Mr. Neil S. Carns
Senior Vice President
and Chief Nuclear Officer
Northeast Nuclear Energy Company
c/o Mr. Richard T. Laudenat
Director - Regulatory Affairs
P. O. Box 128
Waterford, CT 06385

May 13, 1997

SUBJECT: MILLSTONE NUCLEAR POWER STATION, UNIT NOS. 1 AND 2 - REQUEST FOR ADDITIONAL INFORMATION REGARDING THERMO-LAG RELATED AMPACITY DERATING ISSUES (TAC NO. M82809)

Dear Mr. Carns:

By letters dated December 27, 1996, and December 13, 1996, Northeast Nuclear Energy Company (NNECO) submitted responses to the NRC staff's Request for Additional Information (RAI) dated August 12, 1996, related to Generic Letter (GL) 92-08, "Thermo-Lag 330-1 Fire Barriers," for Millstone Nuclear Power Station, Units 1 and 2, respectively. The staff, in conjunction with its contractor, Sandia National Laboratories, has completed the second review of NNECO's submittals, and has identified a number of open issues and concerns requiring clarification.

Please respond to the enclosed RAI within 60 days of the date of this letter so that the outstanding issues can be resolved for the application of Thermo-Lag 330-1 Fire Barriers at Millstone Power Station. Your response is needed for resolving our concerns on the ampacity derating factor determinations for Millstone Nuclear Power Station, Units 1 and 2.

Sincerely,
Original signed by D. McDonald for:
Phillip F. McKee
Deputy Director for Licensing
Special Projects Office
Office of Nuclear Reactor Regulation

Docket Nos. 50-245 and 50-336

Enclosure: As stated

cc w/encls: See next page

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NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

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Acting for Phillip F. McKee
Deputy Director for Licensing
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REQUEST FOR ADDITIONAL INFORMATION

MILLSTONE NUCLEAR POWER STATION, UNITS 1 AND 2

FIRE BARRIER AMPACITY DERATING ISSUES

(TAC NO. M82809)

1.0 STAFF REQUEST FOR ADDITIONAL INFORMATION (RAI)

1.1 Response to Staff RAI dated August 12, 1996

The licensee was requested by the subject Nuclear Regulatory Commission (NRC) RAI to verify that those Millstone Nuclear Power Station (MNPS) fire barriers which utilized ampacity correction factor (ACF)/ampacity derating factor (ADF) values based on the Texas Utilities Electric (TUE) ampacity test results are representative of the Comanche Peak Steam Electric Station (CPSES), Unit 2 tested fire barrier configurations. In the licensee's submittals dated December 27, 1996, and December 13, 1996, for MNPS Units 1 and 2, respectively, the licensee responded that the new set of calculations provided the specific ACF/ADF values. This response is considered nonresponsive to the staff concern.

In order to take credit for any test results, the tested configuration must be representative of the installed plant configurations. The question being asked is whether or not it is appropriate to extrapolate the TUE ampacity test results to MNPS fire barriers. The licensee is requested to confirm that all fire barrier construction for the applicable configurations are representative of the barrier construction used in CPSES, Unit 2, ampacity derating tests. If there are deviations or differences between MNPS-installed Thermo-Lag configurations and tested configurations, the licensee should provide an assessment of the impact of the test results that are being credited by the licensee. Further, the subject response should focus on a description of the physical characteristics that will influence the heat transfer behavior for the installed fire barriers.

1.2 Response to September 5, 1996, Staff Conference Call Questions with Licensee

1.2.1 In the licensee's submittals dated December 27, 1996, and December 13, 1996, for MNPS Units 1 and 2, respectively, with regard to the item pertaining to the consideration of the total number of conductors in derating cables in conduits, the licensee responded that for conduit installations, ampacity was derated based on the number of conductors in the conduit and the grouping factor for the conduits.

Sandia National Laboratories (SNL) finds that the licensee seems to be applying the older National Electric Code (NEC) conductor count derating factors that explicitly assume a 50-percent load

diversity without justification given the existing diversity. The licensee is requested to provide technical justification for the apparent use of older NEC conductor-count derating factors and to address the SNL finding. See Sections 2.1.4.3 and 2.2.4.3 of the SNL letter report [attached].

1.2.2 In the licensee's submittal dated December 27, 1996, for MNPS, Unit 1, with regard to the item pertaining to derating cables/ampacity of cables in overfilled conduits, the licensee responded that the ampacity of conductors in the conduit is based on the number of conductors in the conduit and that industry standards do not require any derating based on percent fill.

