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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATING TO AN APPLICATION TO UTILIZE AN ALTERNATIVE

TO THE REQUIREMENTS OF 10 CFR 50.55a

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION UNIT NO. 1

DOCKET NO. 50-220

FACILITY OPERATING LICENSE NO. DPR-63

INTRODUCTION

During the Nine Mile Point Unit 1 Spring 1984 Refueling and Maintenance Outage, leakage from several control rod drive (CRD) penetrations was observed. These penetrations were repaired by roll expanding the CRD housing into the reactor vessel wall in order to limit leakage. The repairs performed on the penetrations were reviewed by the staff in a Safety Evaluation dated June 29, 1984. The staff concluded that leakage from the penetrations did not represent a significant safety consideration.

During the Spring 1986 Refueling and Maintenance Outage, an additional CRD penetration was repaired by roll expanding, and two previously repaired penetrations were rolled above and below the previously rolled area to limit leakage resulting from joint relaxation. In August, another CRD penetration was found to be leaking and was repaired by roll expanding.

All the penetrations repaired in 1984 and 1986 successfully passed post repair pressure tests with no leakage. However, further joint relaxation could result in some leakage. In addition, it is possible that future roll repairs may not be as successful in limiting leakage.

By letter dated December 11, 1986, Niagara Mohawk requested approval to utilize an alternative to the requirements of 10CFR50.55a(g) as provided for by Section 50.55a(a)(3) in the case of hardship or unusual difficulties.

Section 50.55a(g) of the Regulations provides that components which are part of the coolant pressure boundary shall meet the requirements for Class 1 components of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI.

IWA 5250(a) requires that the source of leakage detected during a system pressure test be evaluated by the owner and appropriate repairs be made. Niagara Mohawk stated that the repair of the control rod drive penetrations in accordance with this paragraph would result in unusual difficulties without a compensating increase in the level of quality and safety. Niagara Mohawk has repaired the leaking CRD penetrations by roll expanding the control rod drive housing and has proposed criteria for allowable leakage from the CRD penetrations.

DISCUSSION

IWA 5250 of Section XI of the ASME Code requires that the source of leakage detected during the conduct of a pressure test on a system be located and evaluated by the owner for corrective measures and repair. However, an ASME Code acceptable repair of a cracked CRD penetration stub tube would require welding and a machining operation. The technology and tools to perform this repair do not exist or are highly developmental at present. A weld repair would require the installation of a dry caisson around the stub tubes in which to perform the welding and remote machining and welding equipment to fit within the constraints of the caisson.

Because of these constraints, the licensee implemented a program to address the problem of leakage associated with stub tube cracking. This program consists of the development of rolling tools and procedures to roll expand the CRD housing into the reactor vessel bore in order to limit leakage. This program also includes the development of mechanical seal concepts and prototypes that could be used in the event of relaxation and leaking of the rolled joint.

The rolling tool and procedures have been refined since the 1984 outage to improve their effectiveness. The length of the initial roll band has been increased to reduce the end effects that limit the effective roll length. Procedures and tests for increasing the wall thinning are also ongoing. The Electric Power Research Institute (EPRI) performed an evaluation of the metallurgical effects of the rolling and concluded that the susceptibility of the CRD to intergranular stress corrosion cracking is not increased as a result of rolling.

In the event that rerolling with increased wall thinning is not successful in reducing leakage to acceptable levels, the licensee would consider valving out the cooling water to the control rod drive. The increased contact pressure on the vessel wall due to the thermal expansion of the housing should reduce leakage. This has been demonstrated at a foreign plant.

Tables 1 and 2 give the stringent maximum allowable leakage constraints which, if exceeded, will trigger a contingency plan as follows:

If a control rod drive penetration exceeds the maximum leakage of 0.1 gpm after being rolled to 5-½% to 6-½% wall thinning or if more than five penetrations continue to leak after attempts at rolling, Niagara Mohawk will implement a contingency plan at the earliest possible refueling outage. Niagara Mohawk will submit its contingency plan for repair to the NRC for review and approval prior to implementation.

TABLE 1

CRD Penetrations
Allowable Leakage Rates

OUTAGES < 7 DAYS

CONDITION	ALLOWABLE LEAK RATES (1) 900-1200 PSIG	DEPRESSURIZED	REPAIR ACTIONS (4)
Previously Unrolled (2)	5 drops/sec	1 drop/sec	Roll Expand Over 4-1/2" Length
Rolled Once	50 drops/sec	10 drops/sec	Reroll With Increased Wall Thinning
Rerolled	0.1 GPM (3) 500 drops/sec	0.02 GPM (3) 100 drops/sec	Contingency Plan

NOTES:

(1) Leakage rates are based on a vessel internal pressure of approximately 1000 psig. The allowable leak rate when the vessel is depressurized is based on the square root of the pressure ratio between the test pressure and depressurized condition.

(2) Also applies to housings which have been previously roll expanded over a three-inch length.

(3) With 5 being the maximum number of leaking CRD stub tube penetrations.

