July 19, 2000

Mr. S. E. Scace - Director
Nuclear Oversight and Regulatory Affairs
c/o Mr. David A. Smith
Northeast Nuclear Energy Company
P. O. Box 128
Waterford, CT 06385-0128

SUBJECT: MILLSTONE NUCLEAR POWER STATION, UNIT NO. 2 - SUPPLEMENTAL SAFETY EVALUATION FOR UNRESOLVED SAFETY ISSUE (USI) A-46 PROGRAM IMPLEMENTATION (TAC NO. MA6421)

Dear Mr. Scace:

Enclosed is the U.S. Nuclear Regulatory Commission's (NRC) supplemental safety evaluation (SSE) of Northeast Nuclear Energy Company's USI A-46 implementation program at Millstone Nuclear Power Station, Unit 2 (Millstone 2). This SSE addresses supplemental information about Section 2.4.1, "Equipment Seismic Capacity Compared to Seismic Demand," of the SSE for the A-46 Program implementation at Millstone 2, which you submitted after the original safety evaluation (SE) was issued.

In its SE for USI A-46 program implementation at Millstone 2, dated June 30, 1999, the NRC staff indicated that for the intake structure, the amplification factor between the ground response spectrum and the in-structure response spectra at frequencies of 8 and 9 Hz are too high to justify the use of GIP-2 Method A.1 for the comparison of seismic demand to seismic capacity. The SE stated that you should classify any safe shutdown equipment list (SSEL) component in the intake structure that has a fundamental natural frequency in the range of 8 to 9 Hz, for which Method A.1 was used, as an outlier.

By letter dated October 25, 1999, you provided additional information on the conservatism of the in-structure response spectra for the floor at elevation 14 feet in the Millstone 2 intake structure. The NRC staff has reviewed this information and determined that GIP-2 Method A.1 is considered reasonable for evaluating seismic adequacy of equipment in the Millstone 2 intake structure for the resolution of USI A-46. Therefore, components located in the intake structure for which Method A.1 was used are no longer required to be considered as outliers.

The attachment contains the staff's evaluation of the additional information submitted by you to justify the use of GIP-2 Method A.1 for SSEL components in the intake structure that have a fundamental natural frequency in the range of 8 to 9 Hz.

If you have any questions regarding this matter, please contact me at (301) 415-2426.

Sincerely,

/RA/

Jacob I. Zimmerman, Project Manager, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-336

Enclosure: Safety Evaluation

cc w/encls: See next page

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SUPPLEMENTAL SAFETY EVALUATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

EVALUATION OF NORTHEAST NUCLEAR ENERGY COMPANY RESPONSE TO

SUPPLEMENT NO. 1 TO GENERIC LETTER 87-02

MILLSTONE NUCLEAR POWER STATION, UNIT NO. 2

DOCKET NO. 50-336

1.0 BACKGROUND

In December 1980, the U.S. Nuclear Regulatory Commission (NRC) designated "Seismic Qualification of Equipment in Operating Plants" as Unresolved Safety Issue (USI) A-46. The safety issue of concern was that equipment in nuclear plants for which construction permit applications had been docketed before about 1972 had not been reviewed according to the 1980-81 licensing criteria for the seismic qualification of equipment, such as Regulatory Guide 1.100 (Reference 1), IEEE Standard 344-1975 (Reference 2), and Section 3.10 of the Standard Review Plan (NUREG 0800, July 1981) (Reference 3). To address USI A-46, affected utilities formed the Seismic Qualification Utility Group (SQUG) in 1982.

The NRC staff issued Generic Letter (GL) 87-02 “Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors,” in February 1987 (Reference 4) to provide guidance for the resolution of USI A-46. The staff concluded that the seismic adequacy of certain equipment in operating nuclear power plants should be reviewed against seismic criteria not in use when these plants were being constructed. In 1987, SQUG, representing its member utilities, committed to develop a Generic Implementation Procedure (GIP) for implementing the resolution of USI A-46. SQUG requested a deferment of the 60-day response, as requested in GL 87-02, until after the NRC issued its final SER on the final version of the GIP.

