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Docket No. 50-245
B14849

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Millstone Nuclear Power Station, Unit No. 1
Feedwater Coolant Injection and Low Pressure Coolant Injection/Core Spray Systems

This letter provides additional information regarding the feedwater coolant injection (FWCI) and low pressure coolant injection (LPCI)/core spray (CS) systems at Millstone Unit No. 1. This information is being provided as a followup to the telephone discussion between the NRC Staff and Northeast Nuclear Energy Company (NNECO) that took place on May 13, 1994.

Summary

As described in more detail in this letter, we have assessed the FWCI and LPCI/CS conditions as described in our May 11, 1994,(1) letter and have determined that the current conditions of these systems result in system operability, and in the case of LPCI/CS, without the presence of degraded or nonconforming conditions, with the exception of one support as described below. As we stated in that letter, we fully acknowledge that the resolution of these system conditions did not proceed on a sufficiently aggressive schedule. In light of this, we will evaluate the circumstances surrounding these issues for the purpose of preventing similar situations from occurring in the future.

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(1) J. F. Opeka letter to U. S. Nuclear Regulatory Commission, "Millstone Nuclear Power Station, Unit No. 1 - Feedwater Coolant Injection and Low Pressure Coolant Injection/Core Spray Systems," dated May 11, 1994.

Discussion-FWCI

In a letter dated May 11, 1994, NNECO specified our basis for determining the FWCI system operable with certain support system components having been determined to be not seismically qualified. The operability determination concluded that the FWCI system was capable of performing its intended safety function, and therefore continued to be operable. The primary basis for this operability determination relied upon the FWCI system not being needed to mitigate the consequences of a design basis seismic event. Additionally, we provided information intended to summarize a recently-conducted analysis which shows that FWCI is not needed to demonstrate compliance with 10CFR50.46 and Appendix K of 10CFR50. We identified in the May 11, 1994, letter that it was our current plan to utilize the provisions of 10CFR50.59 to relax the commitment for the FWCI system to be seismically qualified and that it was likely that a license amendment would be required prior to implementation. In so doing, the licensing basis of the FWCI system at Millstone Unit No. 1 would be changed.

During subsequent discussions with the NRC, the Staff requested that NNECO demonstrate that FWCI would operate following a design basis event. In this regard, NNECO assessed the operation of FWCI following a postulated event, assuming the affected components would not operate. Specifically, the FWCI nonconformances evaluated are certain electrical components and the condensate booster pump lube oil system.

It is our judgment that the lack of seismicity of the condensate booster pump lube oil system would not render the FWCI system inoperable since the condensate booster pumps associated with the selected FWCI string would be in operation at the time of a postulated event. The original design of the system was to prevent bearing failure during "cold" starts of the pump. Due to the condensate booster pump being in operation prior to a postulated event, the bearings are adequately lubricated through the use of an oil slinger and forced lube oil system. If the postulated event were to occur in conjunction with a loss of normal power, the pumps would be powered within two minutes by the gas turbine generator. In this case, the bearings are expected to remain adequately lubricated during this "hot" start.

Conservatively assuming the electrical components associated with the FWCI area coolers do not operate following a postulated event, the temperature rise in the vicinity of the pumps was evaluated for the consequential effect on FWCI. We determined that the temperature rise was not significant enough to disable the FWCI system for at least ten minutes.

In light of the expected plant response to a design basis event, the benefit of FWCI is in the first several minutes following the postulated event, prior to the operators taking any manual actions. After that time it is reasonable to credit operator actions to initiate other available and seismically qualified systems in accordance with the guidance provided by the emergency operating procedures. Therefore, based on NNECO's judgment that FWCI will operate for at least ten minutes following a postulated event with the identified conditions, FWCI is operable. Additional detail in support of this judgment is available for review by the Resident Inspector Staff.

As discussed with the Staff, there are programs outstanding (such as IPEEE) which will further assess the seismic adequacy of the condensate and feedwater systems. Based on the results to date of our evaluation of the overall safety significance of the FWCI system for seismic events, our near-term plans are to pursue relaxation of the commitment for the FWCI system to be seismically qualified. Should we determine that a license amendment is required to relax this commitment, we will submit the license amendment request for Staff review and approval.

