UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED TO MODIFICATIONS TO CORRECT CORE SHROUD REPAIR DEVIATIONS NIAGARA MOHAWK POWER CORPORATION NINE MILE POINT NUCLEAR STATION, UNIT NO. 1 DOCKET NO. 50-220

1.0 INTRODUCTION

During the 1995 refueling outage for Nine Mile Point Nuclear Station, Unit No. 1 (NMP-1), Niagara Mohawk Power Corporation (NMPC) made a modification to repair the core shroud. The repair, which was made to ensure the structural integrity of the core shroud by replacing the function of the circumferential welds.with four stabilizer assemblies, was reviewed and approved by the NRC staff on March 31, 1995 (Reference 1).

During the post-installation inspection of the shroud repair, NMPC identified conditions that differed from the intended repair design (References 2 and 3). NMPC committed to implement corrective actions during the next refueling outage to restore the shroud stabilizer functions in accordance with the original intent. NMPC provided plans for final design modifications on August 14, 1996, as part of a long-term corrective action plan (Reference 4). (Preliminary plans for the modification were provided in a May 30, 1996, letter which preceded the final design documentation provied in the August 14, 1996, letter).

NMPC proposes two modifications to the existing stabilizer assemblies. One modification involves the replacement of the tie rod at the 270° location since the lower spring of this stabilizer assembly currently bears, in part, on the blend radius of the recirculation nozzle. The proposed modification is to replace the tie rod and springs assembly with one having the spring on the opposite side of the tie rod, so that the spring will bear on the reactor pressure vessel as originally intended.

The other modification extends the lower spring contact so that it will straddle the weld at the H6A location in accordance with the intended design objective. Currently, the lower spring contact with the shroud does not extend beyond weld H6A at any of the four locations. Consequently, if weld H6A were fully cracked, and if the design condition of a steam line LOCA plus a seismic event were to occur, the shroud would not be laterally constrained to the extent intended by design. The proposed modification adds an extension piece to extend the spring contact beyond weld H6A and restores this feature to its intended function. The extended contact and the core plate wedges also provide a redundant load path between the core plate and the lower spring as was intended in the original design. This modification applies to the 90°, 166° and 350° stabilizer assemblies. The replacement assembly at the 270°. location will also correct this deviation.

Enclosure

2.0 EVALUATION

NMPC's post-installation inspection revealed that the lower wedge on the 270° tie rod was bearing on a portion of the blend radius for a recirculation nozzle rather than on the reactor vessel wall. The inspection results are documented in Reference 3 and are further evaluated in General Electric report GENE B13-01739-25 (Reference 3.1). This latter report addressed concerns about the contact area and the stability of the contact on the inclined surface of the nozzle blend radius.

The lower wedge can be relocated to a position providing contact over a larger area on the vessel wall by moving the lower spring to the opposite side of the stabilizer assembly. NMPC contends that by relocating the lower spring, the concerns about contact stability and contact area are resolved and the stabilizer assembly maintains its intended functional requirements.

The lower springs restrict the core plate displacement during a seismic event. The stabilizer assembly is designed for a single lower spring to carry the entire horizontal seismic load at the core support. However, the direction of the load may be such that more than one spring shares the load. The limiting spring deflection and spring loads occur when only one of the lower springs reacts to the horizontal load. Relocating the spring has no affect on the maximum spring load or maximum spring deflection.

Relocating the lower spring does change the spacing between adjacent springs and the spacing does affect the net reaction when two springs share the lateral load. The lower spring contact with the reactor pressure vessel is changed by about 4° when it is moved to the opposite side of the tie rod. The 4° change from the as-installed location results in a maximum of 108° spacing between adjacent lower springs. The minimum spacing between adjacent lower springs is 76°.

When the four lower springs are 90° apart, the equivalent spring constant is the same for all directions of the applied load. The equivalent spring constant is the total load applied by the lower springs divided by the displacement in the direction of the applied load. Because of the non-uniform spring spacing, the variation in the equivalent spring constant is from +24% to-31%. An increase in the equivalent spring constant tends to increase the total reaction load and decrease the total displacement. Although the total reaction load increases, the load is shared by two springs and the load on either spring is bound by the case where one spring carries the entire load. A decrease in the equivalent spring constant results in a larger displacement in the direction of the load. Hence, displacements under worst-case accident loads need to be verified.

NMPC performed seismic analyses based on a design basis earthquake for critical crack conditions, consistent with the original seismic analysis (Reference 4.1). The two cases that were determined to result in governing loads and displacements at the lower stabilizer springs were analyzed. One case assumed a roller at the H6B location. The other case assumed a roller at

the H1 weld location and hinges at the other welds in the seismic analytical model. The displacements were determined to be within the allowable values specified in the design specification (Reference 4.2). The loads on key internal components were determined to be less than, or equal to, the loads calculated on the basis of an uncracked, unmodified shroud. The shroud frequency shifts due to the stiffness changes were very small and were in the frequency range where the spectral amplitudes were almost flat or mildly ramping, thus resulting in insignificant effects as stated above.

Based on its review, the NRC staff finds that relocating the lower spring, as proposed, will provide an adequate bearing area on the vessel wall. The calculated loads and displacements will be within the allowable values in the design specifications. Therefore, the NRC staff finds this modification acceptable.