On May 22, 1992, the staff issued Supplement No. 1 to GL 87-02 which transmitted its final SER (“Supplemental Safety Evaluation Report No. 2 on Seismic Qualification Utility Group’s Generic Implementation Procedure, Revision 2, Supplemental Safety Evaluation Report No. 2, SSER No. 2, Reference 5) on the then final version of the GIP (GIP Revision 2, as corrected on February 14, 1992, or simply GIP-2, Reference 6). In the supplement to GL 87-02, the staff requested that USI A-46 licensees who are members of SQUG either provide a commitment to use both the SQUG commitments and the implementation guidance described in GIP-2, as supplemented by the staff's SSER No. 2, or provide an alternative method for responding to GL 87-02. In a letter dated September 21, 1992, (Reference 7) Northeast Nuclear Energy Company (NNECO), the licensee for Millstone Nuclear Power Station, Unit No. 2 (Millstone 2) and a member of SQUG, committed to the implementation of GIP-2 for resolving USI A-46 at Millstone 2. The NRC subsequently approved the licensee’s approach and schedule in a letter dated November 20, 1992 (Reference 8).

Enclosure

By letter dated January 22, 1996, (Reference 9), the licensee submitted a report summarizing the results of its USI A-46 implementation program, in accordance with the commitments made in its 120-day response (Reference 7) to NRC's Supplemental SER No. 2 (Reference 5). The staff reviewed the report and issued a request for additional information (RAI) on August 29, 1996, (Reference 10). The licensee subsequently submitted its response to the RAI in a letter dated January 17, 1997, (Reference 11). The staff reviewed the licensee's response and determined that further information was required from the licensee in order for the staff to complete its review. The licensee responded to the NRC's request for clarification in a letter dated February 8, 1999, (Reference 12).

In its SE for USI A-46 program implementation at Millstone 2, dated June 30, 1999, (Reference 13) the NRC staff stated that for the intake structure, the amplification factor between the ground response spectrum (GRS) and the in-structure response spectra (IRS) at frequencies of 8 and 9 Hertz are too high to justify the use of GIP-2 Method A.1 for the comparison of seismic demand to seismic capacity. The SER further stated that the licensee should classify any safe shutdown equipment list (SSEL) component in the intake structure that has a fundamental natural frequency in the range of 8 to 9 Hz, for which Method A.1 was used as an outlier.

During a telephone conference between the NRC staff, the licensee, and EQE International (consultant to SQUG), NNECO stated that there are unique levels of conservatism associated with the original seismic analysis of the intake structure which cause the apparent high amplification factors of the IRS with respect to the GRS. The licensee was informed, that if it submitted any additional information to better explain the nature and level of conservatism in the in-structure response spectra for the intake structure, the information would be evaluated by the staff.

Attached to a letter dated October 25, 1999 (Reference 14), the licensee submitted a technical report entitled "NNECO Response To The Staffs Concern That the Intake Structure Amplification Factor Is Too High To Justify The Use of GIP-2 Method A. 1." This supplement to the SER for USI A-46 program implementation at Millstone Unit 2 is the staff's evaluation of Reference 14.

2.4.1 Equipment Seismic Capacity Compared to Seismic Demand

There are five GIP-2 methods for comparing equipment seismic capacity to the seismic demand. Method A.1 compares the SQUG Bounding Spectrum (BS) to the safe shutdown earthquake (SSE) GRS. Method A.2 compares the Generic Equipment Ruggedness Spectrum (GERS) to 2.25 times the SSE GRS. Method B.1 compares 1.5 times the BS (reference spectrum (RS)) to the conservative design or to the median-centered SSE IRS. Method B.2 compares the GERS to conservative design SSE IRS. Method B.3 compares the GERS to 1.5 times the median-centered SSE IRS.

The licensee used Method A.1 to evaluate the seismic adequacy of equipment located at elevations less than 40 feet above the effective grade, and Method B.1 for equipment located at elevations greater than 40 feet above the effective grade. GIP-2 places limitations on the use

of Method A.1. These limitations are that the SSE GRS may be used for comparison to the BS when:

- The equipment is mounted in the nuclear plant at an elevation below about 40 feet above the effective grade.

- The equipment, including its supports, has a fundamental natural frequency greater than about 8 Hz.

