Repro 8/16

August 12, 1982

Docket No. 50-409
LS05-82- 08-019

Mr. Frank Linder
General Manager
Dairyland Power Cooperative
2615 East Avenue South
LaCrosse, Wisconsin 54601

Dear Mr. Linder:

SUBJECT: SEP TOPIC III-5.B, PIPE BREAK OUTSIDE CONTAINMENT
LACROSSE BOILING WATER REACTOR

In your letter dated June 29, 1981 (LAC-7635), you submitted a safety assessment report on the above topic. We have completed our evaluation, which is enclosed. We conclude that the plant is adequately protected from the dynamic effects of pipe break outside containment subject to resolution of the following in the Integrated Plant Safety Assessment:

1. Clarification of pipe whip damage criteria and jet impingement model.

2. Verification that the potential releases from the worst high energy line break with single failure of the inboard isolation valve does not exceed 10 CFR Part 100 guidelines.

3. Evaluation of the effects of failure in the steam heating system in the electrical equipment room.

The need to actually implement changes as a result of these items will be determined during the Integrated Safety Assessment. This safety evaluation may be revised 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.

5604
DSU use(38)
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Sincerely,

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

Enclosure:
As stated

cc w/enclosure: * SEE PREVIOUS CONCURRENCE

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cc w/enclosure: See next page

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SEP EVALUATION

OF

PIPE BREAK OUTSIDE CONTAINMENT

TOPIC III-5.B

FOR THE

LA CROSSE BOILING WATER REACTOR

TABLE OF CONTENTS

SYSTEMATIC EVALUATION PROGRAM

TOPIC III-5.B

LACROSSE BOILING WATER REACTOR PLANT

TOPIC: III-5.B, Pipe Break Outside Containment

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 shutdown 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 shutdown the reactor plant.

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.

III. RELATED SAFETY TOPICS

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

B. 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 1E Safety-Related Equipment."

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

D. 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 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).

The licensee's break location criteria and methods of analysis for evaluating postulated breaks in high energy piping systems outside containment have been compared with the currently accepted review criteria as described above. The review relied upon information supplied by the licensee, Dairyland Power Cooperative (DPC), in References 1 and 2.

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).

differences from the review criteria are identified, engineering judgement is utilized to evaluate the consequences of postulated pipe breaks to assure that the pipe break would not cause the loss of the required functions of "safety-related" structures, systems and components and to assure that the plant can be safely shutdown in the event of such a break.

V. EVALUATION

A. Background

In December 1972, the staff sent letters (Reference 1) to all power reactor licensees requesting an analysis of the effects of postulated failures of high energy lines outside of containment. A summary of the criteria and requirements in this letter is set forth below.

1. Protection of equipment and structures necessary to shutdown the reactor and maintain it in a safe shutdown condition, assuming a concurrent and unrelated single active failure of protected equipment, should be provided from all effects resulting from ruptures in pipes carrying high energy fluid, where the temperature and pressure conditions of the fluid exceed 200°F and 275 psig, respectively, up to and including a double-ended rupture of such pipes. Breaks should be assumed to occur in those locations specified in the "pipe whip criteria." The rupture effects to be considered include pipe whip, structural (including the effects of jet impingement), and environmental.

2. In addition, protection of equipment and structures necessary to shutdown the reactor and maintain it in a safe shutdown condition, assuming a concurrent and unrelated single active failure of protected equipment, should be provided from the environmental and structural

effects (including the effects of jet impingement) resulting from a single open crack at the adverse location in pipe carrying fluid routed in the vicinity of this equipment. The size of the crack should be assumed to be 1/2 the pipe diameter in length and 1/2 the wall thickness in width.

