UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

EVALUATION OF CORE SPRAY PIPING WELD

COOPER NUCLEAR STATION

NEBRASKA PUBLIC POWER DISTRICT

DOCKET NO. 50-298

1.0 BACKGROUND

By letter dated November 22, 1995 (Reference 1), Nebraska Public Power District (District), the licensee, submitted flaw evaluations of three indications in the core spray piping. These indications were identified through in-vessel inspection activities performed during the fall 1995 refueling outage at Cooper Nuclear Station (CNS). Two of the indications were discovered on the thermal sleeve of Loop A and one indication was near the tee box of Loop B. These indications were in the heat affected zone (HAZ) of weld numbers A-1, A-21, and B-12, respectively.

By letter dated December 21, 1995 (Reference 2), the Nuclear Regulatory Commission (NRC) staff issued a safety evaluation which concluded that the final flaw sizes at the end of the next fuel cycle will not exceed the Code allowable flaw length, and that CNS can be safely operated for the next fuel cycle without repairing the subject flawed welds. The staff also concluded that continued plant operation beyond next fuel cycle should be supported by the results of reinspection and re-evaluation of the indications in accordance with the Code.

By letter dated May 7, 1997 (Reference 3), the District provided the results of the visual re-examination performed during the 1997 refueling outage. The examinations did not identify any change in length in the two indications on Loop A and the third indication on Loop B could not be located after cleaning. Since no flaws were identified in the area of Loop B weld #12, this indication was considered to be non-relevant by the licensee. By letter dated May 9, 1997 (Reference 4), the NRC staff reviewed the May 7, 1997 letter, and concluded that the previous analyses and assumptions accepted in the staff's letter dated December 21, 1995, remains applicable to the current indications. This conclusion was based on the limited crack growth observed over the past cycle. Again the staff concluded that the flaw sizes at the end of the next fuel cycle will not exceed the Code allowable flaw length, and that CNS can be safely operated for the next fuel cycle without repairing the flaws in the area of A1 and A21 welds. Plant operation beyond the next fuel cycle should again be supported by the results of reinspection and re-evaluation of the indications.

By letter dated November 6, 1998 (Reference 5), the District provided the results of the examination of the two flaw indications on the core spray piping. These examinations were performed during the 1998 refueling outage (RFO 18). The District requested that the NRC staff concur with the licensee's conclusions that CNS can be operated safely for an additional

ENCLOSURE

cycle (Cycle 19) without repairing the flawed core spray piping welds based on the results of the examination. The District has concluded that it is safe to operate CNS for one additional cycle without repairing based on adequate structural integrity margin, acceptable loose parts evaluation, adequate core spray flow, and monitoring industry developments for improved examination techniques and repair technologies.

2.0 EVALUATION

2.1 FLAW EVALUATION

The staff accepted the licensee's 1995 and 1997 evaluations because (1) the licensee used the bounding crack growth rate of $5X10^{-5}$ inch/hour, (2) the licensee employed the methodologies and the acceptance criteria specified in IWB-3640 and Appendix C of the American Society of Mechanical Engineers (ASME) Code, and (3) the predicted crack length at the end of the next fuel cycle is less than the allowable crack length. The detected flaw lengths reported in 1997 were 5.6 inches for the flaw in weld A-21 and 9.1 inches for the flaw in weld A-1. The allowable flaw length reported in 1997 for both flaws were 11.8 inches. The licensee reported in this submittal the results of the second reexamination conducted in the 1998 outage: 5.6 inches (zero growth) for the flaw in weld A-21 and 9.5 inches (0.4-inch growth) for the flaw in weld A-1. Again, the growth is much less than the 1.2 inches per cycle based on the bounding growth rate. Adding 1.2 inches to the detected flaw lengths of 5.6 and 9.5 inches would result in predicted flaw lengths of 6.8 and 10.7 inches at the end of the next fuel cycle, which are still less than the allowable flaw length of 11.8 inches. Hence, the staff determined that the Unit can be operated without repair of the subject indications for one more cycle.

