

NORTHEAST UTILITIES



THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

General Offices • Selden Street, Berlin, Connecticut

P.O. BOX 270
HARTFORD, CONNECTICUT 06141-0270
(203) 665-5000

October 23, 1985

Docket No. 50-245
B11805

Director of Nuclear Reactor Regulation
Attn: Mr. Christopher I. Grimes, Chief
Systematic Evaluation Program Branch
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

References: (1) J. F. Opeka letter to C. I. Grimes, dated May 17, 1985.
(2) H. L. Thompson letter to J. F. Opeka, dated July 31, 1985.

Gentlemen:

Millstone Nuclear Power Station, Unit No. 1
Integrated Safety Assessment Program

In Reference (1), Northeast Nuclear Energy Company (NNECO) provided a proposed scope for the Integrated Safety Assessment Program (ISAP) review of Millstone Unit No. 1. In Reference (2), the Staff formally issued the results of the ISAP screening review process, establishing the scope of ISAP for Millstone Unit No. 1 and initiating issue-specific evaluations. Reference (1) also indicated that for each issue or topic included in ISAP, NNECO would provide a discussion of the safety objective and an evaluation of the plant design with respect to the issue being addressed to identify specific items to be considered in the integrated assessment. In accordance with this commitment, reviews for the following ISAP topics are attached.

- o ISAP Topic 1.43 - "Water Hammer"
- o ISAP Topic 1.44 - "Asymmetric Blowdown Loads on Reactor Systems"
- o ISAP Topic 1.48 - "Safety Factor for Penetration X-10A"

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If you have any questions concerning the attached reviews, please contact us.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

J.F. OPEKA

J. F. Opeka
Senior Vice President

E. J. Mroczka

By: E. J. Mroczka
Vice President

cc: J. A. Zwolinski

ISAP TOPIC 1.43

WATER HAMMER

ISAP Topic No. 1.43
Water Hammer

I. Introduction

Water hammer occurs when the inertial properties of a piping system fluid are rapidly altered causing the development of potentially damaging pressure pulses. As stated in NUREG-0933 (Reference 12):

"The issue was raised after the occurrence of various incidents of water hammer that involved steam generator feedrings and piping, emergency core cooling systems, RHR systems, containment spray, service water, feedwater, and steam lines. The incidents have been attributed to such causes as rapid condensation of steam pockets, steam-driven slugs of water, pump startup with partially empty lines, and rapid valve motion. Most of the damage has been relatively minor and involved pipe hangers and restraints. However, there have been several incidents which have resulted in piping and valve damage.... No water hammer incident has resulted in the release of radioactivity outside of plants."

The USI was resolved on March 15, 1984 with the publication of NUREG-0927, Revision 1 (Reference 11) and revised Standard Review Plan Sections 3.9.3, 3.9.4, 5.4.6, 5.4.7, 6.3, 9.2.1, 9.2.2, 10.3 and 10.4.7. The purpose of this topic is to provide the status of this USI for Millstone Unit No. 1.

II. Review Criteria

1. Unresolved Safety Issue A-1
2. NUREG-0927, Revision 1
3. TMI Task Action Plans I.C.5 and I.A.2.3

III. Related Topics/Interfaces

1. ISAP Topic 1.48, "Safety Factor for Penetration X-10A"
2. ISAP Topic 2.20, "RWCU Systems Isolation Setpoint Reduction"
3. ISAP Topic 2.22, "Control Rod Drive System Water Hammer"
4. ISAP Topic 2.29, "FWCI Assessment Study"

IV. Evaluation

By letter dated July 7, 1982 (Reference 2), NNECO was requested to provide the NRC with the status of and progress towards completion of the Unresolved Safety Issues (USIs) at Millstone Unit No. 1. Although not specifically applicable to Millstone Unit No. 1, Reference 3 requested licensees to confirm the applicability of the NRC Staff generic positions and conclusions developed on individual USIs. On October 13, 1982 (Reference 5), NNECO presented its positions on each USI applicable to Millstone Unit No. 1; USI A-1, Water Hammer, was addressed in this submittal.

