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Director of Nuclear Reactor Regulation
Attention: Mr. John F. Stolz, Chief
Operating Reactors Branch No. 4
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

NRC DOCKET 50-366
OPERATING LICENSE NPF-5
EDWIN I. HATCH NUCLEAR PLANT UNIT 2
ANALYSES AND REPAIRS OF LARGE-DIAMETER STAINLESS STEEL PIPING WELDS

Gentlemen:

During the inservice inspection conducted during the Plant Hatch Unit 2 1983 maintenance/refueling outage, unacceptable ultrasonic indications were observed in Recirculation and Residual Heat Removal (RHR) system piping welds. Georgia Power Company (GPC) hereby submits the following information concerning the inservice inspection, investigation of the cause of cracking, analyses and repairs, future inspections, and modification/replacement plans.

INSERVICE INSPECTION

SCOPE OF EXAMINATIONS

By letter dated May 26, 1983, GPC provided NRC Region II with a listing of the Recirculation, RHR, and Reactor Water Cleanup (RWCU) piping weld examinations that were performed during the recent inservice inspection conducted at Plant Hatch Unit 2. The listing was provided as part of the response to NRC I&E Bulletin 83-02, "Stress Corrosion Cracking In Large-Diameter Stainless Steel Recirculation System Piping at BWR Plants," issued by NRC on March 4, 1983. A copy of the GPC letter is enclosed herein as Attachment 1 to this submittal.

As noted in the response to I&E Bulletin 83-02, the inservice inspection program was augmented to include at least the minimum number of welds required by Item 2 of the subject bulletin. This included the following:

a. Ten welds in recirculation piping of 20-inch diameter, or larger.

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b. Ten welds of the jet pumps inlet riser piping and associated safe-ends.

c. Two sweepolet-to-header (manifold) welds of jet pump risers nearest the end caps.

The subject Recirculation System welds were chosen on the basis of high stress rule index (SRI) number and carbon content.

As a result of observing unacceptable crack-like indications in the original scope of examinations for the Recirculation System, the sample was increased pursuant to the guidance of ASME Section XI, IWB-2430. Ultimately, a 100% examination of the 4", 6", 12", 22", and 28" Class 1 Recirculation System welds (ASME Category B-J welds only) was performed. This accounted for the examination of ninety-six (96) Category B-J welds. In addition, six (6) of the Category B-F welds which accounted for 50% of that particular category weld were examined per the requirements of NUREG-0313, Revision 1. The examination of the Category B-F welds did not reveal any unacceptable indications, therefore, the scope of examination for that particular category weld was not increased.

Pursuant to the requirements of NRC NUREG-0313, Rev. 1, stainless steel welds of the RHR system were also examined. One hundred percent (100%) of the 20" and 24" stainless steel piping welds were examined. Unacceptable indications were observed in both the 20" and 24" piping.

In addition, five (5) RWCU System piping welds were examined. No unacceptable indications were observed. Therefore, the scope of examinations for RWCU was not increased. The welds examined were selected on the basis of high SRI and carbon content.

Please refer to Attachment 3 of our letter dated May 26, 1983 for the inservice inspection isometric drawings of the Recirculation, RHR, and RWCU piping systems. Welds which were examined using ultrasonics (UT) are denoted by encircled weld numbers.

RESULTS

NRC Region II was provided with a listing of results of piping inspections in the GPC letter dated May 26, 1983. Please refer to Attachment 1 of that letter for a listing of the Recirculation, RHR, and RWCU system piping welds examined and the results thereof. The subject listing also provides information concerning the SRI number, carbon content, type weld, and how fabricated (shop weld/field weld), where available.