Summary-LPCI/CS

NNECO, in our May 11, 1994, letter, stated that an operability determination had been performed on the LPCI/CS torus attached piping and concluded that the systems were operable to a peak torus temperature of 209°F. We indicated that we planned to pursue, in accordance with our license condition, resolution of the piping and support stress concerns in accordance with the overall ranking of the modifications in the Integrated Safety Assessment Program (ISAP). The Staff requested that NNECO assess whether the systems were in compliance with 10CFR50.55a. The Staff indicated that if the LPCI/CS piping was not in compliance with this provision of the regulations, that relief or request for use of alternate criteria would be required, in accordance with appropriate sections of 10CFR50.55a, prior to startup.

With the insight gained from the May 13, 1994, telephone discussion with the Staff, NNECO subsequently undertook a reassessment of the LPCI/CS torus attached piping.

The reassessment considered whether the portions of the LPCI/CS systems that are subjected to peak post-accident torus water temperatures are in compliance with the ASME Code. The peak torus temperature and the torus hydrodynamic loads are separated by a long time delay; thus, these two conditions have been evaluated independently. These piping systems meet Mark I containment limits (i.e., Service Level B) for torus hydrodynamic loads and other design basis loads. The peak postaccident torus water temperature condition, considered separately from the Mark I loads, has shown that the piping meets ASME Service Level D limits. We note that one piping support with anchor bolts, not addressed by ASME Code requirements, has a safety factor between three and four. Our preliminary assessment is that upgrades to bring this piping support to a safety factor of four or greater can be performed with the unit on line. We will take action to effect this upgrade expeditiously. As such, our reassessment demonstrates that the structural integrity of the LPCI/CS systems is assured for all design basis loads and that we comply with the ASME Code. Although we believe that application of the allowables associated with Service Level D demonstrate operability, it is our intent to attain the additional margin associated with Service Level B allowables. Accordingly, we will make the necessary modifications on an expedited schedule, to reflect Service Level B allowables. As with the anchors previously discussed, we believe that these modifications can be performed with the unit on line. A description of the proposed method to be used to modify the anchors is provided in the next section. Also, Attachment 1 provides information requested on May 16, 1994, regarding load combinations and acceptance criteria for piping and pipe supports. This information includes an excerpt from a technical report sent to the Staff in a letter dated August 25, 1983.[2]

Discussion-LPCI/CS

The LPCI and CS systems were originally designed and constructed to ASA B31.1, 1955 edition, using original Millstone Unit No. 1 design-basis loads. As part of the Mark I Containment Program, torus attached piping was evaluated for the effects of suppression chamber hydrodynamic loads in addition to other Millstone Unit No. 1 design-basis loads (pressure, deadweight, seismic, and thermal expansion), using load combinations discussed in an NRC SER.[3] This reanalysis effort used a maximum operating temperature of 165°F for the piping addressed herein, based on the Millstone Unit No. 1 piping line list. However, in 1969 a Millstone Unit No. 1 accident analysis performed by General Electric determined that the peak post loss of coolant accident (LOCA) torus water temperature can reach 203°F, a value greater than the original design temperature of 165°F. The

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(2) W. G. Counsil letter to U.S Nuclear Regulatory Commission, "Millstone Nuclear Power Station, Unit No. 1, Long-Term Torus Program.

(3) U.S. Nuclear Regulatory Commission Safety Evaluation Report, Mark I Containment Long-Term Program, NUREG-0661, July, 1980.

Mark I Containment Program was not conducted using the higher temperature due to the fact that the piping line list had not been updated to reflect the higher temperature. This was identified[4] and the affected systems were determined to be operable. Further analysis conducted in 1992 determined that the water temperature could reach 207°F given the worst-case single failure and the limiting initial conditions. The operability determination conducted in 1990 bounded this temperature. The discovery of the discrepancy associated with the LPCI/CS system was the subject of a License Event Report and subsequent Staff inspection activity.

The 1990 evaluation conducted to support system operability was performed for the applicable portions of the LPCI and CS systems, and for the effects of a peak torus post-LOCA temperature of 209°F (2 degrees above the final analysis temperature). The scope of the review included all affected piping, piping supports, equipment nozzles, and anchorage.

