SAFETY EVALUATION BY THE

OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 17

TO LICENSE NPF-9

DUKE POWER COMPANY

PART A: Dilution of Boron Concentration in the Boron Injection Tank

PART B: Containment Upper Compartment Temperature

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SAFETY EVALUATION REPORT

DILUTION OF BORON CONCENTRATION IN THE BORON INJECTION TANK

McGUIRE NUCLEAR STATION UNIT 1

BACKGROUND

Westinghouse has incorporated a Boron Injection Tank, containing a highly concentrated boron solution (20000 ppm), into their nuclear steam supply system design to meet the requirements of the Standard Review Plan Section 15.1.5, "Steam System Piping Failures Inside and Outside of Containment (PWR)." The acceptance criteria for this event seek assurances that the capability to cool the core is maintained and that the resulting offsite dosage complies with the requirements set forth in 10 CFR 100. For postulated steam line break events, a potential for return to criticality exists as the moderator temperature decreases. The Boron Injection Tank (BIT) was specifically designed to mitigate the consequences of this event with the high-head safety injection system (HHSI) by purging the highly concentrated boron solution (20,000 ppm) into the primary system.

Experience with the BIT has placed excessive maintenance requirements upon the plant operators and technicians. As a result, the licensee has proposed to reduce the BIT boron concentration, remove the heat tracing, and change the boron injection system technical specification. (Ref. 1).

EVALUATION

The BIT was designed to mitigate the consequences of postulated steam line break events. During these events, the high head safety injection pumps automatically align to discharge through the BIT, which contains 900 gallons of highly concentrated boric acid solution (20,000 ppm). This solution is then flushed into the primary system to assure adequate shutdown reactivity. The current requirement for a high boron concentration in the BIT was a result of conservatism in the previous safety analysis. To justify the reduction in BIT boron concentration, the licensee reanalyzed the following events assuming a BIT concentration of only 2000 ppm boron: (i) rupture of a main steam line, (ii) accidental depressurization of the main steam system, and (iii) inadvertent operation of the ECCS during power (Ref. 1).

The steam line rupture accident was analyzed with the assumption of a stuck RCCA, with or without offsite power, a single failure in the safety injection system and a break area of 1.4 ft^2, (i.e., the flow restrictor area). The LOFTRAN code had been used to calculate the core heat flux and RCS temperature and pressure. The

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minimum DNBR was calculated from the THINC code. The results indicated that the reactor returned to power and the maximum heat flux was 19.9% of the design value, the maximum RCS pressure was 1303 psia, well below the 110% design pressure. With regard to the DNBR, the licensee, in a letter dated April 19, 1982, (Ref. 2) responded to our request for additional information and indicated that the DNBR evaluated shows the same general trend as the plot of DNBR vs. time in WCAP-9225 (Steamline Break Topical Report) for similar plant types. The DNBR did not decrease below 1.3.

The event of accidental depressurization of the main steam system was analyzed with the LOFTRAN code assuming a stuck RCCA, with or without offsite power, and a single failure in the Engineered Safety Features. The case analyzed was a steam flow of 248 lbs/sec at 1100 psia from one steam generator with offsite power available. The steam flow rate was the maximum capacity of any single steam dump, relief or safety valve. The results indicated that with one charging pump in operation supplying a boron solution at 2000 ppm to the RCS, sufficient negative reactivity was provided to prevent the reactor from returning to power. Although only five state points were evaluated, the licensee stated that the DNBR showed the same general trend as the main steam line break event and did not fall below the value of 1.3. This event is less limiting than the steam line rupture accident.

The inadvertent operation of ECCS during the power operation event was analyzed with the digital computer program LOFTRAN assuming initial reactor power at 102%, and a low absolute value of the Doppler Power coefficient. The licensee stated that because of the power and temperature reduction during the transient, operating conditions did not approach the core limits and the results were relatively independent of time to reactor trip. The licensee further stated that spurious safety injection with or without reactor trip would not affect the integrity of the reactor coolant system. The DNBR was always greater than the initial value of 1.62.