Regarding Millstone Unit No. 1, NNECO informed the NRC Staff on February 26, 1981 that the analytical efforts to include the effects of water-hammer loading on the isolation condenser supply and return lines had been completed. Additionally, in order to maintain piping stresses for water hammer loadings within acceptable limits, several additional restraints were installed during the 1980-1981 refueling outage. Therefore, as of the beginning of Cycle 8, the isolation condenser system was designed to withstand normal operation plus water hammer loads with a Factor-of-Safety greater than four (4). Based upon NRC Staff review of NNECO's February 26, 1981 submittal, the NRC Staff concluded in their Safety Evaluation dated November 6, 1981 that there is reasonable assurance that the Millstone Unit No. 1 isolation condenser will withstand the effect of water-hammer loads.

As a result of an inadvertent reactor scram on August 10, 1981, Millstone Unit No. 1 experienced a water hammer event in the isolation condenser system. An engineering evaluation was performed subsequent to the water hammer event and conclusively demonstrated the structural adequacy of the isolation condenser system to withstand its design load. A summary of this evaluation, along with a substantial amount of information regarding the August 10, 1981 event, was submitted to the NRC Staff on April 27, 1982 (Reference 1). Included in this submittal were NNECO's short-term and long-term plans to essentially preclude water hammer events in the future.

Specifically, NNECO's April 27, 1982 letter committed to:

- o implement a feedwater pump trip on high reactor level;
- o lower the RWCU system isolation setpoint to provide system availability for reactor vessel fill and address associated post-accident radiological concerns;
- o evaluate lowering the programmed reactor water level setpoint following reactor trip to avoid vessel overfill; and
- o implement low flow feedwater controller improvements to allow remote system actuation from the control room and maintain constant reactor vessel water level automatically.

A feedwater pump trip on high reactor vessel water level has been implemented; in fact, NUREG-0993 references this fact. Lowering the RWCU system isolation setpoint is being evaluated as part of ISAP Topic 2.20, "RWCU System Isolation Setpoint Reduction," and is further discussed in NNECO's letter to the NRC dated September 6, 1985 (Reference 7). Low flow feedwater controller improvements were implemented in June 1984.

NNECO is currently evaluating water hammer loads in the Control Rod Drive (CRD) System resulting from scram events via ISAP Topic 2.22, "Control Rod Drive System Water Hammer." NNECO does not consider this issue to be a safety concern for Millstone Unit No. 1 (Reference 6). Additionally, via ISAP Topic 1.48, "Safety Factor for Penetration X-10A," NNECO is evaluating concerns involving the capability of penetration

anchor X-10A to accommodate waterhammer loads in the isolation condenser system.

V. Conclusions

In a Safety Evaluation dated August 30, 1982 (Reference 5), the NRC Staff concluded that NNECO's short-term and long-term corrective actions for water hammer events assure that Millstone Unit No. 1 can continue to operate without endangering the health and safety of the public.

Based on the actions taken by NNECO in response to potential water hammer concerns, NNECO concludes that this issue no longer has any safety significance for Millstone Unit No. 1, and has, therefore, been resolved.

VI. References

1. W. G. Council letter to D. M. Crutchfield, dated April 27, 1982.
2. G. Lainas letter to W. G. Council, dated July 7, 1982.
3. D. M. Crutchfield letter to J. A. Kay, dated August 17, 1982 (Docket No. 50-29).
4. D. M. Crutchfield letter to W. G. Council, dated August 30, 1982.
5. W. G. Council letter to D. M. Crutchfield, dated October 13, 1982.
6. J. F. Opeka letter to C. I. Grimes, dated August 13, 1985.
7. J. F. Opeka letter to C. I. Grimes, dated September 6, 1985.
8. NUREG-0371, "Task Action Plans for Generic Activities (Category A)," U.S. Nuclear Regulatory Commission, November 1978.
9. NUREG-0800, "Standard Review Plan," U.S. Nuclear Regulatory Commission.
10. NUREG-0606, "Unresolved Safety Issues Summary," U.S. Nuclear Regulatory Commission (Latest Edition).
11. NUREG-0927, Revision 1, "Evaluation of Water Hammer Occurrences in Nuclear Power Plants," U.S. Nuclear Regulatory Commission, March 1984.
12. NUREG-0933, Revision 2, "A Prioritization of Generic Safety Issues," U.S. Nuclear Regulatory Commission, June 30, 1985.
13. NUREG-0993, Revision 1, "Regulatory Analysis for USI A-1, Water Hammer," March 1984.