(4) Repair action will be initiated if leak rates are in excess of the allowables specified above.

TABLE 2

CRD Penetrations
Allowable Leakage Rates

OUTAGES > 7 DAYS

CONDITION	ALLOWABLE LEAK RATES (1) 900-1200 PSIG	DEPRESSURIZED	REPAIR ACTIONS (5)
Previously Unrolled (3)	No evidence (2) of leakage	No evidence (2) of leakage	Roll Expand Over 4-1/2" Length
Rolled Once	5 drops/sec	1 drop/sec	Reroll With Increased Wall Thinning
Rerolled	0.1 GPM (4) 500 drops/sec	0.02 GPM (4) 100 drops/sec	Contingency Plan

NOTES:

(1) Leakage rates are based on a vessel internal pressure of approximately 1000 psig. The allowable leak rate when the vessel is depressurized is based on the square root of the pressure ratio between the test pressure and depressurized condition.

(2) Secondary signs of leakage, such as dried water stains or dried corrosion products around housings and penetrations, do not necessarily require corrective action. Repairs will be considered as part of preventive maintenance as long as the outage schedule permits.

(3) Also applies to housing which have been previously roll expanded over a three-inch length.

(4) With 5 being the maximum number of leaking CRD stub tube penetrations.

(5) Repair action will be initiated if leakage rates are in excess of the allowables specified above.

As possible contingency alternatives, the licensee has two types of mechanical seals under development. One type will leave the existing stub tube in place and seal against both the bottom vessel head and above the crack location in order to isolate the crack. The second type removes the existing stub tube and replaces it with a mechanical seal. This seal will also provide structural restraint for the CRD housing. A prototype has been fabricated and successfully hydrostatically tested at ambient temperature. Feasibility testing of the tooling for stub tube removal is currently underway. In addition, the licensee is continuing to pursue the development of the technology, tools and methods to perform weld repair of the control rod drive stud tube penetrations.

EVALUATION

The staff in its June 29, 1984, Safety Evaluation on the safety implications of stub tube cracks found limited leakage not to be a significant safety concern. This determination was based on:

1. The cracks are located in the stub tube base material, which is not considered part of the vessel reinforcement, and therefore, do not affect the structural integrity of the reactor vessel pressure boundary.

2. Stub tube cracks will not affect the ability of the CRD to perform its intended safety function (i.e. no adverse effect on the CRD operability or ability to scram).

3. A CRD housing ejection is not possible since the housing to stub tube J-weld is not damaged. The stub tube is loaded in compression and is not affected by cracks, and the steel CRD housing support structure beneath the vessel serves as a back-up.

In addition, the amount of allowable leakage from stub tube penetrations is within the capacity of the normal make-up systems. If leakage were to increase, it would be detected by using one of the three drywell unidentified leakage measuring systems.

- Level rate-of-rise in drywell floor drain tank (control room alarm and recorder, 0.25 gpm sensitivity)

- Pump-out timer (control room alarm and timer, sensitivity of 5 gpm in 18 minutes, 0.5 gpm in 180 minutes, etc.)

- Integrated flow to waste disposal is monitored.

Furthermore, the plant Technical Specifications limit the reactor coolant unidentified leakage to five gpm maximum and a two gpm increase in unidentified leakage in any twenty-four hour period.

In a submittal dated June 8, 1984, the licensee included an analysis of the maximum leakage from a postulated 360 degree circumferential through-wall stub tube crack. The maximum flow through the as-installed annulus between a stub tube penetration and an unrolled CRD housing was estimated to be a maximum of 120 gpm. The maximum flow from a roll repaired penetration should be significantly lower due to the elimination of this annulus.

CONCLUSIONS

The staff concludes that the proposed program provides an acceptable alternative to 10CFR50.55a(g) and Section XI of the ASME Code, paragraph IWA 5250(a)(2), for the following reasons:

1. Leakage from the CRD penetrations does not represent a adverse safety consideration.

2. The small amount of allowable leakage is well within the capacity of the normal makeup system.

3. Increased drywell leakage would be detected.

4. The proposed leakage criteria are supported by industry experience.

5. Leakage inspections will be performed.

6. The proposed leakage criteria provides sufficient time to complete the final development of the prototype mechanical seal and associated tooling and investigate other methods such as weld repair.

Based on the considerations discussed above, the staff concluded (1) that the proposed alternative program may be used in accordance with 10CFR50.55a(a)(3) since it has been demonstrated that compliance by the licensee with 10CFR50.55a(g) and ASME Code, Section XI, paragraph IWA 5250(a)(2), would result in hardship or unusual difficulties without a compensating increase in the level of quality and safety, (2) that the proposed alternatives provide an acceptable level of quality and safety, and (3) that granting relief where the code requirements are impractical is authorized by law and will not endanger life or property, or the common defense and security, and is otherwise in the public interest considering the burden that could result if they were imposed on the facility.

ACKNOWLEDGEMENT

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Dated: March 25, 1987