August 06, 1982

Docket No. 50-409
LS05-82-08-009

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

Dear Mr. Linder:

SUBJECT: LACROSSE - SEP TOPIC XV-14, INADVERTENT OPERATION OF ECCS THAT INCREASES REACTOR COOLANT INVENTORY

Enclosed is a copy of the staff's safety evaluation of SEP Topic XV-14, which is based in part on your topic assessment submitted on August 25, 1981 (LAC-7756).

You are requested to examine the facts upon which the staff has based its evaluation and respond either by confirming that the facts are correct, or by identifying errors and supplying the corrected information.

Your response is requested within 30 days of receipt of this letter. If no response is received within that time, we will assume that you have no comments or corrections and will consider the topic complete.

The enclosed safety evaluation will be a basic input to the integrated safety assessment for your facility unless you identify changes needed to reflect the as-built condition of your facility. The assessment 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.

SE04
DSU USE (38)
ADD:
T. Michaels

Sincerely,

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

Enclosure:
As stated

cc w/enclosure:
See next page

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DATE	8/03/82	8/3/82	8/3/82	8/3/82	8/4/82	8/5/82	8/4/82

Mr. Frank Linder

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SYSTEMATIC EVALUATION PROGRAM
TOPIC XV-14
LACROSSE

TOPIC XV-14, INADVERTENT OPENING OF ECCS THAT INCREASES REACTOR COOLANT INVENTORY

I. INTRODUCTION

Inadvertent operation of high pressure emergency core cooling systems (ECCS) under normal operations could result in an increase in primary system inventory and an increase in core inlet subcooling. Nuclear power would increase.

For LACBWR, only the high pressure core spray (HPCS) system is capable of injecting water at normal system pressures.

II. REVIEW CRITERIA

Section 50.34 of 10 CFR Part 50 requires that each applicant for a construction permit or operating license provide an analysis and evaluation of the design and performance of structures, systems and components of the facility with the objective of assessing the risk to public health and safety resulting from operation of the facility, including determination of the margins of safety during normal operations and transient conditions anticipated during the life of the facility.

Section 50.36 of 10 CFR Part 50 requires the Technical Specifications to include safety limits which protect the integrity of the physical barriers which guard against the uncontrolled release of radioactivity.

The General Design Criteria (Appendix A to 10 CFR Part 50) establish minimum requirements for the principal design criteria for water-cooled reactors.

GDC 10 "Reactor Design" requires that the core and associated coolant, control and protection systems be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during normal operation, including the effects of anticipated operational occurrences.

GDC 15 "Reactor Coolant System Design" requires that the reactor coolant and associated protection systems be designed with sufficient margin to assure that the design conditions of the reactor coolant pressure boundary are not exceeded du ing normal operation, including the effects of anticipated operational occurrences.

GDC 26 "Reactivity Control System Redundance and Capability" requires that the reactivity control systems be capable of reliably controlling reactivity changes to assure that under conditions of normal operation, including anticipated operational occurrences, and with appropriate margin for malfunctions such as stuck rods, specified acceptable fuel design limits are not exceeded.

III. RELATED SAFETY TOPICS

Various other SEP topics evaluate such items as the reactor protection system. The effects of single failures on safe shutdown capability are considered under Topic VII-3.

IV. REVIEW GUIDEINES

The review is conducted in accordance with SRP 15.5.1 and 15.5.2.

The evaluation includes review of the analysis for the event and identification of the features in the plant that mitigate the consequences of the event as well as the ability of these systems to function as required. The extent to which operator action is required is also evaluated. Deviations from the criteria specified in the Standard Review Plan are identified.

V. EVALUATION

For the reactor system under normal operating pressure, the only ECC system that could operate is the high pressure core spray (HPCS). The HPCS is driven by two positive displacement pumps (capacity 50 gpm each) which take suction from the overhead storage tank. The HPCS water is at approximately 70°F. The pumps discharge to a core spray ring header at up to 1450 psig. The ring header supplies 72 individual spray nozzles. One nozzle is located just above each fuel assembly, approximately 9" above the active core length and about 5" above the top end of the fuel pins. The spray nozzle produces a spray cone of 120°. Each nozzle spray rate is set to match the power of the appropriate fuel assembly; flow rates vary from 0.4 to 0.87 gpm at normal HPCS flow total of 50 gpm.

The licensee analysis[1/] of inadvertent ECC actuation indicates that the maximum ECC flow rate (100 gpm), injected as a spray from above the core, does not enter the active core length under either full recirculation flow or minimum[2/] recirculation flow conditions. The licensee calculates the following average flow rates per fuel assembly:

	Maximum Recirc. Oper.	Minimum Recirc. Oper.
Recirculation flow	143,000 lb/hr	43,000 lb/hr
Core exit velocity	11.8 fps	3.6 fps
Recirculation mass velocity	17,000 lb/min-ft^2	5,300 lb/min-ft^2

These values are based upon a core exit quality of 0.06; the minimum flow case is prorated directly from the maximum flow case assuming negligible changes in thermodynamic variables.