In response to NRC letters, a report concerning postulated high energy pipe ruptures outside containment was filed by the licensee on January 17, 1974. A subsequent letter from DPC dated August 15, 1974, answered additional questions requested by AEC letter dated April 8, 1974. The licensee also submitted additional information by letters dated January 23, 1975, and January 12, 1976. Based on these transmittals, the staff issued Amendment No. 5 to Provisional Operating License No. DPR-45 for the LaCrosse Boiling Water Reactor (Reference 2). This amendment added interim surveillance requirements to the Technical Specifications for the LaCrosse Boiling Water Reactor pending completion of certain modifications to the facility to assure that it will withstand the consequences of postulated ruptures in the high energy fluid piping outside containment without loss of capability to achieve and maintain safe shutdown of the facility. The required facility modifications were performed during the period 1974-1976.

The licensee's reevaluation of the effects of pipe breaks outside containment under SEP Topic III-5.B involves the comparison of the LACBWR plant with current criteria for pipe breaks outside containment, which was submitted with a letter dated June 29, 1981 (Reference 3). An "effects oriented" approach is used to determine the acceptability of plant response to pipe breaks, i.e., each structure, system, component, and power supply which must function to mitigate the effects of the pipe break and to safely shutdown the plant is examined to determine its susceptibility to the effects of the postulated break. Break effects considered are compartment pressurization, pipe whip, jet impingement, spray and flooding. Environmental conditions of temperature, pressure and humidity are addressed under USI A-24.

The previous evaluation of pipe breaks outside containment for the LACBWR plant was performed using some methods and criteria which are no longer used by the staff in the review of current plants. For example, the current definition of a high energy fluid system is one that is maintained under conditions where either or both the maximum operating temperature and pressure exceeds 200°F and 275 psig is different from the definition applied in the previous review where a high energy fluid system was one in which both temperature and pressure exceed 200°F and 275 psig. The SEP reevaluation of this topic is performed using the current criteria in Stnadard Review Plan 3.6.1 and 3.6.2 and their attached Branch Technical Positions.

B. Summary of Findings

The results of the SEP reevaluation of pipe breaks outside containment for LACBWR are provided in Table 1. The following paragraphs provide additional information used to evaluate certain pipe breaks listed in Table 1.

The safe shutdown systems which were examined from the standpoint of protection from pipe break effects are:

1. Reactor Control and Protection Systems,
2. Shutdown Condenser,
3. Manual Depressurization System,
4. Alternate Core Spray,
5. Emergency Service Water Supply System,
6. Reactor Building and Turbine Building Main Steam Line Isolation Valves,
7. Instrumentation for the Above Systems and Equipment; and
8. Emergency Power (ac and dc) for the Above Systems and Equipment.

B.1. Pipe Whip and Jet Impingement

The design of the LACBWR plant is somewhat unusual in that it is a BWR which employs a relatively large, PWR-type cylindrical steel containment structure. As a result, several systems important to safety are located wholly or predominantly within containment. These include the Shutdown Condenser, the Manual Depressurization System, the High and Low Pressure Core Spray Systems, the high energy portion of the Alternate Core Spray System.

Potential interactions between portions of safety systems located outside of containment with high energy fluid systems are confined to two locations: 1) the pipe tunnel area between containment and the turbine building, and 2) the mezzanine floor level of the turbine building near the east turbine building wall. In the enclosure to Reference 3, the licensee referenced a 1974 study (Reference 4) in which the licensee investigated pipe break effects in these areas and concluded that the function of the ACS (the only safe shutdown system at risk from HELB effects) could be assured if suitable facility modifications were made. The recommended modifications included addition of pipe whip restraints at specified locations in the main steam line and main bypass line, and the addition of a valve capable of isolating the HPSW system from the alternate core spray line. The latter modification precludes degradation of ACS flow capability in the event of damage to the HPSW system from HELB effects. These required facility modifications have been made by the licensee.

