins, therefore, does not result in failure of the entire structure.

If the purlins do not provide any axial resistance, lateral load transfer in the N-S direction in the roof would occur entirely through the W14x30 sections. The E-W girders would provide some assistance even though they would be bending about their weak axis.

Ignoring the effect of the girders and assuming the purlins provide no assistance in load carrying capacity results in failure of the W14x30s at approximately 171 mph. The W14x30 sections in the N-S direction or the girders in the E-W direction would transfer the lateral load to the supporting columns.

Accounting for both upstream and downstream forces and using the composite steel-concrete capacity calculated by the licensee, the staff obtained a limiting windspeed of approximately 120 mph which has a probability of exceedence of approximately 7×10^{-5}/year.

The capacity calculation performed by the licensee was based on wall bending in a vertical direction (about a horizontal axis) and ignored the benefit of bending in a horizontal direction. Horizontal bending of the upstream and downstream concrete walls, although still relying on the intermediate columns, would have the benefit of being attached at the ends to the concrete walls running parallel to the wind direction and using these walls as shear walls to resist the lateral load. It appears that this may have been the intention in the original design because the horizontal reinforcement (#5 @ 6") is more substantial than the vertical reinforcement (#4 @ 18"). Accounting for horizontal wall bending in this way would increase the structural capacity over that calculate by the staff; the staff estimates that structural capacity would increase substantially if horizontal bending and shear walls were taken into account.

The operating floor consists of a reinforced concrete slab on reinforced concrete beams. The slab is 14 inches thick with #9 bars @ 12" in both directions. The operating floor would, therefore, provide substantial protection for the isolation condenser below.

The staff concludes that the reactor building enclosure structure is capable of withstanding at least 120 mph and even more if the effects of bending and shear walls were accounted for; therefore, the likelihood of a tornadic wind which would cause substantial structural damage to the reactor building is below 7×10^{-5}/year.

On this basis, and in consideration of the inherent protection afforded to the isolation condenser by the operating floor, the staff concludes that no modifications to this structure are warranted.

B. Ventilation Stack (IPSAR 4.4.2)

The staff concluded in its SER (Ref. 2) that the ventilation stack is capable of withstanding a 214 mph windspeed which corresponds to a probability of exceedence of approximately 5×10^{-6}/year. As discussed in the IPSAR, the staff was concerned that failure of the stack could affect safety-related structures.

The licensee, in submittals dated December 3, 1982 and October 7, 1983, provided a consequence analysis of stack failure and concluded that safe shutdown could be achieved if the stack were to collapse primarily because the Millstone 1 stack is not located in close proximity to major plant structures and components. The licensee has postulated stack failure at the base and assumed the stack held together so that any structures within a distance of the stack length could be hit. The licensee determined that the following structures and components are potentially vulnerable to damage under these assumptions.

Millstone Unit 1:

1. Condensate Storage Tank
2. Waste Surge Tank
3. Domestic Water Tank
4. Radwaste Shipment Building
5. Radwaste Storage Building
6. Xenon-Krypton Building
7. Reactor Building Access Lock

Millstone Unit 2:

8. Portions of the Auxiliary Building (specifically: Cyanaloc Tank and Pump Room, Railroad bay and Maintenance shop.)
9. Diesel Generator room B
10. Diesel Generator room A

Shared Facilities:

11. Firewater Tanks (2)
12. Firewater Pumphouse
13. Unit 1 & 2 Solidification Chemical Storage Building
14. Alternate Access Point
15. Transmission Towers (2)
16. Various office facilities, warehouses, maintenance facilities, and temporary construction facilities

The licensee states that items which could affect the safe operation of Unit 1 are the condensate storage tank, firewater tanks and pumphouse because these cooling sources supply make-up to the shell side of the isolation condenser. However, because of the separation, it is not possible for the stack to damage both water sources simultaneously and, even if both sources were unavailable, there would still be alternate means of maintaining safe shutdown.

