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

RELATED TO REINSPECTION OF CORE SHROUD DURING RFO-14

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION, UNIT NO. 1

DOCKET NO. 50-220

1.0 INTRODUCTION

By letter dated March 31, 1995, the NRC staff issued a safety evaluation (SE) regarding the core shroud stabilizer design for Nine Mile Point Nuclear Station, Unit No. 1 (NMP1). The SE acknowledged that Niagara Mohawk Power Corporation (NMPC) would address certain issues by the upcoming spring 1997 inspection during refueling outage 14 (RFO-14), and would submit its plan for reinspection of the core shroud repair assemblies and core shroud following RFO-13. The NRC staff recommended in the SE that NMPC perform certain actions to qualify the ultrasonic testing (UT) techniques used to inspect weld H8 and to develop an effective method to locate the segment welds of the top guide support ring. The SE also noted that NMPC would reinspect all reported indications on the top side of the H8 weld during the spring 1997 outage. The reinspection would verify the postulated crack growth of these indications. NMPC had not planned to reinspect the UT-identified indications (on the lower side of H8) until the next required UT inspection as determined by its fracture mechanics analysis. This analysis was submitted to the NRC in a February 7, 1997, letter.

By letter dated October 4, 1995, NMPC submitted its inspection plan for the core shroud and its repair assemblies. The plan described the inspections to be performed for the core shroud stabilizer assemblies, repair anchorage, H8 weld, shroud top guide ring segment welds, and vertical shroud welds. In its letter of February 7, 1997, NMPC confirmed its intent to conduct shroud inspections in the spring 1997 outage in accordance with the inspection plan it previously submitted. NMPC also provided additional information about the shroud inspection plan, addressed the issues mentioned above, and provided a fracture mechanics analysis.

As discussed in your letter of February 28, 1997, and an associated phone call with the NRC staff on February 21, 1997, NMPC updated its plans for inspecting the vertical welds from that described in the October 4, 1995, letter. The vertical weld inspection scope discussed in that earlier letter was based on a draft version of BWRVIP-07, "Guidelines for Reinspection of BWR Core Shrouds," which was not submitted. (Subesequently, it was submitted and became EPRI Report TR-105747 dated February 1996). NMPC stated that its current plans are in accordance with the BWRVIP-07 guidelines with one exception as described below. In the February 28, 1997 letter, NMPC also corrected statements made in its February 7, 1997, letter about the scope of inspection of the H8 weld.

2.0 DISCUSSION AND EVALUATION

2.1 Inspecting Vertical Core Shroud Welds

NMPC stated that it would conduct shroud inspections in accordance with the February 1996 revision of the BWRVIP-07 with one exception. For the vertical weld inspections scheduled for the spring 1997 refueling outage, NMPC proposed to modify the method for sample expansion as presented in BWRVIP-07 as Option B.

The Option B guidelines state:

> "If the cumulative cracking in either the original sample or the expansion sample is greater than 10 percent of the equivalent length of weld inspected, then the inspection scope shall be expanded to verify the minimum required uncracked length for each vertical weld that is not structurally replaced by existing hardware and/or the repair."

In lieu of the Option B guidelines, NMPC's proposed approach for NMP-1 is:

> "If the cumulative cracking in either the 50% expansion sample or the 100% expansion sample is greater than 10% of the equivalent length of weld inspected, then the inspection scope shall be expanded to verify the minimum required uncracked length for each vertical weld that is not structurally replaced by existing hardware and/or the repair."

NMPC provided the following justification for the change:

> "This clarification is required because 10% of a 25% sample of the total vertical cumulative length (100% for NMP1 is 451 inches) represents only 11 inches of cumulative cracking which is within the industry experience norm. NMPC does not consider cumulative indications totaling 11 inches or a single indication of 11 inches as an anomaly which requires a complete Lmin of all vertical welds based on recent industry experience with shroud vertical weld inspections.
>
> The BWRVIP-07 Guidelines were written considering a typical BWR-3/4/5 shroud which has approximately 800-1100 inches of cumulative vertical weld; where 10% of a 25% sample represents an indication on the order of 20 to 28 inches.
>
> The shroud vertical weld inspection planned for NMP1 for REFOUT97 concentrates on the mid-shroud V9, V10, V11 welds. The V9 and V10 welds are 90.12 inches long and the V11 weld is 63.5 inches long. The initial 25% inspection (113) inches is an EVT from the outside diameter of any combination of the above 3 welds. The initial attempt to expand the scope to 50% (226 inches) would look at 3 of these welds.

> (NOTE: the minimum ligament for structural integrity including crack growth for V9, V10 is 27 inches per weld and V11 requires 16 inches). Considering these factors, the proposed criteria for expanding the inspection to a minimum ligament inspection of all vertical welds is considered conservative and consistent with the guideline intent."

The NRC staff reviewed the NMPC's proposed exception to the BWRVIP-07 recommendation for the inspection of vertical core shroud welds. The NRC staff finds that the NMPC has not provided adequate technical bases to deviate from the BWRVIP-07 guidelines. The BWRVIP-07 guidelines represent a concerted effort by the industry to develop uniform practices and criteria to be implemented consistently by boiling water reactor (BWR) owners. The criteria as provided in BWRVIP-07 do not appear to be overly burdensome.