The licensee calculates ECC downward flow rates and velocities (average per assembly at 100 gpm total flow) of approximately 1.39 gpm and 0.04 fps and mass velocity of 134 lb/min-ft^2. These values represent a limiting case pertaining to the location at which any ECC downward flows could have just entered the top of the fuel assembly shroud (where applicable flow area is reduced by pin cross-sections), but not yet reached the active core length. The licensee concludes that the large (average) flow ratios at this point prevent the ECC from ever reaching the active core length and that ECC flows reverse direction and can enter the core only via a bottom inlet recirculation mode.

1/ See Reference 1.

2/ A GE analysis (Ref. 2) of Allen's Creek Unit No. 1 indicates that, for a narrow range of low power levels, increased radioactivity insertion from ECC actuation can be maximized (vs. decreased reactivity effects which could occur at high power levels).

NRC staff review concludes that the applicant flow analysis is essentially valid. Although the analysis considered only average flow rates per assembly, the maximum ECC nozzle flow rate (i.e., for the maximum power channels) would locally reduce the large flow ratios by only 25% and ECC flow reversal would still occur under both maximum and minimum recirculation flow conditions. In addition, the licensee assumption of no change in thermodynamic variables for prorating the maximum recirculation flow case to estimate the minimum flow case results in conservative (i.e., lesser) upward flow rates.

The licensee separately analyzed the transients resulting from an uncontrolled feedwater event[3/] for the case of operation at 102% of full power. In this event, feedwater flow increases to the maximum flow available from both pumps (2800 gpm) vs. normal operation with only one pump (1300 gpm) in approximately 3 seconds. The reactor scrams at 120% of full power, peak power occurs at approximately 180% of full power and power decays to zero at approximately 12 seconds. The CPR[4/] remains above 1.32 and no damage to the core results.

In the licensee analysis of this feedwater event, no credit is taken for the first scram signal in order to account for the additional single failure criterion requirements of the Standard Review Plan (15.1.1.II.C.2.d). The normal first scram signal is the "unsafe power to flow ratio" scram; this would ordinarily occur at 115% power.

3/ See Reference 3.

4/ The CPR criterion is based on Exxon XN-2 critical heat flux correlation, Ref. 4, Supplement 3, Part II.

Since maximum inadvertent ECC flow rates (100 gpm) are substantially lower than maximum uncontrolled feedwater flows (2800 gpm), the licensee concludes that the potential for increased inlet subcooling is much less in the ECC event and hence any ECC-initiated transient would be bounded by the uncontrolled feedwater event transient.

The staff concludes that the licensee conclusion that the uncontrolled feedwater flow event will bound the inadvertent ECC actuation event is appropriate.

The licensee analysis also states that the ECC event will not cause unacceptable fuel damage since reactor pressure vessel relief valve set points (at 1390 and 1426 psig) are significantly less than the levels required to collapse free standing fuel cladding.

The staff concludes that the licensee conclusion that no damage will occur to the core as a result of core cladding collapse caused by an ECC transient is valid. Cladding is 20 to 22 mils thick stainless steel and collapse pressures are approximately 2450 psig. Reactor vessel safety valves are set at no higher than 105% of design pressure (1400 psig). Consequently, no cladding collapse would occur.

VI. CONCLUSIONS

The consequences of inadvertent ECC actuation in the LaCrosse Boiling Water Reactor have been evaluated. This event is bounded by transients produced by uncontrolled feedwater addition which is being analyzed separately under SEP Topic XV-1.

REFERENCES

1. August 25, 1981 letter from F. Linder (DPC) to D. Eisenhut (NRC), Subject: Dairyland Power Cooperative LaCrosse Boiling Water Reactor (LACBWR) Provisional Operating License No. DPR-45 SEP Topic XV-9, Startup of Recirculation Loop at Incorrect Temperature and SEP Topic XV-14, Inadvertent Operation of ECCS (LAC-7756).

2. Docket 50-466, Testimony of Eugene C. Eckert on behalf of Houston Lighting and Power Company on Doherty Contention 7--LPCI Cold Slug, dated April 20, 1981.

3. Licensee document: LaCrosse Boiling Water Reactor, SEP Safety Evaluation Report, Topic XV-1, Decrease in Feedwater Temperature, in Increase Feedwater Flow, and Increase in Steam Flow, dated March 5, 1982 (LAC-8138).

4. February 25, 1977 letter J. P. Madgett (DPC) to R. W. Reid (NRC), Subject: Dairyland Power Cooperative LACBWR Provisional Operating License to DRP-45, Application for Amendment to License.