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May 7, 1996

Docket No. 50-321

HL-5153

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Edwin I. Hatch Nuclear Plant - Unit 1
Augmented Inservice Inspection of
Core Shroud Vertical Welds

Gentlemen:

During the Unit 1 Spring 1996 refueling outage, Georgia Power Company (GPC) performed augmented examinations of the core shroud vertical and ring segment welds, along with inspections of core shroud stabilizer assemblies, gusset plates, and core plate wedges, subsequent to the stabilizer modification. As a result of initial examination, expanded scope examinations were performed such that accessible regions from the outside diameter of all the vertical welds were visually inspected using an enhanced VT-1 examination. The initial examinations identified two indications associated with welds V5 and V6. No other indications were identified. The indications have been evaluated using both linear elastic fracture mechanics and limit load analysis. This conservative analysis shows that the indications in the vertical shroud welds are well below the allowable lengths. The enclosure provides a description of GPC's inspection plan, the results of the initial and expanded scope inspections, and an evaluation of the findings.

Georgia Power Company is continuing to work with the Boiling Water Reactor Vessel Internals Project (BWRVIP) to develop inspection and evaluation guidelines. GPC plans to implement the appropriate guidelines as they become available.

Should you have any questions in this regard, please contact this office.

Sincerely,

J. T. Beckham, Jr.

JKB/eb

Enclosure: Augmented Inservice Inspection of Core Shroud Vertical Welds

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cc: *Georgia Power Company*
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Enclosure

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Initial Inspection Plan

During the Unit 1 Spring 1996 refueling outage, Georgia Power Company (GPC) performed inservice inspections of the core shroud vertical and ring segment welds. GPC also performed visual inspections of the stabilizer assemblies, gusset plates, and core plate wedges. During the 1994 refueling outage, a pre-emptive repair on the core shroud was implemented by installing the stabilizer assemblies. As part of the stabilizer assembly installation, a limited visual inspection of vertical shroud welds was performed. The inspection consisted of an enhanced visual examination from the outside diameter of approximately 18 inches of the V5 and V6 welds near the intersection of circumferential weld H4. No indications requiring evaluation were identified.

As described in GPC's letter dated December 19, 1994, GPC's post repair inspection plans initially consisted of an enhanced VT-1 examination of one vertical weld near the intersection with weld H4 during each refueling outage and weld locations observed to have indications > 2 inches long. However, for the Spring 1996 refueling outage, GPC elected to inspect 25 percent of the total length of the vertical shroud welds. Performance of this scope is consistent with the Boiling Water Reactor Vessel Internals Project (BWRVIP) "Guidelines for Reinspection of BWR Core Shrouds" and also meets GPC's previous commitment.

For Unit 1, no shroud vertical welds are considered to be structurally replaced by existing hardware and/or the repair. The vertical welds between circumferential welds H1 and H7 are considered to be within the scope of the BWRVIP reinspection guidelines. The total length of vertical welds within the scope of inspection is 560 inches; therefore, the minimum length inspected was 140 inches. To comply with reinspection guidelines, welds V5 and V9 were inspected for an initial inspection scope of 150 inches. The inspection method was enhanced VT-1 from the outside surface of the shroud, with demonstration of the capability to detect a 0.0005 inch wire and clean accessible surfaces with a nylon bristle brush.

Initial Inspection Results

Two indications were observed on weld V5. One indication was approximately 12 inches in length, and the second indication located in the base material adjacent to the weld was approximately 2 inches in length.

Inspection Scope Expansion

Consistent with the BWRVIP reinspection guidelines, the initial inspection scope was expanded to include enhanced VT-1 examination of 100 percent of the length of weld V5 on the inside surface, and 50% of the length of all remaining vertical welds on the outside surface. As a result of the expanded scope inspections, one 32-inch long indication was observed on the left side of weld V6 at the intersection with weld H4, and four small axial crack-like indications were observed on the right side of weld V6. Inspections were again expanded to include 100 percent of length of weld V6 on the inside surface and 100 percent of the length of all remaining vertical welds on the outside surface. No other indications were observed as a result of the scope expansion.

Evaluation of Findings

The indications were conservatively assumed to be 100 percent through-wall for the entire length. The cracking mechanism was assumed to be intergranular stress corrosion cracking (IGSCC), based upon industry experience with core shroud cracking and the presence of IGSCC-susceptible material. Fracture mechanics analyses were performed considering accident conditions and assuming both circumferential welds H4 and H5 are fully cracked (360° through-wall) to determine the allowable through-wall crack lengths. The analysis considered both linear elastic fracture mechanics (LEFM) and limit load. Based upon the fracture mechanics analyses, the allowable through-thickness cracks for welds V5 and V6 are 58.8 inches, including a safety factor of 1.5, inspection uncertainty, and crack growth for one cycle of operation. This assumption compares well to the as-found indications of 14 inches total on weld V5 and 32 inches on weld V6. The minimum required uncracked ligament, including crack growth for 2 years and allowing for inspection uncertainty, for welds V5 and V6, is 40 inches for each weld. This consideration compares favorably to the as-found uncracked lengths of 84 inches for weld V5 and 66 inches for weld V6.

Assuming an outside partial through-wall crack 32 inches in length, the expected thickness crack growth for normal water chemistry in one cycle is 2.5×10^{-5} inches/ hr $\times$ 12000 hr = 0.30 inch. The assumed crack growth rate was based upon the recent draft BWRVIP report addressing crack growth rates. For hydrogen water chemistry, the expected thickness growth is lower than for normal water chemistry. Thus, the probability of the crack becoming a through-wall crack is extremely low. For the more realistic case of no through-wall crack at H4 and H5, the critical crack length for an axial crack length is in excess of the length of the weld itself (length > 98 inches), confirming the large crack tolerance in the shroud.

The crack driving force for an assumed vertical weld crack is the hoop stress in the shroud. For normal operation, the hoop stress is 0.5 ksi, which corresponds to a ΔP value

of 8.5 psi. Even for a steam line break, the hoop stress is only 1.8 ksi, which corresponds to peak pressure of 30.5 psi. In both cases, the driving force is small.

Conclusion

Based on the results of the initial augmented inservice inspections and the expanded scope inspections, GPC concludes that the indications identified do not present any safety concerns. GPC is evaluating the need to perform additional examinations (e.g., ultrasonic examination or boat samples) during the next refueling outage to provide additional information and/or confirmation of the indications. Determination of the appropriate inspection to be performed during the next Unit 1 refueling outage will be completed prior to that outage.

Reference

1. "Guidelines for Reinspection of BWR Core Shrouds," BWRVIP-07, EPRI Topical Report TR-105747, February 1996.