With regard to the deletion of the Technical Specification on heat tracing for the BIT, the licensee stated that the current requirement for heat tracing was due to high boron concentration in the BIT and associated piping. Reduction of boron concentration to less than 4000 ppm would eliminate the need for heat tracing. Heat tracing would be required for boron concentration above 4 weight percent, corresponding to approximately 7000 ppm.

CONCLUSION

The staff has reviewed Duke Power Company's submittal for dilution of boron concentration in the BIT and related Technical Specification changes for McGuire Nuclear

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Station Unit 1. The supporting analysis demonstrated compliance to Sections 15.1.1, 15.1.2, 15.1.3, 15.1.4, 15.1.5, 15.5.1, and 15.5.2 of the Standard Review Plan, while assuming 2000 ppm boron concentration in the BIT.

The analytical methodology (i.e., use of LOFTRAN) for evaluating the accident events discussed previously is presently undergoing staff review. Our review at this time indicates reasonable assurance that the conclusions based on the licensee's submittal will not be appreciably changed by completion of review. Although limited clad perforation following a steam line break event is permitted by the SRP, the licensee has demonstrated that no clad perforation is calculated to occur. Therefore, there exists adequate margin of safety to acceptable limits as specified in the SRP. Moreover, we conclude that because the acceptance criterion of a DNBR greater than 1.3 is met both for the low and high boron concentration, the safety margin has not been significantly reduced. Based on our review of the licensee's evaluation, the staff concludes that the licensee's proposed Technical Specification modifications to reduce the allowable boron concentration and remove the heat tracing for the BIT are acceptable.

REFERENCE

1. Letter to H. R. Denton from W. O. Parker, McGuire Nuclear Station Unit 1, Docket No. 50-369, Proposed Amendment to License NPF-9, March 2, 1982.

2. Letter to H. R. Denton from W. O. Parker, McGuire Nuclear Station Unit 1, Docket No. 50-369, Proposed Amendment to License NPF-9, April 19, 1982.

SAFETY EVALUATION REPORT

CONTAINMENT UPPER COMPARTMENT TEMPERATURE

McGUIRE STATION UNIT 1

BACKGROUND

The McGuire Nuclear Station utilizes an ice condenser as a pressure mitigating system in containment. As shown on the attached figure the McGuire containment is physically divided into an upper and lower compartment. The barrier is designed to prevent steam from bypassing the ice condenser in the event of a postulated pipe rupture. Thus steam emanating from either a loss of coolant accident or a main steam line break inside containment will be forced to flow through the ice baskets which are located along the containment's perimeter. Since the steam resulting from a pipe break is largely condensed in the ice condenser, the containment internal design pressure is only 15 psig.

The air temperature inside containment is closely monitored during operating modes 1, 2, 3 and 4. The containment peak pressure analyses in the FSAR assumes a minimum upper compartment temperature of 75°F and a minimum lower compartment temperature of 100°F. These minimum temperatures maximize the initial mass of air in containment. The initial mass of air is important in calculating the limiting containment internal pressure.

McGuire Unit 1 was shut down for most of December 1981 due to repairs of the main turbine. No heat was generated in the Reactor Building during this time, and thus the cold weather was able to slowly cool the building. Also, the equipment hatch to the outside was briefly opened to allow some equipment to be taken into containment. Due to the great amount of thermal mass in the reactor building, it took a period of time for the cold to affect the temperature in containment. When the licensee attempted to bring the Unit back to power in early January 1982, the upper compartment average temperature fell below the minimum allowable. Technical Specification 3.6.1.5 conservatively requires a minimum upper compartment temperature of 85°F and a minimum lower compartment temperature of 100°F.