The NRC staff further finds NMPC's conclusion that the proposed exception is conservative and consistent with the intent of BWRVIP-07 to be lacking in support. The sampling and expansion provisions of the guidelines are based on percentages, not on arbitrary lengths that penalize certain licensees. The NRC staff is unaware of any data to support the statement that 11 inches of cracking in vertical welds is typical in BWRs. Even if it were typical, it is the percentage of total crack length that is relevant. The BWRVIP guidelines do not state that they were written considering a typical BWR-3/4/5 shroud containing about 800-1100 inches of cumulative vertical weld or suggest that the 10% cracking criteria should be modified according to the cumulative lengths of welds. The fact that NMPC has fewer total inches of weld means it is required to inspect fewer inches of weld than other licensees, and thus, the guidance is less burdensome to NMPC than to other licensees. Indeed, NMPC did not indicate that inspecting according to the guidelines would be a hardship. Accordingly, the NRC staff concludes that NMPC's proposed deviation from the BWRVIP-07 guidelines does not provide a reasonable method for determining the minimum required uncracked length of vertical welds if cracking is found in the original sample, and is not acceptable.

2.2 Locating Ring Segment Welds

For the ring segment welds, NMPC stated that it will use:

> "[E]ddy current (EC) examination to locate the top guide ring segment welds and then perform enhanced visual examinations (EVT) of the welds. The standards for EC of BWR core shroud welds developed for the BWRVIP (BWRVIP-03) will be used. NMPC may also use EC to locate the shroud vertical welds as needed. If the top guide ring segment welds cannot be located, NMPC has performed finite element analyses to evaluate the effect of postulated cracks in these welds on the integrity of the shroud and its repair assemblies. The analysis concluded that relatively large through-thickness cracks (approaching 95% of the ring width) can be tolerated without significantly reducing the shroud stiffness or the tie rod assembly preload. The analysis conservatively

assumed 360 degree through-thickness cracking at the adjacent shroud horizontal welds H2 and H3. By letter dated March 27, 1995, NMPC reported that EVT of about 144 inches of the H2 weld performed during the last refueling outage found no relevant indications; therefore, the analysis is conservative based on the exam results. Thus, if the ring segment welds cannot be located, then the analysis and the previous H2 weld inspection confirms that the effectiveness of the shroud repair is not impaired by the postulated radial cracking."

Based on its review of NMPC's submittal, the NRC staff finds that NMPC has met its commitment described in the NRC staff's March 31, 1995, SE to develop an effective method to locate the segment welds of the top guide support ring. The industry has shown this method to be successful, and there is no recommendation in BWRVIP-07 concerning this matter.

2.3 Reinspecting the H8 Weld

NMPC stated that it qualified UT methods for the H8 weld using a mock-up block that is directly representative of the materials, dimensions, and geometry of the H8 weld. Further details are set forth in GE report GE-NE-B13-01805-83, Revision 2, "H8 Shroud Re-inspection Analysis for Nine Mile Point Unit 1," dated October 30, 1996.

NMPC plans to inspect the H8 weld using an enhanced VT-1 examination of the top surface of the H8 weld in the locations observed to have indications to confirm the postulated crack growth of these indications. In the previous inspection, NMPC found five indications on the top surface of the H8 weld by visual examination and one on the underside by UT. The latter indication was not accessible to visual examination. Of the five indications on the top side, four were about 1/2 inch long and one about three-fourths of an inch long. The indication on the underside was about 3 inches long and 1/2 inch deep. During the upcoming inspection, NMPC will inspect only the top surface by the same methods previously used. NMPC performed a crack growth calculation for the indication on the underside in accordance with the BWRVIP-07 guidelines. This evaluation showed that the required UT inspection interval of the H8 weld would be 6 years.

The NRC staff finds NMPC's plans to inspect the H8 weld during the spring 1997 outage to be acceptable. Using the same methods to reinspect the H8 weld will provide valid data for comparison with the baseline data. The plans are in accordance with commitments described in the previous SE. NMPC's flaw evaluation was performed in accordance with BWRVIP-07, and the results demonstrated that the indications on the lower side of the weld need not be inspected during RFO-14. After completion of the core shroud inspections for RFO-14, NMPC should evaluate the results of its reinspection of the top surface of the H8 weld, develop a plan for the next reinspection of this weld, and submit the results and the plan to the NRC staff before the next scheduled refueling outage.

3.0 CONCLUSION

NMPC stated that it intends to inspect the core shroud and repair assemblies in accordance with the BWRVIP-07 guidelines. The NRC staff finds this commitment acceptable for one operating cycle. The NRC staff is currently reviewing these guidelines and considers their use acceptable in the interim while the NRC staff completes its review of the guidelines for generic applicability.

As discussed above, the NRC staff does not find NMPC's proposed exception to conducting its reinspection of the vertical welds acceptable at this time. NMPC should conduct its inspections in accordance with the BWRVIP-07 criteria during RFO-14. After completing the core shroud inspections for RFO-14, NMPC should evaluate the results of its reinspection of the H8 weld, develop a plan for the next reinspection of this weld, and submit the results and the plan to the NRC staff before the next scheduled refueling outage.

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