The staff notes that although failure of the stack cannot damage both water sources, damage from other tornado effects such as missiles in conjunction with stack failure can result in both sources being unavailable. Should both sources become disabled, a source of make-up will still exist, however, because the licensee has committed by letter dated December 2, 1983 (Ref. 7), to provide a source of water to the isolation condenser that is fully protected from tornado missiles in response to the tornado missile topic (IPSAR Section 4.7). After installation of the tornado missile protected source of make-up is completed, a backup source of make-up will exist should both the condensate storage tank (or condensate transfer pumps) and firewater tanks (or firewater pumps) become damaged from stack failure, missiles, or wind.

Regarding Millstone Unit 2, failure of the Unit 1 stack could potentially affect operation of the B diesel generator and the room cooling air intake and exhaust vents of the A diesel generator. Damage from stack failure sufficient to disable the ventilation for the diesel would also provide a vent path to the atmosphere. Thus, operation of the A diesel generator, most likely would not be affected.

In view of (1) the low probability of a windspeed which would cause stack failure (5×10^{-6} /year), (2) the conservative assumptions in the stack failure analysis, (3) the low likelihood of a loss of all redundant safety-related equipment, and (4) the availability of a missile-protected cooling source, the staff concludes that no modifications to the ventilation stack are warranted.

C. Effects of Failure of Non-qualified Structures Upon Other Structures (IPSAR 4.4.3)

The IPSAR identified the possibility of damage to the control room if the north wall on the upper level of the reactor building failed in an outward direction and the potential for failure of the turbine building to affect the switchgear room. The licensee addressed these issues in a submittal dated March 16, 1984.

The licensee concluded that failure of the upper portion of the reactor building will not occur below a windspeed of 245 mph and that the probability of exceedence associated with a 245 mph tornado is sufficiently low (1×10^{-6}/year) so that failure of the upper portion of the reactor building upon other structures is not a concern. As discussed in Section A above, the staff concludes that the reactor building is capable of withstanding at least 120 mph (7×10^{-5} /year). On this basis, and in view of the directional failure which would be required to cause impact on the control room and the inherent strength of the control room roof to withstand impact, the staff concludes that the likelihood of such an event is sufficiently low that no corrective action is required.

The licensee concludes that a collapse of the turbine building on the switchgear room will not prevent safe shutdown since safe shutdown can be achieved using the isolation condenser. The staff notes that failure of the turbine building may also endanger the ventilation equipment area. The staff has reviewed structural capacities of the turbine building and does not agree with all of the assumptions used in the licensee's analysis; however, the staff agrees that hot shutdown can be accomplished without equipment in the switchgear room or ventilation equipment area by means of the isolation condenser.

The switchgear room equipment is necessary to achieve cold shutdown by normal means. Alternate means to achieve cold shutdown could be readily developed, such as utilizing power from Unit 2 or bypassing the switchgear room and powering pumps directly. The available water sources to the isolation condenser would permit maintaining hot shutdown until such arrangements can be made. As part of the fire protection program, the staff has reviewed alternate means of achieving safe shutdown as discussed in the staff's November 8, 1985 evaluation. Therefore, the staff concludes that modifications to the turbine building are not warranted.

D. Components Not Enclosed in Qualified Structures (IPSAR 4.4.4)

The major safety-related components not enclosed in qualified structures identified in the licensee's February 2, 1984 submittal are the firewater tanks and the condensate storage tank. The licensee has examined the structural integrity of these tanks by comparing the tornado induced loads to the seismic induced loads for which an analysis has already been performed. The licensee concluded that both tanks are capable of withstanding the full site-specific windspeed of 300 mph and 2.25 psi pressure drop.

The staff has reviewed the calculations presented by the licensee and concludes that the tornado loads would be smaller than the seismic loads even after computing the tornado loads in a different manner than the licensee. The seismic analysis concluded that the critical elements of the condensate storage tank (CST) are adequate to withstand the .20g safe shutdown earthquake (SSE); however, NUREG/CR-2024, which provides the basis for conclusions given in the seismic SER, concluded that anchor bolt pullout would not be expected during an SSE if the embedment length meets building code requirements. The details of embedment were not available during this review. The CST and firewater tanks are two of three water sources to the isolation condenser which are relied on by the licensee to achieve safe shutdown in the event of damage to other safety-related components. In view of the reliance being placed on the ability of the plant to safely shutdown using the isolation condenser and the importance of the CST and firewater tanks to the isolation condenser, the staff requests that the licensee confirm that the anchor bolts for the CST and firewater tanks are able to provide substantial resistance against high winds and tornadoes.