ISAP TOPIC 1.44

ASYMMETRIC BLOWDOWN LOADS ON REACTOR SYSTEMS

ISAP Topic No. 1.44
Asymmetric Blowdown Loads on Reactor Systems

I. Introduction

In the event of a postulated reactor coolant system pipe rupture at the reactor vessel nozzle, asymmetric LOCA loading could result from forces induced on the reactor internals by transient differential pressures across the core barrel and by forces on the vessel due to transient differential pressures in the reactor cavity. This issue was determined by the NRC to have generic implications for all PWRs and designated as Unresolved Safety Issue A-2, "Asymmetric Blowdown Loads on Reactor Primary Coolant Systems". The USI was resolved in January 1981 with the issuance of NUREG-0609 (Reference 1). The purpose of this topic is to provide the NRC with the status of USI A-2 for Millstone Unit No. 1.

II. Review Criteria

1. Unresolved Safety Issue A-2, "Asymmetric Blowdown Loads on Reactor Primary Coolant Systems."
2. 10 CFR 50, Appendix A, General Design Criterion 4.

III. Related Topics/Interfaces

None.

IV. Evaluation

By letter dated July 7, 1982 (Reference 2), NNECO was requested to provide the NRC with the status of and progress towards completion of the Unresolved Safety Issues (USIs) at Millstone Unit No. 1. Although not specifically applicable to Millstone Unit No. 1, Reference 3 requested licensees to confirm the applicability of the NRC Staff generic positions and conclusions developed on individual USI. On October 13, 1982 (Reference 4), NNECO presented its positions on each USI applicable to Millstone Unit No. 1; USI A-2, "Asymmetric Blowdown Loads on Reactor Primary Coolant Systems," was addressed in this submittal.

As stated in Section 1 of NUREG-0609, "Asymmetric Blowdown Loads on PWR Primary Systems":

"Although similar loads associated with a postulated rupture of piping in primary systems in boiling-water reactors (BWRs) are expected to occur, the overall safety significance is considered to be much less because of lower operating pressures in primary systems in BWRs."

V. Conclusions

Based on the information discussed above, NNECO maintains that USI A-2 has no safety implications for and is not applicable to Millstone Unit No. 1.

VI. References

1. NUREG-0609, "Asymmetric Blowdown Loads on PWR Primary Systems," January 1981.
2. G. Lainas letter to W. G. Counsil, dated July 7, 1982.
3. D. M. Crutchfield letter to J. A. Kay, dated August 17, 1982 (Docket No. 50-29).
4. W. G. Counsil letter to D. M. Crutchfield, dated October 13, 1982.
5. NUREG-0933, Revision 2, "A Prioritization of Generic Safety Issues," June 1985.

ISAP TOPIC 1.48

SAFETY FACTOR FOR PENETRATION X-10A

ISAP Topic No. 1.48
Safety Factor for Penetration X-10A

I. Introduction

Following a water hammer incident in December 1979, the isolation condenser system at Millstone Unit No. 1 was declared inoperable due to concerns regarding presumed degradation of the isolation condenser supply line anchor at containment penetration X-10A. Subsequently, NNECO evaluated the presumed degradation of the original anchor design bases. The purpose of this topic is to provide the NRC with the status of this evaluation.

II. Review Criteria

1. NRC I&E Bulletin 79-02
2. NRC I&E Bulletin 79-14

III. Related Topics/Interfaces

1. ISAP Topic No. 1.43, "Water Hammer"
2. ISAP Topic No. 2.29, "FWCI Assessment Study"

IV. Evaluation

NNECO has been evaluating the presumed degradation of the isolation condenser supply line anchor at penetration X-10A. Specifically, NNECO has been evaluating the safety factors for the anchor bolts of the support, the potential for degradation of the original anchor design bases and anchor improvements that would meet the required safety factors.