- The amplification factor ratio between the GRS and the IRS is not more than approximately 1.5.

Among other locations, the licensee used Method A.1 to compare seismic demand to seismic capacity for the intake structure at elevation 14 feet. As noted above, in its evaluation of the Millstone Unit 2 USI A-46 resolution implementation the staff determined that for the intake structure the amplification factor between the GRS and the IRS at frequencies of 8 and 9 Hz is too high to justify the use of GIP-2 Method A.1 for the comparison of seismic demand to seismic capacity.

In Reference 14, the licensee stated that the original Millstone Unit 2 intake structure seismic analyses, which supported the design basis IRS, were not documented with enough detail to specifically define the level of conservatism in any greater detail than described in its February 8, 1999 submittal (Reference 12) without additional analyses. The licensee stated that it was able to attain an understanding of the structural response and the associated partial level of conservatism with minimal effort by using the following inputs in a sensitivity study of the intake structure analysis:

- Structural Model (masses, stiffness, node locations, etc.) identical to the Design Basis Bechtel Model.

- Foundation modeled as fixed-base at the -27-foot elevation while neglecting any effects of structural embedment (identical to the design basis stick model).

- A structural damping of 7 percent of critical damping for reinforced concrete structures per Regulatory Guide 1.61 for the SSEL case.

- Input Motion time history matching a Regulatory Guide 1.60 spectrum, anchored to 0.1g zero period acceleration (ZPA), which was more readily available than the original Bechtel input. The licensee states that while this motion is different from the Housner spectrum originally used as input, it is valid for use in this analysis to quantify the structural amplification and is not intended to reflect any design basis conditions.

The licensee made two comments about these inputs. The first comment is that 7 percent of critical damping used for the intake structure reanalysis is higher than the licensing basis value of 65 percent for the SSE analysis, but it is valid for use in the sensitivity study to quantify the structural amplification and is not intended to reflect any design basis conditions. The

licensee's second comment is that while the Regulatory Guide 1.60 shape, with a ZPA of 0.1g, is different from the licensing basis Housner spectrum, it is valid for use in the sensitivity analysis to quantify the structural amplification and is not intended to reflect any design basis conditions.

The licensee states that this study evaluates the sensitivity associated with two substantial sources of conservatism with the original Bechtel analyses:

- Structural Damping - The licensee states that based on the available data, the original operating basis earthquake design basis seismic analyses appear to have been based on a structural damping value of 2 percent of critical damping, rather than the licensing basis values of 3 percent for the operating basis earthquake and 5 percent for the safe shutdown earthquake as documented in the Final Safety Analysis Report. The licensee further claims that safe shutdown earthquake responses were then scaled, without consideration for damping, to conservatively estimate the safe shutdown earthquake in-structure response spectra.

- Time History - The licensee states that the synthetic time history used in the development of the original design basis IRS exhibits conservatism for frequencies above 3 Hz when its response spectrum is compared to the smooth design basis site spectrum for 5 percent of critical damping. The licensee notes that even though this effect has already been accounted for in Reference 13, it was restated since it is included in the reanalyses to determine an appropriate estimate of the amplification factor for the intake structure.

The licensee performed the limited sensitivity study of the Millstone Unit 2 intake structure to obtain the in-structure response spectra at Elevation 14 feet using the original design basis structural model, input ground motion consistent with Regulator Guide 1.60 and structural damping of 7 percent of critical which is consistent with Regulatory Guide 1.61 for the safe shutdown earthquake design of reinforced concrete structures. The resulting in-structure response spectrum, which is shown in Figure 1 of Reference 14, has its peak at approximately 6.75 Hz. The amplification at this peak, when compared to the approximate acceleration of 0.27g at 6.75 Hz from the spectrum calculated from the input time history, is 5.33.

The licensee considers this value (5.33) to be more appropriate than the value of 14 documented in Reference 13 which was based on the limited numerical information provided in its February 8, 1999, submittal (Reference 12). The licensee states that this amplification factor is a worst case factor for the entire in-structure response spectra and the value would be less (down to about 4.4) for the frequency range at or greater than 8 Hz.