The 1990 evaluation used the effects of the peak torus post-LOCA temperature to evaluate pipe stress, which were considered in combination with seismic and LOCA dynamic loads in order to evaluate supports and equipment, using Service Level B allowables. The review involved eight pipe stress models, all but one of which met the above criterion for pipe stress. The model which did not meet this criterion was the torus ring header and suction branches to the CS and LPCI pumps. Furthermore, using the loading definitions contained within this letter, it has been determined that the original operability evaluation was consistent with the guidance contained in Generic Letter (GL) 91-18. The piping was shown to meet these criteria. Support reviews on the eight models (approximately 250 supports) resulted in all supports meeting Mark I Containment Program criteria with the exception of 12.[5] These 12 were evaluated as operable using the Mark I Containment Program load combinations. Equipment nozzle and anchorage loads were shown to meet Mark I Containment Program limits.

Event combinations for torus attached piping systems were established as part of the Mark I Containment Program. These combinations are shown in Figure 4.3-2 of NUREG 0661, which classifies all combinations as Service Level B for the subject

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(4) Millstone Unit No. 1 License Event Report 50-245/91-002-00, dated March 11, 1991.

(5) This is a different number than the 40 supports identified within LER 91-002-00 due to additional analysis conducted subsequent to the LER.

piping systems. Pipe stresses, pipe support, and equipment loads due to thermal expansion in combination with all Mark I Containment Program hydrodynamic loads were evaluated for the LPCI and CS systems and were determined to meet Service Level B criteria for a peak torus temperature of 165°F. An initial review of these systems to determine if these Service Level B limits could be met for the higher temperature was successful for all piping except for three locations within one model, and 12 pipe supports, as discussed above.

The peak post-accident thermal condition occurs 15 hours after the LOCA. In the limiting case, torus water heats up to 165° after one hour post-LOCA. The pool hydrodynamic loads addressed in the Mark I Containment Program are terminated within 15 minutes of the onset of the accident.

Since the pool hydrodynamic loads and the peak temperature case are separated by this long time delay, we believe that it is reasonable to decouple them. The thermal condition should be considered separately from the Mark I Containment Program hydrodynamic loads and criteria.

The temperature used in the Mark I Containment Program analysis (165°F) is a conservative estimate of the torus bulk temperature during peak hydrodynamic loads. Further, the Millstone Unit No. 1 Updated Final Safety Analysis Report states that the torus temperature at the end of blowdown is 140°F.[6] Thus the torus attached piping analysis, which demonstrates compliance with Service Level B limits, is considered to be valid for all coincident thermal and dynamic loads that occur post-LOCA.

The peak post-LOCA torus water temperature predicted by more recent analysis (207°F) must be addressed as a separate load condition for its effect on the structural integrity of essential piping, supports, and equipment. The increase in bulk torus temperature is postulated to occur at least ten hours after the accident (post-LOCA). The LPCI and CS systems are required to maintain pressure-boundary integrity during this time. Having met Level B limits for Primary and Secondary loads, the remaining challenge for the system to perform its safety function is mostly due to one cycle of a Secondary (self-limiting) load (thermal expansion at 207°F). Based on this, we believe consideration of the peak post-LOCA torus temperature as a Service Level D load for these systems is appropriate. Pipe stress allowable limits for thermal expansion, which were met for Service Level B at 165°F, are based on fatigue criteria for 7,000 cycles of

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(6) Millstone Unit No. 1 Updated Final Safety Analysis Report, Section 6.2.1.1.4.1.

temperature change. Service Level D Code criteria do not require a pipe stress check for thermal expansion since one cycle is postulated, and fatigue failure is not a concern. Pipe supports and equipment must be evaluated for peak post-LOCA temperature loads using Service Level D criteria, with other coincident design-basis loads.

The eight models that constitute the LPCI and Core Spray attached piping systems have been reviewed based on separating the Mark I Containment Program hydrodynamic loads from the post-LOCA thermal case. This review was performed using hand calculations (versus computer models) and the judgment of experienced engineers. The results of this review are that all piping and pipe supports meet Code limits. Safety factors on expansion anchor bolts, which are not addressed in the ASME Code, are greater than the required safety factor of 4.0, for all but 1 pipe support. For this support, the safety factor is 3.5, for the Service Level D load combination. As previously stated, our preliminary evaluation is that the upgrade necessary to achieve a safety factor of 4 or greater can be performed with the unit on line. We will effect this upgrade expeditiously. Although we believe that application of the allowables associated with Service Level D demonstrate operability, it is our intent to attain the additional margin associated with Service Level B allowables. Accordingly, we will make the necessary modifications on an expedited schedule, to reflect Service Level B allowables. As with the pipe support previously discussed, we believe that these modifications can be performed with the unit on line. As requested by the Staff on May 16, 1994, the following is a description of the method which is being evaluated to make these modifications:

The preliminary plans for the reduction of pipe thermal stress are to reduce the stiffness of two anchors. Thermal expansion of the piping results in torsional pipe loads on both of these anchors, so only a single area of restraint must be modified. The two anchors are almost identical in design.

