DESIGNATED ORIGINAL

Certified By Debbie Krag

March 31, 1982

Docket No. 50-245
LS05-82-03-109

Mr. W. G. Counsil, Vice President
Nuclear Engineering and Operations
Northeast Nuclear Energy Company
Post Office Box 270
Hartford, Connecticut 06101

Dear Mr. Counsil:

SUBJECT: MILLSTONE 1 - SEP TOPIC III-5.B, PIPE BREAK OUTSIDE CONTAINMENT

In your letter dated December 4, 1981, you submitted a safety assessment report on the above topic. The staff has reviewed your assessment and as noted in the enclosed draft evaluation, clarification on some items, is needed in order for the staff to complete its review. You are requested to provide your schedule for addressing these concerns within 30 days of receipt of this letter.

Sincerely,

Original signed by:

Dennis M. Crutchfield, Chief
Operating Reactors Branch No. 5
Division of Licensing

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ADD:
G. Staley
D. Persinko
P. Chen

Enclosure:
As stated

cc w/enclosure:
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OFFICE	SEPB:DL	SEPB:DL	SEPB:DL	SEPB:DL	SEPB:DL	ORB#5:PM	ORB#5:BC
SURNAME	EMcKenna:dk*	GCwalina*	PYChen*	RHermann*	WRussell*	JShea*	DCrutchfield for
DATE	3/15/82	3/22/82	3/22/82	3/24/82	3/24/82	3/25/82	3/31/82

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LS05-82

Mr. W. G. Counsil, Vice President
Nuclear Engineering and Operations
Northeast Nuclear Energy Company
Post Office Box 270
Hartford, Connecticut 06101

Dear Mr. Counsil:

SUBJECT: MILLSTONE 1 - SEP TOPIC III-5.B, PIPE BREAK OUTSIDE CONTAINMENT

In your letter dated December 4, 1981, you submitted a safety assessment report on the above topic. The staff has reviewed your assessment and our conclusions are presented in the enclosed safety evaluation report.

As noted in our evaluation, additional information is required in order for the staff to complete its review. You are requested to provide your schedule for addressing these concerns within 30 days of receipt of this letter.

The enclosed safety evaluation will be a basic input to the integrated safety assessment for your facility. The assessment may be reviewed in the future if your facility design is changed or if NRC criteria relating to this topic are modified before the integrated assessment is completed.

Sincerely,

James Shea, Project Manager
Operating Reactors Branch No. 5
Division of Licensing

Enclosure:
As stated

cc w/enclosure:
See next page

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Mr. W. G. Counsil

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SEP EVALUATION

OF

PIPE BREAK

OUTSIDE CONTAINMENT

TOPIC III-5.B

FOR

MILLSTONE-1 NUCLEAR POWER PLANT

TABLE OF CONTENTS

I. INTRODUCTION

The safety objective of Systematic Evaluation Program (SEP) Topic III-5.B, "PIPE BREAK OUTSIDE CONTAINMENT", is to assure that pipe breaks would not cause the loss of required function of "safety-related" systems, structures and components and to assure that the plant can be safely shut down in the event of such breaks. The required function of safety-related systems are those functions required to mitigate the effects of the pipe break and safely shut down the reactor plant.

II. REVIEW CRITERIA

General Design Criteria 4 (Appendix A to 10 CFR Part 50) requires in part that structures, systems and components important to safety be appropriately protected against dynamic effects, such as pipe whip and discharging fluids, that may result from equipment failures.

The current criteria for review of pipe breaks outside containment are contained in Standard Review Plan 3.6.1, "Postulated Piping Failures in Fluid Systems Outside of Containment", including its attached Branch Technical Position, Auxiliary System Branch 3-1 (BTP ASB 3-1) and Standard Review Plan 3.6.2, "Determination of Break Locations and Dynamic Effects Associated with the Postulated Rupture of Piping", including its attached Branch Technical Position, Mechanical Engineering Branch 3-1 (BTP MEB 3-1).

III. RELATED SAFETY TOPICS AND INTERFACES

1. This review complements that of SEP Topic VII-3, "Systems Required for Safe Shutdown".

2. The environmental effects of pressure, temperature, humidity and flooding due to postulated pipe breaks are evaluated under Unresolved Safety Issue A-24, "Qualification of Class IE Safety-Related Equipment".

3. The effects of potential missiles generated by fluid system ruptures and rotating machinery where also considered and are evaluated under SEP Topic III-4.c, "Internally Generated Missiles".

4. The original plant design criteria in the areas of seismic input, analysis design criteria are evaluated under SEP Topic III-6, "Seismic Design Considerations".

