



UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

UNION ELECTRIC COMPANY
CALLAWAY PLANT, UNIT 1
DOCKET NO. STN 50-483

INTRODUCTION

During head disassembly at the beginning of Refuel II, some difficulty in removing studs was encountered. Five of the 54 vessel head studs were not removed during the outage. One of these five, stud no. 2, remains in a partially inserted position such that complete tensioning of the stud is not feasible. The other four studs (nos. 4, 5, 7 and 9) became stuck almost immediately when attempts were made to turn them out. These studs have been left in their stuck positions, with varying degrees of disengagement from the normal installation position.

EVALUATION

Responding to the above stud removal problems, the licensee has undergone a series of short-term corrective actions. Included were cleaning, inspections, and rework of all reactor vessel studs and accessible stud holes. The procedures for reinserting reactor vessel studs have also been revised to incorporate recommendations from Combustion Engineering and Westinghouse concerning installation, lubrication and tensioning in order to reduce the potential for any additional head closure problems in subsequent refuelings. These procedures, as detailed in the licensee's submittal of October 29, 1987, are an improvement over the original ones and are acceptable to the staff.

The licensee evaluated the amount of thread damage which could have been sustained by studs nos. 4, 5, 7 and 9 during removal efforts. The October 29, 1987 submittal reports that the calculation shows a maximum predicted thread damage of 2.6 threads. Assuming this damage and the maximum known stud disengagement, the minimum required thread engagement criteria are found to be met with margin remaining, and this justifies continued use of studs nos. 4, 5, 7 and 9. This has been independently confirmed by the licensee in the earlier results of the stud tensioning program, as documented in the Callaway Plant Mechanical Preventive Maintenance Procedure, MPM-BB-QR16, Rev 3.

The licensee also calculated the O-ring relaxation resulting from one, two and three adjacent studs. It was determined that leakage through the O-rings would not occur with one or two adjacent studs detensioned. Leakage past the O-rings is probable with three adjacent studs not tensioned. Such leakage would be detected, however, by an increase in temperature on the leak-off line from the annular space between the two O-rings. The increase in temperature, in turn, would be detected by installed temperature indicators and alarmed at 160°F in the plant control room. In addition, the leakage indication will also be based on an increase in reactor coolant system identified leakage greater than 0.5 pgm. The staff finds this leakage detection approach to be conservative and, therefore, acceptable.

Additionally, the licensee made calculations to determine that with stud no. 2 untensioned the resulting higher stresses in the remaining 53 studs still remain well below the code allowables. The licensee also performed analyses to determine the stresses on stud bolt materials and head and flange materials for the following cases:

- (1) Number 2 stud untensioned and no. 1 and no. 3 studs failing in service;
- (2) Number 2 stud untensioned and nos. 4, 5, 7, and 9 studs failing in service.

The results indicated that for both cases all material stresses for studs, vessels, and head would be within ASME Section III code allowables. It was also determined that, while O-ring leakage is probable for case no. 2, it would be detected as explained previously and the unit could be shut down in an orderly manner. The staff finds the results of the above licensee's investigation to be acceptable.

During refueling operations, the five stuck studs were encased in protective enclosures. In addition, a wet lay-up technique was used, using a 200 ppm concentration of hydrazine and demineralized water, to prevent boric acid exposure and rust formation. This technique has been successfully applied for the entire refueling operation and will be used to protect stud locations during all future refuelings.

Finally, the licensee has committed to the following actions related to the issue:

- (1) All 54 vessel head studs will be removed during Refuel III (the next refueling outage) using the technique evaluated to best address the Callaway Plant situation.
- (2) If, during operation, the vessel head inner O-ring exhibits leakage, the unit will be brought to hot standby within 6 hours and cold shutdown within the following 30 hours. Leakage indication will be based on receipt of an O-ring leak-off temperature alarm in the control room and an increase in reactor coolant system identified leakage greater than 0.5 gpm.

CONCLUSION

Based on these commitments and the evaluations made above, including justification for the continued use of studs nos. 4, 5, 7 and 9, the staff has determined that the issue of the reactor vessel head closure studs has been satisfactorily resolved by the licensee.

ACKNOWLEDGEMENT

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