These anchors are extremely rigid. Torsional stiffness for the anchors as presently installed is 3.9×10^9 in lbs/rad. We plan to reduce the stiffness by removing and/or modifying some of the steel structure that provides the high stiffness. The design of the anchors is such that these modifications can be done without ever reducing the torsional stiffness below the final calculated value during the modification process — the anchors will be fully functional at all times.

We will assure that the "softening" of the anchors will not affect dynamic response by limiting the amount of softening and calculating its effect on the important response frequencies of the piping. The dominant input frequency is the piping in the torus shell frequency which is in the 15 to 20 Hz range. Responses of this section of the piping are not high, based on a review of the dynamic anchor loads. We will adjust these dynamic responses to account for small frequency shifts that will occur in the pipe response frequencies in relation to the shell (excitation) frequency.

To further support this approach, several conservatisms in the analyses performed, and related evaluations, are noted:

1. Torus attached piping analyses were based on linear elastic models with "rigid" support stiffnesses. Nozzle and support flexibility, and existing gaps in supports, will tend to accommodate thermal growth. Thermal expansion piping stress and support loads are thus over-predicted.

2. Combination of seismic and LOCA thermal support loads is conservative based on the low probability of simultaneous occurrence of these loads.

3. A review was performed as part of the Millstone Unit No. 1 Hardened Vent installation to determine the ability of torus attached piping to accommodate displacements associated with temperatures resulting from severe accidents. This review concluded that these systems would maintain pressure-boundary integrity for torus temperature conditions in excess of 300°F.

The evaluation methodology and criteria are judged to be conservative and a realistic means of addressing the peak post-LOCA torus temperature. Compliance with Code criteria is demonstrated, and pressure-boundary integrity is assured.

<u>Generic Letter 91-18</u>

During the May 13, 1994, conference call, the Staff asked that NNECO provide our perspective regarding the provisions of GL 91-18.

We believe that GL 91-18 provides excellent guidance in evaluating operability for nonconforming or degraded conditions. We consult it frequently, and it has served us well in this regard. Our interactions with the NRC Staff over the past several weeks have heightened our awareness regarding the need to communicate more explicitly when circumstances involving contemplated departures from its guidance present themselves. Our assessment of the circumstances surrounding the FWCI, LPCI/CS issues will include the relationship between the guidance contained within GL 91-18 and our actions.

Conclusion

In light of the above discussion, NNECO presents the following conclusions:

1. It is our judgment that the FWCI system will operate for at least 10 minutes following a design basis event.

2. 10CFR50.59 will be followed to relax the commitment that the FWCI system be seismically qualified, likely via a license amendment.

3. With respect to the LPCI/CS issue discussed herein, NNECO complies with 10CFR50.55a as described in this letter.

4. The pipe support with a safety factor of 3.5 is operable and will be upgraded in the near term to a safety factor of at least 4.0.

5. The modifications necessary to reflect Service Level B allowables will be made in the near term.

We believe that safe unit operation can commence for the reasons described in this letter, and we will be communicating with the Staff to confirm that the issues identified are satisfactorily addressed.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

FOR: J. F. Opeka
Executive Vice President

BY: E. A. DeBarba
E. A. DeBarba
Vice President

cc: T. T. Martin, Region I Administrator
J. W. Andersen, NRC Acting Project Manager, Millstone Unit No. 1
P. D. Swetland, Senior Resident Inspector, Millstone Unit Nos. 1, 2, and 3

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Attachment 1

Millstone Nuclear Power Station, Unit No. 1

LPCI/CS System Stress Information

May 1994

LPCI / Core Spray Operating Temperature Change

Code Stress Evaluation

The attached table, taken from NUREG-0661, Mark I Containment Long Term Program Safety evaluation report describes the load combinations for the Mark I loads. As shown in this table, the loads are all considered as Level B. The piping stresses were evaluated in accordance with the requirements of ASME III, 1977 Summer 78 addenda. This evaluation demonstrates compliance with level B service limits for primary and secondary stresses with load combinations as shown in the attached table. All supports were evaluated to the level B service limits for these loadings.