When the average temperature in containment began reaching the lower limit and after it dropped below the limit, the temperature was increased by using the H_2 recombiner heaters. On January 1 and 2, 1982 the hyrdogen recombiners were operated four separate times in order to increase the upper compartment temperature above the minimum valve of 85°F (see LER 82-03, Reference 1).

On March 2, 1982, the licensee submitted a proposed Technical Specification change to lower the minimum upper compartment temperature from 85°F to 75°F.

EVALUATION

Due to the ice condenser system the McGuire containment is only designed to 15.0 psig. The peak calculated containment pressure is 14.8 psig. This calculation was performed using the Westinghouse LOTIC-3 computer code which has been reviewed and found to be acceptable by the staff.

As stated previously the initial mass of air in containment can have a significant affect on the peak pressure transient calculation. This is particularly true for small containments incorporating low design pressures. By placing a technical specification limit on the minimum operating temperature, the initial mass of air present in containment is limited. If a large pipe break is postulated inside containment, the containment pressure is increased by both the partial pressure of steam and the partial pressure of air as it is heated and expands.

The upper and lower compartment temperature limits are not standard for all ice condensers and are calculated on a plant specific bases. Generally speaking, plants that have a small margin between the peak calculated and design pressure for containment must maintain a relatively high minimum operating temperature in order to reduce the partial pressure of air. This can be seen in the cases of McGuire and Sequoyah in the table below. Bounding calculations using the ideal gas law show that both the McGuire and Sequoyah peak calculated pressures inside containment would approach design conditions if the minimum operating temperatures were lowered by approximately 10°F. Conversely, plants with a relatively large margin between calculated and design pressures such as D.C. Cook are able to operate with lower initial containment temperatures.

	D.C. Cook	Sequoyah	McGuire
Containment Design Pressure (psig)	12.0	12.0	15.0
Calculated Containment Pressure (psig)	9.4	11.8	14.8
Upper Compartment Temp. Range (°F)	60-100	85-110	75*-100
Lower Compartment Temp. Range (°F)	60-120	100-120	100-120

*Proposed

Since the limiting containment pressure calculations found in the McGuire FSAR consistently assume 75°F as the minimum upper compartment temperature, there is no loss of margin between the proposed technical specification and that found acceptable in the staff's Safety Evaluation Report. The current value of 85°F found in the McGuire Technical Specifications is unnecessarily conservative and has no apparent basis.

In addition, during the course of our review, we realized that McGuire's Technical Specification Bases section 3/4.6.1.5 inadvertently quotes the wrong peak calculated and design pressure for containment. These values have been corrected in the Bases.

CONCLUSION

Based on our review of the licensee's submittal, we conclude that the proposed Technical Specification change reducing the minimum average air temperature in the primary containment upper compartment from 85°F to 75°F does not have any adverse effect on safety of plant operation or the health and safety of the public.

The proposed Technical Specification 3.6.1.5 and the revised Bases section 3/4.6.1.5 is attached.