IV. REVIEW GUIDELINES

The licensee's break location criteria and methods of analysis for evaluating postulated breaks in piping systems outside containment have been compared with the currently accepted review criteria as described in Section II above. The review relied upon information submitted by the licensee, Northeast Nuclear Energy Company (NNECo), in Reference 1, 2, 3, 4, 5 and 6.

The scope of review under this topic was limited to avoid duplication of effort since some aspects of the topic were previously reviewed by the staff or are included under other SEP topics (see III above).

When deviations from the review criteria are identified, engineering judgement is utilized to evaluate the consequence of postulated pipe break and to assure that pipe break would not cause the loss of needed function of "safety-related" systems, structures and components and to assure that the plant can be safely shutdown in the event of such break.

V. EVALUATION

A. BACKGROUND

In December 1972, the staff sent letters (Reference 7) to all power reactor licensees requesting an analysis of the effects of postulated failures of high energy lines outside of containment. In response to our letter, the licensee submitted an initial report concerning postulated high energy pipe rupture outside containment (Reference 1) dated February 22, 1973. Subsequent information was received on March 2, June 1, and August 30, 1973 (Reference 2, 3 and 4). Additional information was requested in our letter dated January 29, 1974, which was provided by the licensee on March 20, 1974 (Reference 5). In Reference 8, the staff found the licensee's analyses and actions acceptable with respect to the Giambusso letter of December 18, 1972 and concluded that Millstone Unit No. 1 would withstand the consequences of postulated ruptures in high energy fluid piping outside containment without loss of the capability to initiate and maintain safe shutdown of the plant. The licensee's SEP reevaluation of pipe break outside containment (Reference 6), therefore, includes the following:

a. A comparison of the criteria used in the previous Millstone high energy pipe break (HEPB) evaluation with current criteria.

b. Discussion on the available plant shutdown methods.

c. A systematic evaluation of break points which differ from previous pipe break studies.

B. COMPARISON OF THE CRITERIA USED IN THE PREVIOUS MILLSTONE HIGH ENERGY PIPE BREAK EVALUATION WITH CURRENT CRITERIA

A review of the criteria used in Reference 4 versus the currently accepted review criteria described in Section II shows that the criteria used by Reference 4 is the same as current critieria except as follows:

1. The previous Millstone HEPB study (Reference 4)was analyzed for pipe whip, jet impingement, compartment pressurization and related environmental effects on piping systems with service conditions of pressure, $P \geq 275$ psig and temperature, $T \geq 200°F$. Only environmental effects on required safety related equipment in the vicinity of the postulated break were addressed for fluid carrying piping systems with service conditions of either $P > 275$ psig and $T < 200°F$ or $T > 200°F$ with $P < 275$ psig. Current criteria define a line as a high energy system if either the pressure or the temperature

value is exceeded. The licensee's SEP reevaluation (Reference 6) identified five systems which were not analyzed for the effects of pipe whip and jet impingement by the earlier criteria used in Reference 4. These systems are the condensate system, extraction steam, auxiliary steam, control rod drive hydraulic system and isolation condenser system. Breaks in these five systems are postulated using a simplified mechanistic approach (i.e., breaks are postulated at welds and structural discontinuities). Evaluation of these postulated pipe breaks will be addressed in Section V.D, "PIPE BREAK INTERACTIONS" of this Safety Evaluation Report.

2. Current criteria require that through-wall leakage cracks be postulated in moderate-energy line piping ($T<200^{o}F$ and $P<275$ psig). The licensee has not addressed this subject in this SEP topic assessment. The effects of failure in non-Category I piping were reviewed by the licensee in Reference 9. The staff concluded in Reference 10 that Millstone-1 had adequate design features for protection against the rupture of a non-Class I component or piping.

   The licensee is requested to:

   A. Verify that the previous reviews enveloped the potential flooding and spray effects of leakage cracks in moderate energy piping (both Class 1 and non-Class 1), or

   B. Provide an evaluation of the effects on safety-related equipment of leakage cracks in accordance with current review criteria.

3. The criteria used by the licensee to evaluate the effects of jet impingement loads resulting from postulated pipe breaks require clarification. For the isolation condenser system, the licensee references MIT Press, "The theory of Turbulent Jets," (Reference 11) in its jet impingement load evaluation for steam or water-steam mixtures. NRC Standard Review Plan, Section 3.6.2 requires that the jet area expand uniformly at a half angle not exceeding ten degrees. As an alternative, jet expansion within a zone of five pipe diameters from the break location is acceptable for steam or water-steam mixtures, if substantiated by a valid analysis or testing. Our assessment based on the information currently available is that the licensee's jet expansion model for the isolation condenser system results in a non-conservative calculation of the

jet impingement load on a target farther than five pipe diameters from the break location.

