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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PRIMARY SYSTEM PIPING REPLACEMENT

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION, UNIT NO. 1

DOCKET NO. 50-220

1.0 Introduction

On October 15, 1982 the staff issued Amendment 50 to the facility operating license approving the licensee's recirculation system and safe-end replacement program. The licensee undertook this effort when cracking was found adjacent to a large number of safe-end and piping welds. One condition imposed in the amendment was that a stress reanalysis be performed by the licensee and selected portions be submitted to the NRC prior to restart of the facility. The licensee provided the required stress reanalysis in its submittal dated April 22, 1983. Further, the licensee provided in the same submittal, a report of the safe-end repair for Nozzle 15, which we requested in our letters of March 28, 1983 and December 27, 1982. This report was requested because a miscut had occurred in the removal of the Nozzle 15 safe-end and, therefore, a more complicated rework effort was required. Two other items are included in this Safety Evaluation; one is a review of some minor discrepancies in the ASME Code editions used for the piping replacement program, the other is a review of the acceptability of the limited use of some specially processed higher carbon content stainless steel piping in lieu of the low carbon content stainless steel piping originally proposed by the licensee. The evaluation of the above stated items follow.

2.0 Evaluation

2.1 Piping Stress Reanalysis

As a result of cracks found in the reactor nozzle safe ends and the recirculation system piping at Nine Mile Point Unit 1 (NMP1), the licensee has repaired and replaced all safe ends and recirculation piping. As part of the restart requirements, stresses of the recirculation system piping have been reanalyzed by the licensee. The stresses in the recirculation system piping were reanalyzed by the licensee's contractor, the Teledyne Engineering Services (TES). Niagara Mohawk Power Corporation submitted the report from its contractor on April 22, 1983.

The purpose of the stress reanalysis was to show that the repaired reactor recirculation system piping satisfies the requirement of the 1977 ASME Boiler and Pressure Vessel (B&PV) Code, Section III, Subsection NC with all addenda through Winter 1979. This plant was originally designed to the B31.1 Code. Following the completion of the reinstallation, TES performed an as-built walkdown of the recirculation system and its attached piping.

The recirculation system consists of five loops similar in all respects, except for the branch piping arrangements. Of the five, loop No. 12 has no significant branch piping, and loop No. 15 has the largest diameter branch piping. For thermal stress studies, these two loops were selected to

represent limiting cases. Branch lines were modeled as part of the loop and were analyzed up to the first respective anchor points. In addition to thermal loads, deadweight, pressure, seismic and cold spring during the construction, were also accounted for in the analysis. The resulting stresses in both loops were within the allowable design limits. ASME SA358 Type 316, "Nuclear Grade", SA655 austenitic steel piping with 0.02% maximum carbon content and 0.10% maximum nitrogen content was used for the replacement.

An output of the piping system analysis is support loading and component nozzle loading. Using these loads, stresses at supports were also analyzed. When the pipe support loads changed significantly from the original analysis, they were reevaluated. When the loads changed significantly from the original analysis, they were reevaluated. When the loads were essentially the same, no additional analysis was performed. For all reevaluations, analyses results were all within the allowable Code stress design limits and the displacement design limits.

The technical report prepared by TES verified that the design of the NMP1 replacement primary system piping was according to the ASME B&PV Code Section III, Subsection NC and addenda through 1979. Analysis also took account of as-built discrepancies. Based on our review of the report we concur that all stress levels were within design limits, and therefore, find the primary system design acceptable.

2.2 Number 15 Nozzle Safe-End Repair

On June 21, 1982 Niagara Mohawk notified the NRC staff that a miscut had occurred in the removal of recirculation safe end No. 15. The miscut had resulted in the removal of a portion of the Inconel buttering from the nozzle, requiring a repair prior to reinstallation of the new safe end by the methods approved previously by NRC. Niagara Mohawk's letter of November 18, 1982 and the supplementary information provided by a telecon on December 20, 1982, described the intended repair procedure for the No. 15 recirculation nozzle. The repair procedure followed was:

(1) Blend the miscut in the Inconel buttering.