The NEC standard ampacity ratings are based on the assumption that conduits will not be loaded in excess of the limits established elsewhere in the standard. SNL finds that for the licensee to invoke the standard, without including a consideration of all standard provisions, is inappropriate without additional qualification. SNL notes that the NEC does identify methods of calculation for non-standard configuration under "engineering supervision" [i.e., reference to the Neher/McGrath (1957) approach to analysis]. The licensee is requested to verify its standard table based results for the overfilled conduits using the Neher/McGrath approach to analysis.

2.0 CALCULATIONS FOR MNPS UNIT 1

SNL finds that the three conduit applications of Thermo-Lag fire material that the applicable calculations, which were included in the licensee's submittal dated December 27, 1996, were deficient for various reasons. The licensee is requested to address the following concerns raised by SNL. (See Section 4.7 of the SNL letter report [attached] for details.)

2.1 MNPS-1 Installation 1

Installation 1 involves a pair of cables each wrapped individually in a conduit-style barrier. SNL finds that the licensee's analysis of the installations is inadequate because the licensee has applied conduit ACF values to what is effectively an air drop application. The licensee is requested to adjust its analysis to either (1) estimate the base line ampacity assuming that the cable is installed in conduit and then apply the conduit ADF value, or (2) use the open air ampacity limit for the base line assessment but use a more severe ADF value to reflect the harsher penalty associated with air drop fire barrier systems.

2.2 MNPS-1 Installation 2

For Installation 2, SNL finds the licensee's treatment to be inadequate because in addition to the Thermo-Lag, the installation includes

enclosing of the two conduits in question within an outer box made up of several layers of gypsum wall board, and yet the licensee has applied only the standard derating factor associated with a standard single layer conduit installation. This ADF value is considered nonconservative for this application. The licensee is requested to provide a more complete alternate analysis for this case that more accurately reflects the actual installations and conditions.

2.3 MNPS-1 Installation 3

For Installation 3, SNL finds the licensee's analysis to be deficient for the following reasons:

(a) The installation includes various special configurations that will likely result in a more severe ampacity derating impact than would be applicable for the single conduit configuration assumed by the licensee.

(b) The licensee's assessment of baseline ampacity limits has neglected the effects of conduit grouping on ampacity limits.

3.0 CALCULATIONS FOR MNPS UNIT 2

SNL finds that the MNPS Unit 2 calculations, which were included in the licensee's submittal dated December 13, 1996, were deficient for various reasons. The licensee is requested to address the following concerns raised by SNL. (See Sections 3.1 through 3.4 of the SNL letter report [attached] for details.)

3.1 Cable Tray Analyses

3.1.1 Determination of Baseline Cable Tray Ampacity Limits

SNL finds that while the demonstration of a thermal model consistent with the Stolpe analyses is an appropriate aspect of the cable tray ACF calculation, in the context of determining baseline ampacity limits it is unnecessary for the licensee to implement its own version of Stolpe's thermal model in an attempt to reproduce its results for each and every case examined. The licensee is requested to consider abandoning its own model implementation for the purposes of baseline ampacity calculations, and to instead rely on the heat intensity limits as published by Stolpe directly. This would remove one source of several errors in the licensee's submittal, will simplify the submittal, and will increase the overall reliability and scrutability of the licensee's results. While this will result in a very modest increase in the estimated ampacity limits for most of the cable trays considered, it is expected that this simplification of the licensee's analysis will serve the long-term interests of both the licensee and the staff.

SNL has identified numerous errors in the licensee's implementation of baseline ampacity calculations for individual applications. The licensee is requested to address these discrepancies in the cable tray baseline ampacity calculations. However, as noted in 4.1.1.a of the referenced SNL letter report, many of the licensee's individual case heat intensity calculations are, in fact, unnecessary and could be eliminated. SNL also recommends that the licensee could more reliably depend on the Stolpe-published values of heat intensity, and hence could significantly simplify this aspect of the analysis. If the above recommendations were acted upon by the licensee, then certain errors identified by SNL would be rendered moot.

3.1.2 Estimation of Fire Barrier ADF Assessments

With respect to the estimation of fire barrier ADF assessments, SNL finds that the licensee's analysis of cable tray ACF/ADF values as currently presented is fundamentally flawed. The licensee's treatment has not only compromised the critical need for consistency between the baseline and clad analysis cases, but has also violated the fundamental laws of thermodynamics. The licensee is requested either (1) correct the identified concerns regarding the analyses, or (2) provide an alternate basis for the assessment of cable tray fire barrier ACF values. Specific problems with the licensee's model include:

(a) SNL finds that the licensee has failed to demonstrate that the cited 3M ACF value of 0.59 for a tightly covered cable tray is applicable to this analysis. While this approach may be justified, the licensee is requested to include the cited 3M letter and any supporting analyses or experimental results as a part of the submittal and to explicitly justify the applicability of the 3M results to the licensee's analyses of its barrier systems.

