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SUBJECT: Forwards justification for noncompliance w/SRP 3.5.3 & probability analysis justifying lack of protection on nonsafety-related diesel generator exhaust line roof penetrations, per 860319 request.

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NIAGARA MOHAWK

NIAGARA MOHAWK POWER CORPORATION/300 ERIE BOULEVARD WEST, SYRACUSE, N.Y. 13202/TELEPHONE (315) 474-1511

April 17, 1986
(NMP2L 0689)

Ms. Elinor G. Adensam, Director
BWR Project Directorate No. 3
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Washington, DC 20555

Dear Ms. Adensam:

Re: Nine Mile Point Unit 2
Docket No. 50-410

The Nuclear Regulatory Commission's letter dated March 19, 1986 requested information regarding missile protection for Nine Mile Point Unit 2. The letter requests Niagara Mohawk to 1) supply justification for not complying to Standard Review Plan (SRP) 3.5.3, and 2) supply the probability analysis that justifies not requiring tornado missile protection on the nonsafety-related diesel generator exhaust line roof penetrations. Attachment 1 addresses compliance with Standard Review Plan Section 3.5.3, and Attachment 2 provides a summary discussion and results of the probability analysis.

Very truly yours,

CVMangan

C. V. Mangan
Senior Vice President

KS:ja
1479G

Enclosures

xc: R. A. Gramm, NRC Resident Inspector
Project File (2)

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of)

Niagara Mohawk Power Corporation) Docket No. 50-410

(Nine Mile Point Unit 2))

AFFIDAVIT

C. V. Mangan, being duly sworn, states that he is Senior Vice President of Niagara Mohawk Power Corporation; that he is authorized on the part of said Corporation to sign and file with the Nuclear Regulatory Commission the documents attached hereto; and that all such documents are true and correct to the best of his knowledge, information and belief.

CVMangan

Subscribed and sworn to before me, a Notary Public in and for the State of New York and County of Onondaga, this 17th day of April, 1986.

Janis M. Macro
Notary Public in and for
Onondaga County, New York

My Commission expires:

JANIS M. MACRO
Notary Public in the State of New York
Qualified in Onondaga County No. 4784555
My Commission Expires March 30, 1987

Attachment 1

JUSTIFICATION FOR THE USE OF 20-IN. THICK CONCRETE ENCLOSURE FOR MISSILE PROTECTION OF VALVES 2SWP*MOV77A, B IN THE SCREENWELL BUILDING

As stated in Final Safety Analysis Report Section 3.5.3, Amendment 23, 20-in. wall thickness is used for missile protection of the subject valves. Since 4000-psi concrete is used in the construction of these barriers, they are still in compliance with Table 1 of Standard Review Plan 3.5.3 (i.e., minimum acceptable barrier thickness for local damage protection against tornado-generated missiles for Region 1 is 20 in. for 4000-psi concrete). The words in the Final Safety analysis Report amendment were unclear. The amendment was intended to identify these barriers as exceptions to the use of 24-inch missile barriers, not as an exception to the Standard Review Plan acceptance criteria. Therefore, no change to Final Safety Analysis Report Section 1.9 is necessary, since there is no deviation from the Standard Review Plan.

A Final Safety Analysis Report change page is attached to clarify Final Safety Analysis Report Section 3.5.3. This change will be incorporated into Amendment 26.

are identified in Section 3.5.1. The missiles considered in this section are turbine missiles and tornado-generated missiles. All other equipment-generated missiles have been evaluated and are considered noncredible (Section 3.5.1).

Missile Barriers

The protective structures and barriers designed to withstand the effects of turbine-generated missiles are listed in Table 3.5-22 and are shown on Figure 3.5-1. The exterior walls and roof of the Category I structures are designed to withstand the effects of tornado-generated missiles, except the reactor building steel superstructure. These structures are listed in Table 3.5-22 and are shown on Figure 1.2-2.

Category I Electrical Ductlines and Manholes

Category I electrical ductlines are protected from tornado-generated missiles either by being buried under at least 8 ft-0 in of earth cover or by being located directly underneath plant structures which provide missile protection. Category I electrical manholes are provided with a minimum of 12 in earth cover and 2 ft-0 in-thick concrete roof which prevents perforation by tornado-generated missiles. Additionally, a 2 ft-0 in-thick concrete slab block is provided at the top of each Category I manhole cover to prevent impingement and perforation of the manhole cover by tornado-generated missiles.

3.5.3 Barrier Design Procedures

Missile barriers are designed to defeat the missiles described in Section 3.5.1. Defeat of the missile is achieved if the missile is stopped with no generation of secondary missiles and structural collapse of the barrier is precluded.

Local response of steel barriers is evaluated by using the Ballistic Research Laboratory Formula in Gwaltney[7]. The thickness of steel barriers to prevent perforation is obtained by multiplying 1.25 by the thickness for threshold perforation (P) as determined by the Ballistic Research Laboratory Formula.