E. Roofs (IPSAR 4.4.5)

Except for the gas turbine building, the staff did not analyze the effects of roof failure in the topic evaluation. In the February 2, 1984 submittal (Ref. 3), the licensee investigated the roofs of the switchgear room, battery room, and ventilation equipment area. The licensee concluded that the roofs of the switchgear and battery rooms are adequate for a windspeed of 167 mph which corresponds to a probability of exceedence of $2x10^{-5}$/year. The licensee also concluded that the roof decking of the ventilation equipment area is adequate for a windspeed of 76 mph which corresponds to a probability of exceedence of $2x10^{-4}$/year while the steel components can withstand 194 mph.

The staff has reviewed the licensee's analyses and concludes that the roof capacities of the battery and switchgear rooms were conservatively calculated. Although not addressed by the licensee's evaluation, the staff noted masonry block walls in this area and calculated their capacity to be 114 mph ($8x10^{-5}$/yr) for dynamic pressure and 81 mph ($8x10^{-5}$/yr) for differential pressure, as shown in the attached TER.

The staff also reviewed the licensee's submittal regarding the ventilation equipment area which concluded that the limiting windspeed of the steel components is 194 mph. The staff performed independent analyses which resulted in a limiting capacity of 161 mph ($2x10^{-5}$/year) for the ridge girder and 174 mph ($8x10^{-6}$ /year) for the roof beam. As was the case for the reactor building, the licensee assumed that the roof would blow off, thus allowing the girders to resist a higher lateral load. Staff calculations do not support this assumption. In performing these calculations, the staff found the frames of column lines F7 and E7 are unbraced and thus may not provide a high level of lateral resistance.

In general, the probability of roof damage due to high winds is low, except for the decking of the ventilation equipment area. Nevertheless, the licensee relies on the isolation condenser to achieve hot shutdown and would not require the use of equipment in these structures for the following reasons:

(1) If the batteries are damaged, the isolation condenser, located in a tornado protected area of the reactor building, can be operated using local instrument readings and manual valve operations.

(2) If the switchgear or ventilation equipment is damaged, the isolation condenser can maintain the plant at hot shutdown until provisions can be made to achieve cold shutdown, as described under item C above.

In addition, during the original topic evaluation, the licensee had stated that safety-related masonry walls would be modified to withstand current licensing criteria of a 300 mph windspeed and 2.5 psi. However, in the subsequent wind load evaluation and integrated structural assessment, the licensee concluded that failure of the masonry walls in these areas would not prevent safe shutdown, for the reasons described above, and, therefore, modifications to these walls were not warranted.

Based on the hot shutdown capability afforded by the isolation condenser and the low probability of windspeeds which could cause significant structural damage, the staff concludes that no modifications to the roofs or masonry walls described above are warranted.

F. Load Combinations (IPSAR 4.4.6)

The licensee has addressed this issue by analyzing the reactor building for the combined effects of snow and straight wind and has concluded that the structure is adequate to resist these applied loads.

The likelihood of a combination of extreme external hazards is very low because of the low probability of the individual events. However, the combination of less severe but more probable external events should be addressed relative to overall load combinations, including thermal, pipe reaction and transient loads. This issue is part of the licensee's Integrated Structural Assessment which is being evaluated under Topic 1.19 of the Integrated Safety Assessment Program (ISAP) for Millstone 1. It will be addressed in this topic.

G. Tornado Missiles

In Reference 2, the licensee presented proposed modifications that would provide a missile-protected, engine driven pump to provide make-up to the isolation condenser from the city water system. By trying into the city water system, the licensee would provide an essentially protected source of make-up to the isolation condenser. Procedures will instruct the operator on the use of this pump in the event of a tornado. The source of city water is Konomac Lake located approximately 7 miles from the site. If power is lost, backup power to pump this water throughout the city water system is provided by a diesel generator. The staff did not review the city water system for tornado effects because the staff considers the 7-mile separation to be sufficient to provide redundancy to the CST and firewater tanks as a source of make-up for the isolation condenser.