For the remainder of the systems discussed in Reference 4, the forces generated by the jets are given; however, the criteria used to calculate these forces are not explicitly addressed.

The licensee is requested to demonstrate that the Millstone-1 jet impingement evaluation for all systems provides an equivalent level of safety as that provided in S.R.P. 3.6.2.

4. Postulated pipe breaks outside of the primary containment between the penetration and the containment isolation valve in combination with an independent failure of the inside containment isolation valve could result in an unisolable break. Any break downstream of the outside isolation valve that damages either the valve itself or control or power cables for the valve could result in a similar situation. Currently the staff applies the provisions of BTP MEB 3-1 section B.1.b and BTP ASB 3-1 section B.2.C to the review of these areas. The licensee should compare the design of the applicable Millstone-1 systems (e.g., main steam, isolation condenser, etc.) to these provisions.

C. DISCUSSION ON THE AVAILABLE PLANT SHUTDOWN METHODS

The previous high energy pipe break evaluation assumed offsite power was available. Under current criteria, if a reactor trip/turbine trip occurs as a consequence of the break, loss of offsite power should be assumed.

For the SEP topic evaluation, the licensee considered the effect that assuming loss of offsite power would have on the four available shutdown methods. These four methods are: a) Use of isolation condenser, b) Steam dump to main condenser, condensate/feedwater makeup, c) Auto-pressure relief (APR) valves and control rod drive system makeup, and d) APR and core spray or low pressure coolant injection as makeup. Only method b (normal shutdown systems including steam dump to the main condenser) would be affected by loss of offsite power. For each break for which loss of offsite power must be postulated, at least one of the other three shutdown methods would be available.

D. PIPE BREAK INTERACTIONS

The licensee has analyzed the effects of postulated pipe breaks for systems identified in Section B.1 of this SER on a system by system basis. Each system has been analyzed for the effect that postulated pipe breaks would have on the ability to safely shut the plant down or to stay shutdown.

3reaks in the condensate piping would only affect the one shutdown method that relies on the condensate/feedwater system. The extraction steam and auxiliary steam piping is located within the heater bay area and breaks would therefore not affect three shutdown methods.

Breaks in some parts of the control rod hydraulic (CRD) system could result in jet impingement on cable trays controlling the automatic pressure relief valves (APR); two shutdown methods would still be available.

For the isolation condenser drain and firewater makeup lines, two shutdown methods would be available.

Therefore, pipe whip and jet impingement due to breaks in the lines not previously evaluated for these effects would not prevent safe shutdown.

VI. CONCLUSION

Based on the information submitted by the licensee, we have reviewed the criteria pertaining to the locations, types and effects of postulated pipe breaks in high energy piping systems outside containment. We have concluded that the criteria used to define the break locations, types and effects of postulated pipe breaks are in accordance with currently accepted standards. We have also determined that it is acceptable under current SEP criteria to use the interaction study to evaluate the effects of postulated pipe breaks and to determine the acceptability of plant response to pipe breaks.

However, we have found that the subjects of evaluation of the effects of cracks in moderate-energy lines, the jet expansion analyses and evaluation of breaks in the penetration areas, as identified in Sections B.2, B.3 and B.4 respectively, have not been addressed adequately in the licensee's evaluation.

REFERENCES

1. Draft Special Report, "Effects of a High Energy Piping System Break Outside of Primary Containment," Northeast Nuclear Energy Company (NNECO), dated February 22, 1973.

2. Appendix B to the above Special Report, March 2, 1973.

3. Formal version of the above Special Report, June 1, 1973.

4. Revision 1 to the above Special Report, August 30, 1973.

5. Additional information with respect to the above Special Report, March 20, 1974.

6. Report, "Millstone Unit No. 1 SEP Topic III-5.B High Energy Pipe Break Outside Containment," Northeast Nuclear Energy Company, dated December 4, 1981.

7. Letter, A. Giambusso (NRC) to NNECO, "General Information Required of the Effects of a Piping System Break Outside Containment," dated December 18, 1972.

8. Safety Evaluation Report, "Millstone Unit 1 Analysis of the Consequences of High Energy Piping Failures Outside Containment," dated August 14, 1975.

9. Letter, D. Switzer (Millstone Point Company) to D. Skovholt (NRC), dated October 2, 1972.

10. Letter, D. Skovholt (NRC) to D. Switzer on the Possible Failure of Non-Class I Seismic Equipment, dated March 27, 1974.

11. MIT Press, "The Theory of Turbulent Jets," G. N. Abramovich, 1963.