REFERENCES

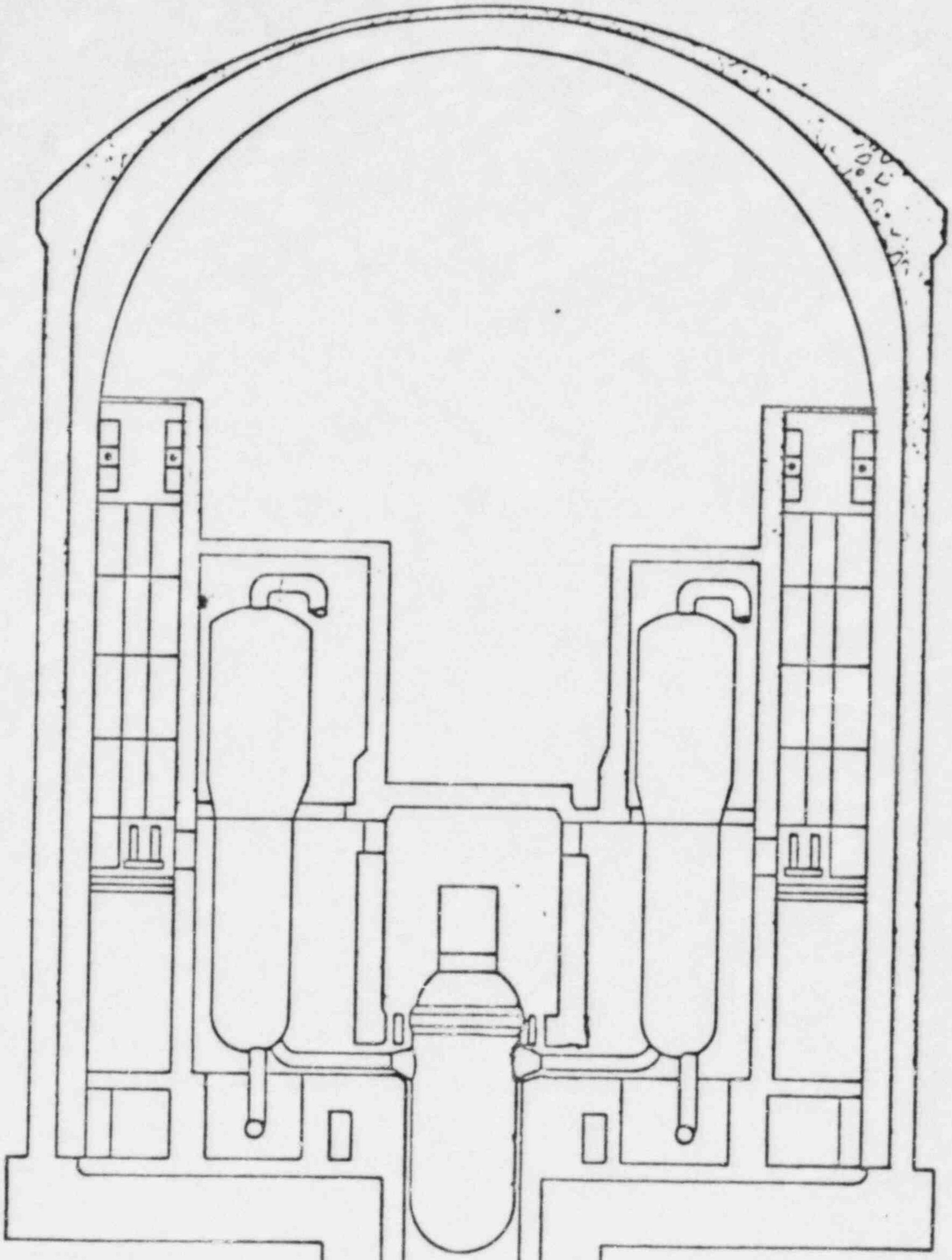
1. Letter from Duke Power Company to NRC Region II (William O. Parker to James P. O'Reilly) dated February 1, 1982. Includes Reportable Occurrence Report RO-369/82-03.

2. Letter from Duke Power Company to NRC (William O. Parker to Harold R. Denton) dated March 2, 1982.

3. McGuire Nuclear Station FSAR, Chapter 6 and Technical Specifications.

4. D.C. Cook Technical Specifications.

5. Sequoyah Technical Specifications.



McGUIRE NUCLEAR STATION

ENVIRONMENTAL CONSIDERATION

We have determined that the amendment does not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendment involves an action which is insignificant from the standpoint of environmental impact and, pursuant to 10 CFR Section 51.5(d)(4), that an environmental impact statement or negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of this amendment.

CONCLUSION

We have concluded, based on the consideration discussed above, that: (1) because the amendment does not involve a significant increase in the probability or consequences of accidents previously considered, does not create the possibility of an accident of a type different from any evaluated previously and does not involve a significant decrease in a safety margin, the amendment does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Date: October 14, 1982

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