The additional evaluation conducted for the long term temperature is in accordance with the requirements of ASME III, 1977 Summer 78 addenda. This evaluation applies only to thermal expansion stress (Equation 10) as all other code load combinations were addressed as level B events and meet level B service limits. The code does not require evaluation of thermal expansion stresses for level D events (Equation 10 identifies this equation as applicable only to level A and B service conditions). We have reviewed the expansion stresses which were elastically calculated and by assuring the stresses are below flow stress we have added assurance of system functionality. The supports were reviewed for the thermal expansion loads (calculated with elastic analysis) combined with the loads resulting from the normal operating and SSE conditions (as generated in the level B analysis) and compared to Level D allowables.

Table 1

CLASS 2 AND 3 PIPING SYSTEMS

EVENT COMBINATIONS		SRV	SRV + EQ		SBA IBA		SBA + EQ IBA + EQ				SBA + SRV IBA + SRV		SBA + SRV + EQ IBA + SRV + EQ				DBA		DBA + EQ				DBA + SRV		DBA + EQ + SRV			
						CO, CH			CO,CH			CO, CH			CO,CH		PS (1)	CO, CH	PS		CO,CH		PS	CO, CH	PS		CO,CH	
TYPE OF EARTHQUAKE			O	S			O	S	O	S			O	S	O	S			O	S	O	S			O	S	O	S
COMBINATION NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
LOADS																												
Normal (2)	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Earthquake	EQ		X	X			X	X	X	X			X	X	X	X			X	X	X	X			X	X	X	X
SRV Discharge	SRV	X	X	X							X	X	X	X	X	X							X	X	X	X	X	X
Thermal	T_A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pipe Pressure	P_A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Pool Swell	P_{PS}																X		X	X			X		X	X		
LOCA Condensation Oscillation	P_{CO}					X			X	X		X			X	X		X			X			X			X	
LOCA Chugging	P_{CH}					X			X	X		X			X	X		X			X	X		X			X	X
STRUCTURAL ELEMENT	ROW																											
Essential Piping Systems																												
With IBA/DBA	10	B	B (3)	B (3)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)	B (4)
With SBA	11				B (3)	B (3)	B (4)	B (4)	B (4)	B (4)	B (3)	B (3)	B (4)	B (4)	B (4)	B (4)	-	-	-	-	-	-	-	-	-	-	-	-
Nonessential Piping Systems																												
With IBA/DBA	12	B	C (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)
With SBA	13				C (5)	C (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	D (5)	-	-	-	-	-	-	-	-	-	-	-	-

NOTES TO TABLE 1

1. Where drywell-to-wetwell pressure differential is normally utilized as a load mitigator, an additional evaluation shall be performed without SRV loadings, but assuming the loss of the pressure differential. Service Level D Limits shall apply for all structural elements of the piping system for this evaluation. The analysis need only be accomplished to the extent that integrity up to and including the first pressure boundary isolation valve is demonstrated, including operability of that valve. If the normal plant operating condition does not employ a drywell-to-wetwell pressure differential, the listed Service Level assignments shall be applicable.

2. Normal loads (N) consist of dead loads (D).

3. As an alternative, the 1.25 S_h limit in Equation 9 of NC-3652.2 may be replaced by Level C (1.85 S_h) provided that all other limits are satisfied. Fatigue requirements are applicable to all columns with the exception of 16, 18, 19, 22, 24 and 25.

4. Footnote 3 applies, except that instead of using Level C (1.8 S_h) in Equation 9 of NC-3652.2, Level D (2.4 S_h) may be used.

5. Equation 10 of NC or ND-3650 shall be satisfied, except that fatigue requirements are not applicable to columns 16, 18, 19, 22, 24 and 25, since pool swell loadings occur only once. In addition, if operability of an active component is required to ensure containment integrity, operability of that component must be demonstrated.

Reconcilliation of Ring Header Anchor Changes With Mark I Documentation

Results of the Mark I piping analysis are included in a report sent to the NRC dated August 25, 1983.[1] We will revise that assessment, as required, to include any adverse changes that occur to the piping stresses or other information in that report.

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(1) W. G. Counsil letter to U.S. Nuclear Regulatory Commission, "Millstone Nuclear Power Station, Unit No. 1 Long-Term Torus Program, dated August 25, 1993.