The isolation condenser removes heat by passing reactor coolant through the tube side via natural circulation. Water to the shell side is supplied by the condensate storage tank or firewater tanks, both of which are vulnerable to tornado missiles, or the diesel-driven pump connected to the underground city water system. The system is initiated by opening a valve on the return line form the condenser to the reactor vessel. The valve can be operated by dc power or manually. Local instrumentation exists which does not require dc power and will permit hot shutdown to be achieved in this manner. Hot shutdown can be maintained until any necessary provisions can be made to achieve cold shutdown. Therefore, the staff concludes that the identified modifications will provide a shutdown path that is adequately protected from tornado missiles. This resolves Section 4.7 of the IPSAR.

III. CONCLUSIONS

The licensee has evaluated each of the items in the final IPSAR where site specific windspeeds could not be adequately resisted or where further review was necessary. Although some of the structures and components could not withstand the full site specific windspeed at a 10^{-7} probability of exceedance per year, the structures and components do possess substantial strength and hot shutdown could be achieved and maintained via the isolation condenser until arrangements could be made to proceed to cold shutdown. The licensee has proposed to install a tie-in to the underground city water system and to provide a portable pump to pump water from that system to the isolation condenser. This modification will provide a missile-protected source of water so that hot shutdown can be maintained.

Information regarding the capacities of the anchor bolts on the condensate storage tank and firewater tank was not unavailable during the staff review. In view of the importance of these tanks as a source of makeup to the isolation condenser which is being relied on as a protected method of achieving and maintaining hot shutdown, the licensee is requested assess the capacity of the anchor bolts in order to assure that they provide substantial resistance against failure.

The staff will complete the review of load combinations in the Integrated Structural Assessment under ISAP Topic 1.19.

Based on the review of the licensee's analyses, the staff concludes that the structures, systems and components required for safe shutdown are capable of withstanding windspeeds with a reasonably low probability of exceedance. Nevertheless, even if the more vulnerable structures and equipment were to fail completely, the staff concludes that with the proposed modifications, there is reasonable assurance that Millstone 1 can achieve and maintain hot shutdown until any necessary provisions to achieve cold shutdown can be made. On this basis, the staff concludes that Millstone 1 is adequately protected against tornados (including missiles) and high winds and no further modifications are warranted.

REFERENCES

1. NUREG-0824, Integrated Plant Safety Assessment Report - Millstone 1, February, 1983.

2. Letter, September 30, 1982, from Shea (NRC) to Counsil (NNECo), Subject: SEP Topic III-2, Wind and Tornado Loadings - Millstone 1.

3. Letter, February 2, 1984, from Counsil (NNECo) to Crutchfield (NRC), Subject: Millstone Nuclear Power Station Unit No. 1, SEP Topics II-3.B Flooding Potential and Protection Requirements, III-2 Wind and Tornado Loadings, III-3.A Effects of High Water Level on Structures, III-7.B Design Codes, Design Criteria and Load Combinations.