The other proposed modification to the shroud repair assembly relates to the lower contact at azimuths 90°, 166° and 350°. NMPC proposes to modify these contacts to extend beyond the H6A weld by adding a U-shaped extension piece. The extension piece will fit over the existing lower contact with the legs of the U extending around the sides of the existing lower contact. The steps at the ends of the legs fit under the lower contact to prevent axial movement. A protrusion at the top extension fits in the gap between the lower contact and the lower spring to restrict the horizontal movement. The added extension piece is captured in all directions on the existing lower contact. The legs of the extension provide a positive spring clamping force of approximately 50 lbs. against the sides of the lower contact. The force is sufficient to prevent any free movement or vibrations. With this arrangement, the additional extension piece will be captured in all directions and will be held secure by the spring loaded clamping force.

The additional extension pieces will be installed with a special tool for handling and to keep the legs sprung apart. When seated in place, the tool releases the legs, allowing them to clamp around the lower contact. This method will allow the piece to be installed without sliding or having to apply excessive force. The same tool can be used to remove the extension piece if required.

The lower springs are designed to limit the core plate displacement during a seismic event. These springs bear against the shroud at the core support ledge and extend above the H6A weld and below the H6B weld. In the event of full separation at weld H6A, the contact extension limits the possible shroud movement and, together with the core plate wedges, provides a redundant load path for the horizontal seismic loads. The core support structure is also held in position by the core support bolts and by the core support alignment pins. However, the analytical calculations for loads and displacements are conservative by not taking credit for this additional restraint. The analysis in Reference 4 indicates that all loads and displacements remain within acceptable values with the extension pieces installed.

The two modifications discussed above affect the displacement at the top guide and core support locations. The NRC staff has reviewed the calculated displacements that will apply after the installation of both modifications. These new values supersede the displacements reported in the original stress report GENE-B13-01739-04, Revision 0, "Shroud Repair Hardware Stress Analysis - Nine Mile Point Unit 1," reviewed by the NRC staff in the previous safety evaluation of March 31, 1995. The bounding transient displacement is a combination of the maximum permanent displacement and the maximum spring compression. For upset and emergency conditions, there is no permanent displacement and the maximum transient displacement has been calculated to be less than the allowable upset transient displacement value of 0.75 inches. Assuming the worst-case scenario for load direction and spring characteristics during a faulted event, the maximum transient displacements have been determined to be less than the allowable faulted transient displacement values of 1.49 inches and 1.87 inches at the core support and top guide levels respectively. The maximum calculated permanent displacement between the two contacts located 108° apart has also been determined to be less than the allowable permanent displacement value of 0.67 inches during a worst-case faulted event.

Based on its review, the NRC staff finds that adding an extension piece over the existing lower contacts will limit the displacement at the H6A weld location to allowable values during worst-case accident conditions. Also, adequate measures have been proposed to prevent free movement of the extension piece during normal operation and postulated accident conditions. Therefore, the NRC staff finds this modification acceptable.

The core spray piping analysis performed to support the shroud repair included a shroud displacement of 0.904 inches horizontally and 0.65 inches vertically, during the worst-case faulted conditions. These displacements do not create an unacceptable loading condition on the emergency core cooling system piping that is expected to perform its intended safety functions during postulated faulted events. The proposed modifications do not change the maximum displacements calculated for the original shroud repair at the upper shroud. Therefore there is no change in loading of the core spray piping.

The hardware for both modifications is designed and fabricated to the same design basis as the original shroud repair hardware. The modified stabilizer assembly includes the same design features as the original hardware. All parts are locked in place or captured by mechanical devices. The fabrication requirements for the two proposed modifications will be in accordance with the previously approved fabrication requirements for the NMP-1 core shroud stabilizers. No welding is required during fabrication or installation.

3.0 CONCLUSION

Based on its review as discussed above, the NRC staff finds that the proposed modifications will restore the core shroud repair to its originally intended design objectives. The loads and displacements at critical locations have been determined to be within the allowable values set forth in the design specifications. The staff therefore finds the proposed modifications to the shroud repair assembly acceptable.

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4.0 REFERENCES

1. Letter from L. B. Marsh, U.S. NRC to Niagara Mohawk Power Corporation, dated March 31, 1995, and attached Safety Evaluation by the Office of Nuclear Reactor Regulation relating to the Core Shroud Repair at Nine Mile Point Unit 1.

2. Letter from Niagara Mohawk Power Corporation to U.S. NRC (NMPIL 0927), dated March 23, 1995, with three attachments.

3. Letter from Niagara Mohawk Power Corporation to U.S. NRC (NMPIL 1067), dated April 30, 1996, with two enclosures.

   3.1 Enclosures 1 and 2 to April 30, 1996, letter: General Electric Nuclear Energy Report No. B13-01739-25, "Core Shroud Repair, 270° Tie Rod Assembly Assessment." (Proprietary and non-proprietary versions).

4. Letter from Niagara Mohawk Power Corporation to U.S. NRC (NMPIL 1111), dated August 14, 1996, with enclosures providing final design documentation for modifications to the core shroud repair assemblies installed in March 1995, with four enclosures.

   4.1 Enclosures 3 and 4 to August 14, 1996, letter: Supplement 1 to General Electric Nuclear Energy Report No. B13-01739-03, "Supplement 1, Nine Mile Point 1, Seismic Analysis, Core Shroud Repair Modification," (Proprietary and non-proprietary versions).

   4.2 Attachment 8.2 of Enclosure 1 to August 14, 1996, letter: Supplement 4 to General Electric Nuclear Energy Report No. B13-01739-04, "Supplement 4, Nine Mile Point 1, Shroud Repair Hardware Stress Analysis."