The procedure used to evaluate the local response of concrete barriers to missile impact with no scabbing is based on Appendix B of SWECO 7703[8]. The thickness of concrete barriers conforms to the minimum acceptable barrier thickness requirements of Table 1 of the

Standard Review Plan (SRP) Section 3.5.3. The minimum thickness of the concrete barriers is 24-in., except that 20-in. thickness with 4000 psi concrete is used for missile protection enclosure of valves 2SWP*MOV77A and B in the screenwell building. This particular case is also in compliance with Table 1 of SRP Section 3.5.3. There are no openings in the missile barriers which would allow a tornado-generated missile to pass through the barrier into the building.

Unless otherwise stated in this section, the missile spectrum A of SRP 3.5.1.4 was chosen for Unit 2 design, since the values of missile impact loads derived from spectrum A are more conservative than the same from spectrum II (i.e., the missile spectrum of Table 2 of NUREG-0800, SRP 3.5.3), except for the automobile missile. In case of the automobile missile, the only difference between the two spectra is in the velocity of missile strike; i.e., the horizontal impact velocity listed in spectrum A is lower than that listed in spectrum II. Spectrum II missiles are considered in designing the missile protection shield structures from motor-operated valves (MOVs) in the screenwell at el 261'-0" and the tornado missile analysis for the diesel generator building exhaust line penetrations.

Unit 2 design is based on the methods and procedures outlined in Appendixes B and C of SWECO 7703[8]. This topical report was submitted to the NRC on September 23, 1977. This report indicates that 24-in thick concrete barriers are capable of withstanding the automobile missile of spectrum II (i.e., with higher velocity) without loss of function. (See Tables C.3-1 through C.3-6, Appendix C of SWECO 7703.) Therefore, since the minimum concrete barrier thickness used in the Unit 2 design is 24 in, the structural barriers are capable of withstanding the missiles from either spectrum A or spectrum II.

The overall structural response of concrete barriers to missile impact is evaluated using the methods presented in Appendix C of SWECO 7703. Using these methods, the structural design of the barrier is controlled by the ductility factor as described herein.

If the barrier is required to carry loads during and after missile impact, the maximum allowable ductility is limited to a factor of 10. In particular:

1. For beam-column members where the compressive load is equal to or less than one-third of that which would produce balanced conditions (i.e., P or

Attachment 2

EVALUATION OF THE TORNADO MISSILE DAMAGE PROBABILITY OF THE DIESEL GENERATORS EXHAUST LINE PENETRATIONS

The analysis was performed in order to demonstrate that the probability of a tornado-generated missile entering the diesel generator building through the exhause line penetration and then consequently impacting safety-related equipment is sufficiently small as to not warrant missile protective barriers. Crimping of the exhaust line is not a concern because of the alternate path through a missile-protected opening.

The analysis used the key references of Attachment A as its basis. Reference 4 of the Attachment contains the approach used to determine the probability of missile damage, and is outlined as follows:

The probability of damage caused by a tornado missile impact can be described as:

(Eq.1) P = Po x Ph x Pdl where Po is the probability of the tornado occurrence at the nuclear plant area. Ph is the conditional probability of hitting a target given the tornado occurrence and Pd is the conditional probability of target damage assuming a hit.

To evaluate Equation 1 in terms of the information available in the key references, it is rewritten as:

(Eq. 2) $$P = \lambda \cdot [N \frac{A}{S} \sum_{f=1}^{6} R(V_f) \cdot \eta(f) \cdot \Psi(f)] \cdot Pd$$

λ is the average of occurrence of tornados and is given in number of occurrences per unit area per year. From the contour map prepared by Fugita in Reference 6, λ is equal to 1.25×10^{-4} per square mile per year for NMP2 site.

The probability of hitting a target area, A, by tornado missiles takes the expression established in Reference 5. In this expression, the total number of potential missiles, N, over a distributed area, S, is considered. For the NMP2 analysis, a total number of 10^4 missiles distributed over a 1000 ft square is used based on Reference 11. The other factor that comes into the expression for the probability of hitting is that for the estimate of the probability for a potential missile to be injected and elevated by a given tornado wind speed. Using the relative frequency of occurrence of the tornados of various strengths, each individual effect due to tornados of various strengths is then summarized to give the overall effect. Further explanations are as follows.

The factor $R(V_f)$ is referred to as tornado-area function according to Reference 8, representing the effective area exposed to the wind with a speed higher than V_f during a tornado strike. The value of $R(V_f)$ is smaller for a higher wind speed V_f according to Reference 8, indicating that the chances to be striken by a higher speed wind is relatively less than by the lower speed wind.

The factor $\eta(f)$ is the probability for a missile to become airborne by a tornado of given wind speed. The valves given in Reference 4 for the 6 Fugita F-scale wind speeds were used for this NMP2 analysis.