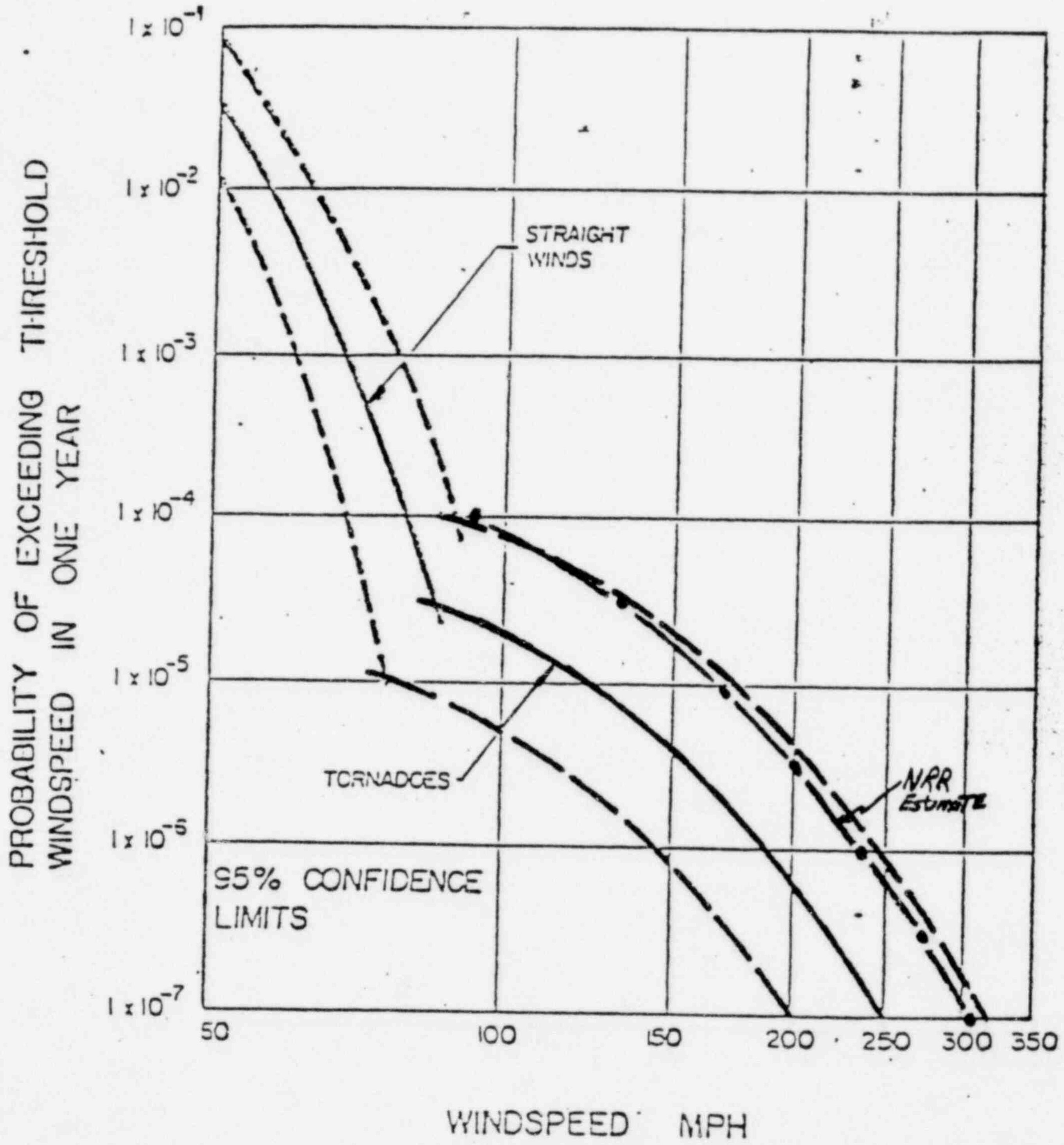
4. Letter, March 16, 1984, from Counsil (NNECo) to Crutchfield (NRC), Subject: Millstone Nuclear Power Station Unit No. 1, SEP Topics II-3.B Flooding Potential and Protection Requirements, II-4.F Settlement of Foundations and Buried Equipment, III-2 Wind and Tornado Loadings, III-3.A Effects of High Water Level on Structures, III-6 Seismic Design Considerations.

5. Letter, October 7, 1983, from Counsil (NNECo) to Crutchfield (NRC), Subject: Millstone Nuclear Power Station Unit No. 1 SEP Topic III-2 Wind and Tornado Loadings.

6. Letter, December 3, 1982, from Counsil (NNECo) to Crutchfield (NRC) Subject: Millstone Nuclear Power Station Unit No. 1 SEP Topic III-2 Wind and Tornado Loadings.

7. Letter, December 2, 1983, from Counsil (NNECo) to Crutchfield (NRC), Subject: SEP Topic III-4.A, Tornado Missiles.

Attachment 1



TORNADO AND STRAIGHT WIND HAZARD PROBABILITY MODEL FOR HADDAM NECK -MILLSTONE POWER REACTOR SITE, CONNECTICUT