(2) Preheat the nozzle in accordance with the approved welding procedure and subsequently repair the weld (ASME B&PV Code, Section III, Div. 1, Article NB-2549, 1980 ed. thru Winter 1980 Addenda).

(3) Maintain preheat and subsequently stress relieve in accordance with the approved procedure (ASME B&PV Code, Section III, Div. 1, Article NB-4640, 1980 ed. thru Winter 1980 Addenda).

(4) Machine the buttering following the heat treatment.

The NRC staff found the repair procedure acceptable in a letter dated December 27, 1982 and requested the licensee following the completion of the repair, to provide the appropriate documentation of the repair activity including a description and sketch of the repair, measured preheat and stress relief temperatures, a comparison of the stress

results from the mock up, with those limits established by the stress analysis and a summary of diametral changes that occurred in the nozzle. The licensee provided the requested information in its submittal dated April 22, 1983.

We have reviewed the results and determined the following:

(1) The stress analysis was adequate to establish acceptable limits for limiting the stresses induced by welding and post weld heat treatment (PWHT).

(2) The results of the stress analysis were adequately verified by the mock-up demonstration and by comparison with the measured results from a similar nozzle repair.

(3) The stresses induced by the welding and PWHT, even with the problems encountered with the heaters, were limited below the limits established.

(4) Sufficient controls were instituted for the welding and PWHT and sufficient non-destructive examinations were performed to minimize the likelihood of the presence of any unacceptable discontinuities in the component.

2.3 Review of Code Applications for the Piping Replacement

License Amendment 50, covering replacement of the recirculation system piping was issued on October 15, 1982. The Safety Evaluation supporting this amendment stated that the fabrication, installation (fit-up) and quality assurance would be accomplished in accordance with ASME Boiler and Pressure Vessel Code, Section III, 1980 Edition and Addenda through Winter 1980.

However, the licensee's letter of August 6, 1982 indicated that the replacement program would be based on the requirements of Section III of the ASME Boiler and Pressure Vessel Code 1977 Edition and various Addenda and other applicable standards. In addition, the licensee's letter of September 27, 1982 indicated that the fit-up requirements of the 1980 Edition of the ASME Boiler and Pressure Vessel Code, Section III through Winter 1980 addenda would be followed. This evaluation provides findings regarding Code Applications during the replacement program.

The licensee stated that:

(1) Material Procurement (re. Fabrication of Pipe)

> Procurement of the replacement recirculation system piping has been in accordance with Section III of the ASME Boiler and Pressure Vessel Code 1980 Edition and Addenda through Winter of 1980. The reactor vessel safe-ends and two (2) elbows were procured in accordance with the 1977 Edition of the code through Summer of 1977 as part of our original contingency program. Upon initiation of the safe-end removal and replacement program an additional nine (9) elbows were also procured to the 1977 Edition of the Code through Summer of 1977.

(2) Installation and Quality Assurance

Fit-up, Quality Assurance and other aspects of the installation have been performed in accordance with the 1977 Code and Addenda through the Summer of 1978.

The requirements for installation (fit-up) in Section III of the ASME Boiler and Pressure Vessel Code 1977 Edition and Addenda through Summer of 1978 and the 1980 Edition and Addenda through Winter 1980 are virtually identical except for minor editorial differences.

With two exceptions, the Code Quality Assurance requirements, applicable to the recirculation system repair are virtually identical. One exception is Paragraph NCA-4134.17, which contains the requirements for Quality Assurance records. The 1980 Code provides a more detailed breakdown of the quality records which must be retained and categorizes them as either "Lifetime" or "Non-Permanent". Tables NCA-4134.17-1 and NCA-4314.17-2 have been included in the 1980 Code to document the requirements for each type of record. Niagara Mohawk will comply with the requirements of the later code.

The second exception is the additional requirement to the 1980 Code in Paragraph NCA-4134.18, Audits. It requires that the certificate holder's Quality Assurance Plan specify the minimum frequency of audits. This requirement is contained in the Newport News Quality Assurance Program.

