November 13, 1981

Docket No. 50-409
LS05-81-11-018

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

Dear Mr. Linder:

SUBJECT: LACROSSE - SEP TOPIC XV-3, LOSS OF EXTERNAL LOAD, TURBINE TRIP, LOSS OF CONDENSER VACUUM, CLOSURE OF MAIN STEAM ISOLATION VALVE, STEAM PRESSURE REGULATOR FAILURE (CLOSED)

In your letter dated June 26, 1981 (LAC-7632) 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, which completes this topic for the LaCrosse Boiling Water Reactor (LACBWR).

The enclosed safety evaluation will be a basic input to the integrated safety assessment for 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.

Sincerely,

Dennis M. Crutchfield, Chief
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Division of Licensing

Enclosure:
As stated

cc w/enclosure:
See next page

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LACROSSE BOILING WATER REACTOR
(LACBWR)

TOPIC: XV-3, LOSS OF EXTERNAL LOAD, TURBINE TRIP, LOSS OF CONDENSER VACUUM, CLOSURE OF MAIN STEAM ISOLATION VALVE (BWR), AND STEAM PRESSURE REGULATORY FAILURE (CLOSED)

I. INTRODUCTION

The events considered in this topic involve a decrease in secondary heat removal. This decrease can cause a sudden increase in reactor pressure.

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.

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 occurrence.

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 during normal operation, including the effects of anticipated operational occurrence.

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 GUIDELINES

The review is conducted in accordance with SRP 15.2.1, 15.2.2, 15.2.3, 15.2.4, (BWR only) and 15.2.5.

V. INDIVIDUAL EVENT EVALUATIONS

Loss of External Load

A. Introduction

A loss of external load can result from the opening of electrical circuit breakers or other external electrical malfunctions. This loss of load to the generator results in the turbine accelerating toward the overspeed trip point. The turbine inlet valves close down rapidly due to the speed governor, attempting to control turbine speed at approximately 105% of rated speed, causing reactor pressure to increase. The sudden increase in pressure causes a high flux scram to occur if the initial power level is greater than 60% power. The overspeed trip on the turbine occurs a short time later (within a few seconds) and causes the turbine stop valve to close, which causes a scram signal to some of the control rods.

The increase in reactor pressure causes the main steam bypass valve to automatically actuate to maintain pressure. Following the scram, the main steam bypass valve continues to operate at intermittent intervals until the pressure begins to decay slowly due to heat losses from the primary purification system, steam to the gland steam generator and air ejectors.

The Dairyland Power Cooperative (DPC) presented an analysis of the loss of external load transient, dated 2/28/74, in Volume 3 of the Application for an Operating License (Ref. 1). The results of a reanalysis of this transient are given in a report to NRC dated 2/25/77 (Ref. 2).

B. Evaluation

The loss of load transient is bounded by the turbine trip event. Reactor scram is initiated directly by signals from closure of the turbine control valves. During the loss of load transient the steam flow to the turbine is interrupted by closure of the turbine control valves, while for the turbine trip transient the flow is interrupted by closure of the stop valves which is more rapid than control valve closure. Thus the transient during loss of load is less severe than the turbine trip transient.

C. Conclusions

As part of the SEP review for LaCrosse we have evaluated the licensee's analysis of loss of external load (Ref. 2) against the criteria for SRP Section 15.2.1. Ba ed on this evaluation we have concluded that this transient is bounded by the turbine trip event which has been evaluated and found in conformance with the criteria of SRP Section 15.2.1.

Turbine Trip

A. Introduction

A turbine trip is actuated by fast closure of the turbine stop valves which abruptly interrupt steam flow to the turbine. Independent of the cause, a turbine trip is followed by a reactor scram initiated directly by turbine stop valve position switches.

The effect of turbine trip is rapid increase in pressure in the steam es and reactor vessel.

presented an analysis of the turbine trip transient, dated 2/28/74, Volume 3 of the Application for an Operating License (Ref. 1). his analysis goes beyond the requirements of SRP Section 15.2.1 in assuming the control rods fail to insert upon the receipt of the scram signal, i.e., an ATWS. Since NRC's criteria are different for ATWS events, the turbine trip transient was reanalyzed and the results are given in a report to NRC dated 2/18/77 (Ref. 3).

B. Evaluation

In the 2/28/74 analysis (Ref. 1), which was done as an Anticipated Transient Without Scram, it was assumed that the reactor was at 100% power at the time of the turbine trip and the control rods did not move in during the transient. The results of this analysis, assuming operation of the turbine bypass and relief systems, indicated that the pressure peaks at about 1315 psia which is below the design pressure of 1400 psig.

In the 2/18/77 analysis (Ref. 3) it was assumed that the reactor was at 102% power at the time of the turbine trip and that the reactor was operating at the end of the fuel cycle at which time the delayed neutron fraction was calculated to be .0055. A value of 20 microseconds was used for the neutron lifetime. The results of this analysis showed that the pressure increase was less than 40 psi and that minimum critical power ratio (MCPR) stayed above 1.32, which is the established CPR criterion based on the Exxon XN-2 critical heat flux correlation which was approved by the NRC on 6/23/76 (Ref. 4).

Furthermore, the results of analyses which assume that the turbine bypass is unavailable indicated that pressure peaks at about 1365 psia and that the MCPR stayed above 1.32. This peak pressure of 1365 psia is still below the design pressure of 1400 psig.