However, it is unclear as to what pipe whip damage criteria and jet impingement model were used in the licensee's SEP reevaluation of the effects of pipe break outside containment as described in Reference 3. For instance, on page 10 of the enclosure to Reference 4, the licensee states "The main steam line break locations (1 though 5) are so oriented that the resulting steam jets are not directed at the control valves." However, the licensee has not indicated how the orientation of the steam jet was determined. Clarification of the assumptions used in the evaluation of the effects of postulated pipe breaks with respect to the jet impingement model, pipe whip damage criteria and pipe motions caused by the dynamic effects of postulated pipe breaks is required.

B.2. Peak Pressures

The licensee has performed analyses (Reference 4) to determine possible adverse effects due to compartment pressurization following high energy line breaks. It was determined that there exists sufficient communication among areas of interest (condenser compartment, turbine building, feedwater pump area, high pressure heater compartment) to preclude buildup of significant differential pressures between these areas. Peak pressure was therefore calculated for the turbine building treated as a single volume. The calculations show that peak building pressure occurs following a main steam line break and could reach 3.39 psig. Such a pressure transient would be quickly relieved by means of local failure of the corrugated metal paneling which constitutes the exterior walls of the turbine building. Damage to interior structural elements would not occur.

The licensee stated that the radiological release to the public resulting from the steam venting through the local failure of the corrugated metal panelling, will not be greater than the release resulting from the steam being exhausted through the turbine building intake vents. Consequently, no changes to the building were required.

B.3. Adverse Environmental Effects

The control room, penetration room and the diesel generator rooms will not be damaged by a high energy line break since all of these rooms are protected by concrete walls and are remote from high energy piping runs.

A steam heating system is used in the electrical equipment room. Since the room is enclosed, steam released due to a failure in the heating system would not be rapidly dispersed and could result in an adverse environment for the batteries, switchgear and other components. The effects of such a failure have not been evaluated.

With respect to pressurization, the control room, electrical room, penetration room and the diesel generator rooms are isolated from the turbine building by concrete walls or substantial steel personnel access doors which open out into the turbine building and are set in steel frames. Based on the standpoint of the ability to withstand the internal turbine building pressure, the licensee concluded that the turbine building wall panels will blow out to relieve building pressure before the concrete walls and doors isolating the specified rooms are damaged. Consequently, no adverse environmental effects are anticipated in the control room, penetration area or diesel generator room. However, review of environmental effects on electrical equipment is more fully addressed under USI A-24.

B.4. Flooding and Spray Effects from Moderate Energy Line Breaks

The licensee has previously addressed (in Reference 5) the flooding and spray effects due to failures in fluid system piping outside containment. Corrective measures such as moisture detectors and drip shields were installed. For this topic assessment, the licensee reexamined effects on safe shutdown systems.

Interaction between MELB flood and spray effects and safe shutdown equipment is generally limited at the LACBWR by means of physical separation (See Table 1).

One area where physical separation is not adequate to completely preclude potential interactions is the electrical penetration room at the location of the 480-V Essential Bus 1A Switchgear. This equipment is subject to spray effects from a postulated MELB in the eight-inch Alternate Core Spray (ACS) line which runs overhead through the penetration room, offset horizontally from the location of the switchgear enclosure by approximately five feet. However, the licensee concluded that the consequences of the worst-case postulated MELB in this area pose no safety concerns, since:

1. A postulated MELB, in the ACS line in this location would not cause a loss of off-site power;

2. it does not compromise the integrity of the RCPB;

3. no mitigating systems are required to operate;

4. shutdown and cooldown of the reactor can be accomplished using ordinary means.

Furthermore, even in the event that the Essential Bus 1A Switchgear is lost, and further assuming that emergency onsite ac power is subsequently needed, this power would still be available from redundant (and separate) Essential Bus 1B. Based on the above discussion, the staff concludes that these interactions would not prevent safe shutdown and therefore, are acceptable.