As outlined above, the licensee stated that the requirements of these two codes are essentially the same. Therefore, they concluded that by meeting the 1977 Code, the 1980 Code requirements are essentially met.

Since the licensee has implemented the additional quality assurance requirements of the 1980 Edition of ASME B&PV Code, Section III, we concur with the licensee position and find the licensee's applications of ASME Code editions acceptable and essentially the same as those contained in our Safety Evaluation dated October 15, 1982.

2.4 Determination on the Use of Specially Treated Stainless Steel Piping with Carbon Content Greater than 0.02 Percent

Niagara Mohawk's letter of August 6, 1982 provided a description of its proposed replacement program for the reactor recirculation system piping. The licensee stated that all replacement material would be 316 NG or equivalent, with a carbon content of less than 0.02 percent. In a letter dated March 15, 1983 the licensee stated: "Several pieces of branch piping to be welded to the 28-inch recirculation piping have longitudinal seam welds with a carbon content exceeding 0.02 percent. Specifically, one 14-inch diameter, 10-foot long fabricated spool piece, and two 12-inch diameter, 2-foot long spool pieces have longitudinal seam welds with a carbon content of 0.052 percent. The branch piping meets ASME Code and material requirements for SA-358, Type 316 Class I pressure boundary material. Since the pipe was solution heat treated after welding, sensitization of the base material adjacent to the longitudinal seam weld is not a problem. However, because of the high carbon content of the weld metal, there is some concern that the base metal adjacent to the weld fusion zone could become diluted with carbon and become sensitized when it is welded into the recirculation system. The resulting material could be subject to intergranular stress corrosion cracking, considering the weld residual stresses and the boiling water reactor water chemistry. To eliminate this concern, a corrosion resistant cladding inlay (ER308L) in the area of the seam weld was added. A solution heat treatment was then employed. The inlay of corrosion resistant cladding was treated as weld repair under ASME Code, Section XI. Applicable repair and non-destructive examination requirements from this section applied.

To prevent future problems with ultrasonic inspection, careful baseline inspection of this area, including mapping of significant reflectors and possible optimization of inspection procedures, will be performed."

In the Safety Evaluation supporting Amendment 50 to the facility license, the staff stated that Type 316 stainless steel, nuclear grade (NG), or equivalent, is a conforming material in consonance with NUREG-0313, Rev. 1, "Technical Report on Material Section and Processing Guidelines for BWR Coolant Pressure Boundary Piping" and, therefore, its use is acceptable for piping exposed to BWR operating environment. The special provisions taken by the licensee for the conventional 316 stainless steel, namely overlay with low carbon 308 stainless steel on the interior surface in the region that would be affected by the field welding coupled with solution heat treating following the overlay, result in piping that is corrosion resistant in the BWR operating environment. Piping processed in this manner is addressed in NUREG-0313, Rev. 1 and is also considered as conforming material. Therefore, we consider these specially processed branch piping segments to be an equivalent to the 316 stainless steel, NG, and, therefore, acceptable for use. Further, NUREG-0313, Rev. 1 states that augmented inspection is not required for conforming materials.

3.0 Conclusion

We have concluded that:

(1) The results of the stress reanalysis for the replaced primary system piping demonstrate that the "as-built" configuration is in conformance with ASME B&PV Code, Section III, Subsection NC originally committed to in Amendment 50.

(2) The nozzle No. 15 safe-end repair was accomplished within the rules of ASME B&PV Code, Section III and, therefore, there is reasonable assurance the component was not degraded by the repair.

(3) The ASME B&PV Codes utilized by the licensee for the piping replacement, with the additional provisions invoked, are essentially the same as those stated in the Safety Evaluation supporting Amendment 50 to the license and, therefore, are acceptable.

(4) The three piping spool pieces with longitudinal seam welds having carbon contents greater than 0.02 percent, when clad in the area to be field welded and solution treated following the cladding, meet the requirements for a conforming material of NUREG-0313, Rev. 1, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping". Therefore, its use is acceptable and augmented inservice inspection is not required.

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