(b) SNL finds that the licensee has compromised the consistency between the baseline and clad case analyses by (1) crediting heat transfer from the sides of the tray only in the last steps of the clad case analysis while not crediting the sides in either the baseline analysis nor the analysis of the 3M-covered tray case, and (2) applying an entirely different set of convective heat transfer correlations to the final analysis of heat transport away from the surface of the fire barrier system. Consistency between the baseline and clad case analyses is critical to a quality derating analysis. SNL finds that, even putting all other concerns aside, this is a critical flaw in the licensee's analysis. The licensee is requested to modify its analyses so as to ensure that its baseline and clad analyses are self consistent throughout its calculation.

(c) SNL finds that because a lower bound estimate of the cable tray cover emissivity was selected, the licensee's analysis has calculated a tray/cover temperature that exceeds the hot-spot temperature of the cables. Further, the licensee has calculated a

negative cable-to-tray/cover thermal resistance value. Both results are clearly nonphysical and represent a fundamental violation of the laws of thermodynamics. One of two approaches was cited as methods to resolve this discrepancy; namely, (1) given the current licensee-approach, the use of a conservative upper bound estimate of the cover emissivity, such as 0.8, would ensure that a conservative bound on the internal thermal resistance is obtained, or (2) supplementing the thermal model so as to impose a balance between the internal and external rates of heat flow for the cables-to-cover-to-ambient system would result in more realistic results. The licensee is requested to provide for a resolution of this concern.

3.2 Conduit Analyses

3.2.1 Determination of Baseline Cable Tray Ampacity Limits

SNL finds that the licensee has not demonstrated that the older, pre-1990 diversity-based conduit conductor count correction factors can be applied to the cases cited. The licensee is requested to either (1) justify its use of the pre-1990 NEC diversity-based correction factors on the basis of existing cable load diversity, or (2) apply the newer post-1990 NEC correction factors for cases in which diversity cannot be verified for plant installations.

3.2.2 Estimation of Fire Barrier ADF Assessments

SNL finds that the licensee's approach to the estimation of conduit ACF/ADF values is acceptable in principle, but that the implementation of this analysis as currently documented is deficient. Two discrepancies were noted; namely, (1) the licensee has not accounted for the uncertainty inherent in the measured baseline ampacity for the TUE tests and the limitations under which the NRC has accepted the application of those test results, and (2) the licensee's implementation of Neher/McGrath equation 42 for heat transfer between the outer surface of the fire barrier and the ambient contains a mistake in how the terms in the denominator of that expression have been grouped. The licensee is requested to consider (1) addressing the first concern by assuming a baseline ampacity of 119 percent of the reported measured value (or 680A) for the case cited by the licensee in its analysis, and (2) addressing the second concern by correcting the term groupings in the Neher/McGrath external heat transport expression.

3.3 Air-Drop Applications

The licensee's descriptions of some electrical raceway cases depict a single cable within a cable tray but not in conduit, which has been wrapped using a conduit-style barrier system. This application would appear to be equivalent to the air-drop-type fire barrier configuration. It would also appear that for the subject cases the derated ampacity limit is taken as the open air ampacity limit multiplied by the conduit fire barrier ACF.

As a general conclusion, SNL finds that the adequacy of the licensee's treatment for individually wrapped cables is indeterminate. The licensee is requested to (1) describe the physical characteristics of the individual cable wrap systems as applied by the licensee, (2) explicitly identify all such applications and their corresponding ampacity assessments, (3) cite the assumed source for the baseline ampacity of each cable in question, and (4) state the assumed ampacity derating value applied to that cable and further clarify the basis for that assumption.

3.4 Wire-Way Analysis

SNL finds that the licensee's discussion of the Z25XA10 Wire-Way is inadequate to its appropriateness. The licensee is requested to (1) provide a physical description of the wire-way, (2) provide a description of the installed fire barrier system, and (3) further justify its treatment of ampacity derating for this wire-way as a conduit.

4.0 RESOLUTION OF OVERLOADED CABLES

The licensee has not yet identified what course of action will be taken to resolve those cables that were identified as overloaded for application at Millstone Nuclear Power Station. The licensee is requested to estimate conservatively the remaining cable life for those cables that have operated under overloaded conditions.

Attachment: Letter report to U.S. NRC, Rev. 0, dated March 27, 1997, prepared by Steve Nowlen of Sandia National Laboratories.