The $\eta(f)$ value is higher for a higher wind speed, representing a higher probability for a missile to become airborne during a higher speed wind. The function $\Psi(f)$ considers the probability for an airborne missile to be elevated to a given elevation. The expression provided in Reference 4 was evaluated for the 6 F-scale tornado wind speeds for the penetration openings at the elevation of the roof of the diesel generator building. The valve of $\Psi(f)$ is also higher for a higher wind speed, as it should be.

Using the data provided above, the probability for the tornado missiles to strike and damage the targets confine within the area given by the penetration openings is:

(Eq. 3) $P = 1.23 \times 10^{-6} A\, Pd$

The diesel generators are located on the floor inside the diesel building. Due to the limitations of roof thickness and the length of missiles, only the missles approaching the roof openings within a vertical core can actually enter the roof openings and pause a threat to the targets situated inside the building. To account for this effect, a conditional probability, Pc, is introduced in Eq. (3) as:

(Eq. 4) $P = 1.23 \times 10^{-6} Pc\, A\, Pd$

The damage probability, Pd, in the above equation is calculated by:

Eq. 5) $Pd = (t_m - t)/(tm - tn)$

Where t is the target wall thickness, tm and tn are the maximum and minimum metal thickness that can be penetrated by a missile. The Ballistic Research Laboratory equation is used to determine tm and tn for the missiles with characteristics as specified in Spectrum II in Reference 3.

Further refinements were then considered in terms of probability to account for NMP2 unique conditions and missile flight characteristics. These additional factors are as follows:

1. A minor reduction of overall probability of damage was obtained by considering natural shielding of other adjacent roof structures.

2. The utility pole was eliminated as a credible missile since it would have to be lifted to an average elevation of 30.9 ft to acquire the correct angle to enter the penetration. This is the average of all missiles based on their given lengths in Reference 3. Based on this reference, the utility pole need not be considered above 30 ft greater than grade level.

With a total penetration opening area of 14.1 ft^2, and a joint probability of PcPd calculated as described above to be equal to 0.005, the probability of damage caused by a tornado missile impact is obtained from Eq. 4 to be 0.87×10^{-7}/year.

Since this value is lower than the acceptable value of 10^{-7} noted in Regulatory Guide 1.117, it is concluded that tornado missile protection is not required.

Several other factors could have been considered to lower the probability of damage. Among them are:

1. The probability of the exhaust pipes being blown away was not considered. The probability calculation presented above assumes that the exhaust pipes running through the penetrations have been totally blown away to render a most conservative result. The chances are the pipes may yield and bend at the penetrations because of their high ductile property. With the presence of even 1 out of the 3 exhaust pipes would greatly reduce the damage probability calculated above.

2. The tumbling effect of a missile is not considered. It is assumed in the above calculation that a missile has only translational velocity at the instant of entering the penetration to maximize the probability for a missile to get through the penetration. It is understandable that any missile with a rotational velocity would interact with the penetration wall, rendering itself of being incapable of entering the penetrations or with a great loss in its velocity and its ability to damage the targets after entering the penetrations.

3. The impact velocity of a missile is assumed all normal to the generators to maximize the damage probability calculation. This is extremely conservative since only the protion of the generators projected right below the penetrations may be subjected to a normal impact.

EVALUATION OF THE TORNADO MISSILE DAMAGE PROBABILITY OF THE DIESEL GENERATORS EXHAUST LINE PENETRATIONS

ATTACHMENT A - LIST OF REFERENCES

1. US AEC Regulatory Guide 1.76, Design Basis Tornado for Nuclear Power Plants, April 1974.

2. US NRC Regulatory Guide, 1.117, Tornado Design Classification, April 1978.

3. US NRC NUREG-0800, SRP 3.5.1.4, Missiles Generated By Natural Phenomena, Revision 2, July 1981.

4. J. Goodman and J. E. Koch, Conditional Probability of the Tornado Impact Given A Tornado Occurrence, Proc. Of The International ANS/ENS Topical Meeting on Probabilistic Rish Assessment, September 20-24, 1981.

5. Fujita, T.T., "Estimate of Area Probability Of Tornadoes From Inflationary Reporting Of Their Frequency," SMRP Research Paper No. 89 University Chicago, October 1971.

6. Fujita, T.T., "Proposed Characterization Of Tornadoes And Hurricanes By Area And Intensity," SMRP Research Paper No. 91, University Chicago, February 1971.

7. Fujita, T.T., "F-Scale Classification Of 1971 Tornadoes," SMRP Research Paper No. 100, University Chicago, April 1972.

8. Y.K. Wen and S.L. Chu, Tornado Risks And Diesign Wind Speed, ASCE, Journal Of Structural Division, Volume 99, No. ST12, December 1973.

9. Gwaltney, R.C., "Missile Generation And Protection In Light-Water-Cooled Power Reactor Reactor Plants," USAEC Report ORNL-NSIC-22, Oak Ridge National Lab., September 1968.

10. EPRI NP-768 and 769, Tornado Risk Analysis Electric Power Research Institute, May 1978.