In Reference 1, NNECO provided information to the NRC Staff regarding the load combinations and design loads that were used to modify the isolation condenser supply line containment penetration anchor, X-10A, subsequent to the water hammer event which occurred on December 19, 1979.

In addition, NNECO responded to NRC Staff findings resulting from their extensive audit of the modifications made to the containment penetration anchor X-10A in References 2 through 6.

In parallel with the water hammer concerns, NNECO was also addressing the requirements of I&E Bulletin 79-02. In Reference 7, NNECO stated that although high energy pipe break (HEPB) loads were not specifically included in the scope of I&E Bulletin 79-02, these loads coupled with normal operating loads would be included in the reanalysis of containment penetration anchor X-10A. As such, NNECO informed the NRC Staff that the anchor bolts met a minimum factor of safety of two for this load condition.

The NRC Staff provided NNECO with a safety evaluation, entitled "Isolation Condenser Steam Line Water Hammer and Pipe Anchor Safety Factor," in Reference 8. In this safety evaluation, the NRC Staff concluded that two design areas do not comply with NRC I&E Bulletin 79-02:

- o I&E Bulletin 79-02 requires a factor of safety of at least four for expansion anchor bolts under all conditions; and
- o to comply with the design condition requirements of I&E Bulletin 79-02, the load conditions for expansion anchor bolts should be: normal operating loads, HEPB loads and design basis earthquake loads.

The effort necessary to document a factor of safety of at least four for the load condition of normal operating and HEPB loads, is presently being assessed. The original pipe break loads utilized in the design of containment penetration anchor X-10A were conservatively calculated and applied in a manner consistent with technology available at that time. As such, the loadings are not based upon a rigorous mechanistic evaluation of discrete pipe break locations such as would be done today. It is NNECO's contention that performing the more rigorous analysis will result in a demonstrated anchor bolt factor of safety of four for the load condition discussed above. The results of the analytical evaluation of containment penetration anchor X-10A will be submitted to the NRC Staff upon completion.

Reference 8 represents the first time the NRC Staff has documented that their interpretation of I&E Bulletin 79-02 requires consideration of the concurrent load condition: normal operating loads, HEPB loads and design basis earthquake loads. The original design basis of containment penetration anchor X-10A did not consider this load condition. It is NNECO's determination that I&E Bulletin 79-02 requirements only apply to original design bases. In addition, recent studies funded by the NRC (Reference 10) reveal that the probability of a large pipe break occurring simultaneously with a seismic event is extremely remote and well below the threshold of consideration for design basis events. Therefore, NNECO concludes that justification to address this load condition does not exist and, as such, no further action in this regard is planned by NNECO.

V. Conclusions

As stated above, the rigorous analytical evaluation of the factor of safety associated with the design of containment penetration anchor X-10A is ongoing. Upon completion it will be submitted to the NRC. In the interim, NNECO believes this issue does not represent a significant safety concern. This is consistent with the NRC's Safety Evaluation (Reference 8), which concludes that there is reasonable assurance that the isolation condenser supply line will withstand the effect of water hammer loads.

VI. References

1. W. G. Counsil letter to D. L. Ziemann, dated January 21, 1980.
2. W. G. Counsil letter to B. H. Grier, dated March 31, 1980.
3. W. G. Counsil letter to B. H. Grier, dated May 8, 1980.

4. W. G. Council letter to B. H. Grier, dated July 31, 1980.
5. W. G. Council letter to B. H. Grier, dated October 31, 1980.
6. W. G. Council letter to B. H. Grier, dated February 26, 1981.
7. W. G. Council letter to B. H. Grier, dated April 7, 1981.
8. D. M. Crutchfield letter to W. G. Council, dated June 3, 1981.
9. W. G. Council letter to D. M. Crutchfield, dated June 12, 1981.
10. NUREG/CR-1889, "Large LOCA - Earthquake Combination Probability Assessment Load Combination Program Project/Summary Report," dated January 1981.