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AmerGen Energy Co, LLC
Clinton Power Station

Non-Core Support Structural Components Assessment

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Revision Status

Revision	Date	DESCRIPTION
0 (Draft)	July 2004	Issued for Review and Comments.
0	November 2004	Issued for Use.
1	February 2005	Revised to incorporate review comments and added section to address fuel lift.
2	February 2005	Revised to incorporate review comments on Revision 1.

Bars in the left margin note changes for Revision 2.

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IMPORTANT NOTICE

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1. INTRODUCTION AND SCOPE

Cracks were detected at some horizontal welds in the core shroud of the Clinton Power Station (CPS). Shroud repair has been designed to *structurally* replace the horizontal welds H1 through H7 at the CPS plant in accordance with the shroud repair design specification 26A6213 (Reference 1).

This report documents the assessment performed to identify the impact of shroud repair on the existing non-core support structures and to demonstrate the adequacy of the affected components. The components evaluated include: (1) fuel, (2) Low Pressure Coolant Injection (LPCI) coupling assembly, (3) core spray piping, and (4) Shroud Head. The assessment of the core support structure component interfaces such as the Top Guide/Shroud interface, and Core Plate/Shroud interface, etc is documented in a separate report, 26A6217 (Reference 2).

2. NON CORE SUPPORT STRUCTURAL COMPONENTS ASSESSMENT

Analyses have been performed in support of the shroud repair design which incorporates the shroud horizontal weld cracks and the shroud repair. As a result, loads are generated in the existing non-core support structural components. The non-core support structural components are assessed to demonstrate their structural adequacy to withstand the loads generated as a result of shroud repair.

Design of the shroud repair has incorporated increased Reactor Internals Pressure Differentials (RIPDs) over the existing (licensed fuel) based values to account for the Extended Power Uprate (EPU). Since existing fuel lift analyses already accounts for the effects of EPU and GE 14 fuel and shroud repair does not affect the vertical fuel lift loads, there is no need to address the effect of fuel lift loads on the non-core support structural components. It is unchanged from the existing fuel lift assessment.

The approach used to the assessment was to compare the enveloped loads (accelerations, shears, and moments as applicable for all cracked conditions) for the shroud repair installed cases with the loads from the original design basis loads (from appropriate references).

2.1 Fuel

Seismic / dynamic analyses performed in support of shroud repair result in inertial acceleration loads for fuel (Table 8.2, Reference 4). The acceleration comparison for the fuel is shown in the Table 2.1-1.

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]] Therefore, the fuel remains qualified for the shroud repair.

2.2 LPCI Coupling

There are three (3) low-pressure coolant injection (LPCI) coupling assemblies in the Clinton RPV-shroud annulus. The coupling arrangement consists of two 8" Dia. elbows, the upper one connected to the RPV nozzle thermal sleeve and the lower one connected to the shroud just below the flange which seats the top guide/grid. The components connecting the two elbows include fittings welded to the ends of the elbows and a sleeve coupling interface between the elbows. The upper and lower ends of the coupling sleeve are housed inside collars, which are threaded to the fittings. This provides a slip joint at each end of the sleeve. Piston ring seals are included at the collar/sleeve slip joints to minimize leakage flow. Stellite #6 overlay exists at the interface of the sleeve and the collar to provide hard contact surface to facilitate relative motion at the contact. In order to minimize flow-induced vibration effects, a strut is welded to the lower elbow, bracing it to the shroud. The injection point inside the shroud is directed to a location below the top guide/grid.

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Assessment

The LPCI coupling is subject to several loading conditions such as pressure, flow loads, dynamic loads, etc. The predominant loads affecting the LPCI coupling as impacted by the shroud repair are assessed, taking into consideration their relative magnitudes and the available stress margins at the governing components/stress locations. Possible impact of shroud repair on the LPCI coupling is in the accelerations due to seismic/dynamic events and the relative anchor movements (thermal and dynamic) between the RPV and shroud attachment points.

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Anchor Displacements: The anchor displacements do not impose any load in the LPCI coupling attachments, by design, since the coupling has vertically telescoping and laterally swiveling Stellite hard-faced sleeve interface. However, a check is made to ensure that the displacements are within acceptable limits.

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]] Therefore, the lateral displacements are acceptable.

]] Thus the dynamic anchor displacement in the vertical direction is not a concern and is acceptable.

]] Therefore, the horizontal thermal displacement is not a concern.

]] Thus vertical thermal displacement is not a concern. [3]]]

Conclusion

As documented above, the LPCI coupling is assessed to be functionally and structurally integral and acceptable in the shroud-repaired condition

2.3 Core Spray Piping

The core spray piping is 5 in. diameter schedule 40 pipe (Reference 8). Upon entering the RPV, at the tee, the piping branches circumferentially in both directions. The pipe is routed horizontally through a guide (guide support is attached to the RPV inner wall, with radial restraint only) and is then routed downward in the annulus for approximately 6 feet, at an azimuthal offset of approximately 52° on one side and approximately 112° on the other of the tee, and is attached radially to the to the shroud. There are two similar, independent loops, and therefore, a common assessment is performed.

Assessment

The core spray piping is subject to several loading conditions such as pressure, flow loads, dynamic loads, thermal loads, etc. The predominant loads affecting the core spray piping as impacted by the shroud repair are assessed, taking into consideration their relative magnitudes and the available stress margins at the governing stress locations. Possible impact of shroud repair on the core spray piping is in the accelerations due to dynamic events and the relative anchor movements (thermal and dynamic) between the RPV and shroud attachment points. The seismic/dynamic accelerations and displacements for cracked and uncracked cases, are taken from Reference 4, Table 8.2.

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]]. However, since there are adequate (approximately 43%) stress margins (per Reference 8) these are acceptable.

[[

]] Therefore, the lateral dynamic displacements are acceptable.

[[

]] and thus have large margins. Thus the vertical seismic / dynamic anchor displacement is acceptable.

[[ ]] The change in the horizontal relative thermal anchor movement between the RPV and the shroud will be very small and therefore, not a concern.

]] Thus no further evaluation is required.

Conclusion

As documented above, the core spray piping is assessed to be functionally and structurally integral and acceptable in the shroud-repaired condition.

2.4 Shroud Head

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]] Thus the loads from shroud repair are acceptable.

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]] Thus Reference 9 documentation does not require updates for shroud repair results.

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2.5 Assessment of relocating four Shroud Head Studs

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2.6 Fuel Lift Assessment

Fuel Lift analysis is reviewed to assess the potential disengagement of fuel from its support which could lead to interference with control rods, and dynamic loads on fuel and core support structure.

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Conclusion

Based on the above assessment, it is concluded that the current fuel lift loads are still valid for the shroud repair. Also based on Reference 12, it is concluded that Fuel Lift Loads are not required to be added to shroud repair hardware design loads.

3. REFERENCES

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