The licensee attributes the conservatism beyond the 5.33 factor, which resulted in the amplification factor of 14 (Reference 13), to the very conservative structural damping used in the original seismic analysis of the intake structure. The licensee states that several other sources of conservatism, such as structural embedment and ground motion incoherence, which

were previously discussed in detail in its February 8, 1999, submittal (Reference 12) have not been incorporated into this sensitivity study.

The licensee divided the 5.33 factor by 3.77 to account for the inherent differences between a median-centered type response and a design type response. This results in an amplification value estimate of 1.41.

The 3.77 factor was obtained from comparisons between the median-centered response spectra and design response spectra for five reenforced concrete structures at four nuclear plants. The ratios of the conservative design spectra to median-centered spectra are 2.53, 5.3, 3.3, 2.3, and 5.4. The mean of the ratios is 3.77. This factor was calculated and documented (Reference 15) by the NRC staff during its review of the R. E. Ginnna Nuclear Power Plant USI A-46 program implementation. The Millstone Unit 2 intake structure is a heavily reinforced concrete shear wall structure similar to the nuclear plant structures referred to in Reference 15.

The sensitivity study that NNECO presented quantified the conservatism contributed by two parameters in the original design basis seismic analysis of the intake structure which are not required by normal plant design procedures. Using the in-structure design type spectrum for the intake structure, obtained without this unrequired conservatism, the licensee's analysis shows that if realistic median-centered in-structure response spectra were developed for the intake structure, the amplification factor for the median-centered in-structure response spectra to the ground response spectrum for frequencies above about 8 Hertz would be about 1.5. Therefore, GIP Method A.1 is considered generally reasonable for evaluating seismic adequacy of equipment in the Millstone Unit 2 intake structure for the resolution of USI A-46 and the licensee is not required to consider components located in the intake structure for which Method A.1 was used to be outliers.

References

1. Regulatory Guide 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants," Revision 2, 1987.

2. IEEE Standard 344-1975, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," dated January 31, 1975.

3. NRC SRP (NUREG-0800), Section 3.10, "Seismic and Dynamic Qualification of Mechanical and Electrical Equipment," Revision 2, July 1981.

4. NRC GL 87-02, "Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue (USI) A-46," February 1987.

5. "Supplemental Safety Evaluation Report No. 2 on Seismic Qualification Utility Group's Generic Implementation Procedure, Revision 2, corrected February 14, 1992."

6. "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Power Plant Equipment," Revision 2, corrected February 14, 1992, Seismic Qualification Utility Group.

7. Letter, J. F. Opeka (NNECO) to Document Control Desk (NRC), “Response to Supplement 1 to Generic Letter 87-02, SQUG Resolution of USI A-46,” dated September 21, 1992.

8. Letter, G. Vissing (NRC) to J. F. Opeka (NNECO), “Evaluation of Millstone 2 120-day Response to Supplement No. 1 to Generic Letter 87-02,” dated November 20, 1992.

9. Letter, E. A. DeBarba (NNECO) to Document Control Desk (NRC), “Millstone Nuclear Power Station, Unit No.2, USI A-46 Walkdown Summary Report and Proposed Expansion of Licensing Basis for Verification of Equipment Seismic Adequacy,” dated January 22, 1996.

10. Letter, D. G. McDonald (NRC) to T. C. Feigenbaum (NNECO), dated August 29, 1996.

11. Letter, M. L. Bowling, Jr. (NNECO) to Document Control Desk (NRC), dated January 17, 1997.

12. Letter, R. P. Necci (NNECO) to Document Control Desk (NRC), dated February 8, 1999.

13. Letter, R. B. Eaton (NRC) to R. P. Necci (NNECO), “Plant -Specific Safety Evaluation Report for USI A-46 Program Implementation at Millstone Nuclear Power Station, Unit No. 2 (TAC No. M69459),” dated June 30, 1999.

14. Letter, R. P. Necci (NNECO) to Document Control Desk (NRC), dated October 25, 1999.

15. Letter, NRC to Rochester Gas and Electric Corporation, “Plant Specific Safety Evaluation of USI A-46 Program Implementation at the R. E. Ginna Nuclear Power Plant," Docket No. 50-244, dated July 17, 1999.

Principal Contributor: R. Rothman

Date: July 19, 2000

Millstone Nuclear Power Station
Unit 2

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