C. Conclusions

As part of the SEP review for LaCrosse we have evaluated the licensee's analysis of the turbine trip event (Ref. 3) against the criteria of SRP Section 15.2.1. Based on this evaluation we have concluded that the analyses performed adequately bound the turbine trip analysis as required by SRP Section 15.2.1. We therefore, find the results of the turbine trip analyses acceptable.

Loss of Condenser Vacuum

A Introduction

the extreme case of sudden loss of condenser vacuum the transient uld be identical to the turbine trip transient with failure of bypass. e most limiting single failure during the transient would be a relief valve failure to open.

The licensee has not presented an analysis of loss of condenser vacuum, but has referenced the results of turbine trip transients (Ref. 3).

B. Evaluation

The worst case loss of condenser vacuum transient is identical to the turbine trip transient with failure to bypass. However, since loss of condenser vacuum results in a loss of bypass, an additional single failure should be assumed to satisfy the SRP 15.2.1, section II acceptance criterion 2d.

The most limiting single failure that could produce the highest peak ressure is a relief valve failure to open. However, this event is unded by the turbine trip analysis performed assuming the turbine ass and relief valves are not available. A relief valve failure to n would not influence the minimum MCHFR because this minimum is atned before any of the relief valves opens.

C. Conclusions

As part of the SEP review for LaCrosse we have evaluated the licensee's analysis of loss of condenser vacuum (Ref. 5) against the criteria of SRP Section 15.2.1. Based on this evaluation we have concluded that this transient is bounded by the turbine trip event which has been evaluated and found in conformance with the criteria of SRP Section 15.2.1.

Closure of Main Steam Isolation Valve

A. Introduction

Inadvertent closure of the main steam isolation valves results in loss of the steam removal path from the reactor to the turbine and may cause vessel overpressurization. A full scram signal is initiated when the main steam isolation valve leaves the open position.

The licensee has analyzed (Ref. 5) closure of the main steam isolation valve with the following initial conditions and assumptions:

1) The reactor is initially operating at 102% of rated power.

2) The Main Steam Line Isolation Valve closes in 6.5 seconds.

3) No credit is taken for the reactor scram and shutdown condenser operation caused by the MSIV closure.

4) The reactor is operating at the end of a fuel cycle.

5) When the reactor scrams due to 102% overpower recirculation flow is cut back to 80% of full power.

6) Operation of the shutdown condenser is initiated when reactor pressure is greater than 1.5 psig.

B. Evaluation

The closure of the main steam isolation valve in 6.5 seconds results in a rise in reactor pressure which collapses voids in the core and causes a sharp increase in reactor power. Six and one-half seconds is a minimum value which causes the maximum pressure rise. Ten seconds is the time interval allowed by the Technical Specifications. At approximately 1.5 seconds, the reactor reaches 120% of full power and scrams. This causes the recirculation pumps to cut back to 80% of full flow which in turn reduces the reactor power. Reactor power continues to decay as the control rods are inserted. At approximately 6 seconds operation of the shutdown condenser is initiated by a reactor pressure of 1325 psia. The reactor pressure continues to increase to about 1365 psia. This is well below the limit (110%) of 1540 psig. The critical power ratio stays above the 1.32 limit.

C. Conclusion

The analysis on main steam isolation valve closure has been evaluated against the criteria of SRP 15.2.1 and we have concluded that it is in conformance with the criteria.

Steam Pressure Regulator Failure

A. Introduction

In case of a steam pressure regulator failure in the direction of decreasing flow the turbine control valve starts to close. This causes an increase in reactor pressure to the setpoint of the main steam bypass valve which opens to limit the increase in pressure. As the bypass valve opens the generator output goes down until the reverse power relay actuates to open the output breaker and close the turbine stop valve. This results in a partial scram.

B. Evaluation

The event induces a very mild transient on the plant (Ref. 5). In the case of the most limiting single failure the transient is bounded by the turbine trip analyses.

C. Conclusions

Steam pressure regulator failure is not as limiting as the turbine trip transient and a quantitative analysis of its consequences is not needed.

VI. TOPIC CONCLUSIONS

For each of the events included in this topic, the staff has determined either that the event is bounded by another event, or that the analysis provided is in compliance with the criteria. Therefore, this topic is complete.

REFERENCES

1. Gulf Nuclear Project 3431 for DPC; Anticipated Transients Without Scram at the LaCrosse Boiling Water Reactor; February 28, 1974; page 3-3

2. Letter for J. P. Madgett of DPC to R. W. Reid of NRC entitled DAIRYLAND POWER COOPERATIVE LACROSSE BOILING WATER REACTOR PROVISIONAL OPERATING LICENSE NO. DPR-45 APPLICATION FOR AMENDMENT TO LICENSE dated February 25, 1977.

3. Nuclear Energy Services, Inc. report for DPC; Responses to Question 4 Transient Analysis for LACBWR Reload Fuel; February 18, 1977.

4. Letter from G. Lear of NRC to W. Nechodon of Exxon Nuclear Power Company, on Topical Report Evaluation, June 23, 1976.

5. Letter from Frank Linder of DPC to D. G. Eisenhut of NRC; DAIRYLAND POWER COOPERATIVE LACROSSE BOILING WATER REACTOR (LACBWR) PROVISIONAL OPERATING LICENSE NO. DPR-45 SEP TOPIC XV-3 - LOSS OF EXTERNAL LOAD, TURBINE TRIP LOSS OF CONDENSER VACUUM, CLOSURE OF MSIV & STEAM PRESSURE REGULATING FAILURE, AND SEP TOPIC XV-4 - LOSS OF NON-EMERGENCY AC POWER TO THE STATION AUXILIARIES; June 26, 1981.