2.2 FLOW EVALUATION

The District's evaluation of the effect of potential leakage through the crack indications assumed a through-wall crack with a length equal to the maximum predicted flaw size of 13.3 inches and a width of 10 mils. The staff notes that the maximum predicted flaw size of 13.3 inches is based on the revised fracture mechanics evaluation which was provided by the licensee to support continued operation through Cycles 20 and 21. The revised fracture mechanics evaluation is not being reviewed in this safety evaluation, however, the staff concludes that it is conservative to use the maximum predicted flaw length for the leakage evaluation. The leakage calculation also considered the unrelated leakage from the T-box vent holes associated with the Loop A core spray piping/core shroud penetrations. The sum of all the potential leakage from the Loop A indications and the Loop A T-box was calculated to be 77.8 gpm. Although this leakage is not significant with regards to total core spray flow, reduction of core spray heat transfer capability due to the leakage must be considered.

The District considered the decrease in core spray flow during the design basis accident (DBA) loss of coolant accident (LOCA). Recently, CNS implemented the SAFER/GESTR LOCA analysis which was reviewed by the NRC staff by letter dated September 23, 1997 (Reference 6). For the upcoming fuel cycle, Cycle 19, the calculated Appendix K peak clad temperature (PCT) is 1075 degrees Fahrenheit and the upper bound PCT is 1460 degrees Fahrenheit. Based on these PCT values, the staff concludes that the calculated core spray leakage will not impact the core spray heat transfer capability. The design PCT for the most limiting DBA LOCA

is 2200 degrees Fahrenheit at a Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) of 14.0 kW/ft. For Cycle 19, the limiting value MAPLHGR is 12.91 kW/ft which is bounded by the value used in the SAFER/GESTR LOCA analysis. Therefore, MAPLHGR is not limited by LOCA or ECCS considerations. Based on these analyses, the staff has concluded that Cycle 19 meets the requirements of 10 CFR 50.46 with the calculated core spray leakage, and therefore, is acceptable.

3.0 CONCLUSION

The staff has reviewed the evaluation of the potential impacts of postulated cracks in the core spray Loop A at CNS. The staff has concluded that operation during Cycle 19 is acceptable with the two indication that were re-examined during RFO 18. The staff's decision is based on: 1) the licensee's flaw evaluation is consistent with its evaluation of 1995 based on fracture mechanics, 2) the predicted flaw lengths at the end of the next fuel cycle is less than the allowable flaw lengths, and 3) the licensee's calculated core spray leakage meets the requirements of 10 CFR 50.46. Thus, reasonable assurance has been provided regarding the structural integrity of the subject core spray piping weld and core spray heat transfer capability with the leakage.

The District has requested review and approval of a new fracture mechanics evaluation which would be applicable to Cycles 20 and 21. That review has not been completed at this time. Until that review has been approved by the NRC staff, the staff concludes that continued operation beyond Cycle 19 without a repair or replacement of the core spray piping should be supported by the results of reinspection and re-evaluation of the indications in accordance with the Code.

4.0 REFERENCES

1. Mueller, J.H., (NPPD), to USNRC, "IE Bulletin 80-13 Response; Visual Inspection of Core Spray Spargers," November 22, 1995.

2. Hall, J.R., USNRC, to G.R. Horn (NPPD), "Cooper Nuclear Station - Evaluation of Core Spray Piping Indications (TAC No. M94097)," December 21, 1995.

3. Graham, P.D., (NPPD), to USNRC, "Inspection of Core Spray Spargers and Piping Cooper Nuclear Station, NRC Docket 50-298, DPR-46," May 7, 1997.

4. Hall, J.R., USNRC, to G.R. Horn (NPPD), "Cooper Nuclear Station - Evaluation of Core Spray Piping Indications During Refueling Outage 17 (TAC No. M95141)," May 9, 1997.

5. Swailes, J.H., (NPPD), to USNRC, "Inspection of Reactor Vessel Internal Core Spray Piping Cooper Nuclear Station, NRC Docket 50-298, DPR-46," November 6, 1998.

6. Hall, J.R., USNRC, to G.R. Horn, (NPPD), "Safety Evaluation by the Office of Nuclear Reactor Regulation Relating to the Use of SAFER/GESTR-LOCA Analysis Nebraska Public Power District Cooper Nuclear Station," September 23, 1997.

Principal Contributor: K. Kavanagh

Date: November 23, 1998