B.5. Piping Failure in Penetration Area

As noted on page 9 of the Enclosure to Reference 4, a pipe break outside containment (between the containment and the outboard isolation valve) combined with a failure of the inside containment isolation valve could result in a non-isolable condition. The reactor system would blowdown to essentially atmospheric pressure. The emergency core cooling systems would automatically actuate to provide core cooling. The licensee should verify that the radiological consequences of a non-isolable break as described above satisfy the guidelines of 10 CFR Part 100.11.

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 pipe whip damage criteria and jet impingement model, consequences of steam heating system failures in the electrical equipment room and consequences of failures in the penetration areas, as identified in Sections V.B.1, V.B.3 and V.B.5 respectively, have not been addressed adequately in the licensee's evaluation.

VII. REFERENCES

1. AEC letter, A. Giambusso to DPC, dated December 18, 1972.

2. Robert W. Reid, Division of Operating Reactors, NRC, to John P. Madgett, General Manager DPC, dated April 5, 1976.

3. DPC letter LAC-7635, from F. Linder to D.G. Eisenhut (NRC), dated June 29, 1981.

4. DPC letter LAC-7733, from F. Linder to D.G. Eisenhut (NRC), dated August 5, 1981, with enclosure: NES letter P-5101-77, to R.E. Shimshak (DPC), dated December 4, 1974

5. DPC letter LAC-1442, J.P. Madgett (DPC) to D. Skovholt (AEC), dated January 29, 1973.

TABLE 1. EFFE[illegible] PIPE BREAK OUTSIDE CONTAINMENT

ZONE	PIPE BREAK	AFFECTED S[illegible]	MITIGATING [illegible]	AFFECTED SAFE SHUTDOWN SYSTEM	ADEQUACY OF PROTECTION REMARKS
Crib House	LPSW, CW	None		ACS (Diesel Driven Pumps)	Adequate. Closest ME Line with respect to Diesel pumps is 6"/ 3" SW line, with separation of approximately 20 feet. Leakage from break in these would not adversely affect Diesel pump operation. Flooding not a concern since leakage would collect in trash trough and drain downstream of intake flume.
Turbine Building Mezzanine (El. 654')	MS, MSBP, CS, (HELB)	ACS		ACS	Adequate. Pipe restraints have been added to the MS & MSBP pipe runs to preclude damage to ACS line from pipe whip. See Evaluation text.
Turbine Building Mezzanine (El. 654')	HPSW, LPSW, CW (MELB)	None		ACS	Adequate. A remote-manual actuated, motor-operated isolation valve has been installed in the HPSW Line close to its connection to the ACS line so the HPSW leakage can be isolated in the event that the HPSW line (a ME system) is broken. This prevents reduction in ACS flow capacity due to diversion of fluid through the break.

TABLE 1 (Continued)

ZONE	PIPE BREAK	AFFECTED MITIGATING SYSTEM	AFFECTED SAFE SHUTDOWN SYSTEM	ADEQUACY OF PROTECTION REMARKS
Turbine Building Grade Floor (El. 640')	HPSW, CW, CCW, LPSW, DW, (MELB)	None	None	Adequate. No safe shutdown equipment at risk from MELB spray or flooding effects in this zone.
Electrical Penetration Room (El. 640')	ACS (MELB)	None	480-V Essential Bus 1A Switchgear	See text.
Pipe Tunnel	HFSW, CCW FW, DW (MELB)	None	None	Adequate. No safe shutdown equipment at risk from MELB spray or flooding effects in this zone.

TABLE 1 (Continued)

List of Abbreviations

ACS	-	Alternate Core Spray System
CCS	-	Component Cooling Water System
CS	-	Condensate System
CW	-	Circulating Water System
DW	-	Demineralized Water System
FW	-	Feedwater System
HELB	-	High Energy Line Break
HPSW	-	High Pressure Service Water
LPSW	-	Low Pressure Service Water
MELB	-	Moderate Energy Line Break
MS	-	Main Steam System
MSBP	-	Main Steam Bypass System
RCPB	-	Reactor Coolant Pressure Boundary
SW	-	Screen Wash System