EXAMINATION METHODS VALIDATION

Validation of the UT procedures was performed previously under NRC I&E Bulletin 82-03, Revision 1 for the examination of large-diameter stainless steel piping at Plant Hatch Unit 1 during the Fall 1982 maintenance/refueling outage. Pursuant to I&E Bulletin 83-02, the licensee need not repeat the validation process provided that the previous validated inspection group perform the new plant examination using identical UT procedures, standards, equipment, and transducers used to complete the previous validation effort. The same inspection group (Southern Company Services) was employed during the inservice inspection at Plant Hatch Unit 2 and used similar procedures, standards, equipment, and transducers as those used previously on Plant Hatch Unit 1. In addition, each Level II UT technician was satisfactorily tested after receiving training in IGSCC detection using cracked thick-wall specimens under the direct supervison of a Level III who had performed the qualification for I&E Bulletin 82-03, Revision 1.

INVESTIGATION INTO THE CAUSE OF CRACKING

BACKGROUND

During the augmented inservice inspections at Plant Hatch Unit 2, an unusually large number of unacceptable indications were observed, particularly involving the Recirculation System riser piping. Recognizing that a similar inspection performed at Unit 1 had revealed no unacceptable indications in the riser piping and only a few unacceptable indications in the Recirculation System manifold (ring header) and RHR System piping, GPC management initiated an investigation designed to uncover the differences between the two units which could explain the disparity of the UT results.

THE INVESTIGATION

Structural Integrity Associates was contracted by GPC to perform the investigation. Central to any investigation into the cause of stress corrosion cracking in structural components is a fundamental understanding of those elements which together form the necessary and sufficient conditions to produce the cracking. For BWR austenitic stainless steel piping, IGSCC results from the interaction of piping material, fabrication processes, fabrication and operational stresses, and the environment to which the structural components are subjected. The areas for which the similarities and differences for the two units were studied by Structural Integrity personnel included the following:

- Fabrication History
- Stresses - Operational and Fabrication
- Reactor Water Chemistry
- Inspection Results - Comparison with Baseline Radiography

SUMMARY OF CAUSE OF CRACKING INVESTIGATION

A number of areas were investigated as potential causes of the accelerated IGSCC behavior observed at Hatch Unit 2 versus Unit 1. These areas included fabrication history, applied and residual stresses, and operational history of the two units (both time/stress cycles and water chemistry). A detailed review of the current inspection results at both units was also conducted. Based on this investigation, the only substantive difference found between the two units was an unusual weld prep/counterbore configuration in the Unit 2 shop welds which resulted in a stress concentration notch or fillet within the IGSCC susceptable weld heat affected zones. This notch also coincided with most of the observed UT indications at Hatch Unit 2. Analyses were performed which indicate that the stress concentrating effect of this notch could accelerate the initiation of IGSCC in this counterbore region sufficiently to explain the observed cracking. Moreover, the presence of this counterbore can also have a confounding effect upon the ultrasonic inspection since it produces an ultrasonic reflector in itself which must be distinguished from IGSCC. It is thus concluded that the shop weld counterbore configuration at Hatch Unit 2 played a significant role in the unusually high number of UT indications observed in the recent inspection.

The review of fabrication records included certified material test reports, weld joint design and procedure specifications, grinding and repair information and piping field storage records. Other than the weld counterbore condition discussed above, no other difference was found which is believed to have had any impact on the IGSCC behavior at the two units. Significantly, the piping carbon levels were comparable, and the unprotected field storage of the Unit 2 piping, originally believed to be a factor was not confirmed by the record search.

The nominal applied and residual stresses at the two units are comparable, as evidenced by a comparison of IGSCC stress rule index data. However, when these nominal stresses are adjusted upward to account for the concentrating effect of the counterbore notch, increases in stress rule index of approximately 0.3 to 0.6 are prediced, which results in a significantly higher stress rule index distribution at Hatch Unit 2.

A comparison of operational histories revealed approximately the same numbers of stress cycles per year at the two units. Thus, since Unit 1 has been in commercial operation for seven years, the cumulative stress cycles at Unit 1 are greater. However, when coupled with the counterbore stress concentration factor discussed above (through the use of IGSCC damage index evaluation for two sample welds), it is observed that the propensity for crack initiation at Unit 2 after four years was greater than that at Unit 1 after seven years.

Water chemistry records did not reveal a significant factor that would contribute to accelerated cracking at Unit 2. The average conductivity was lower in Unit 1 through 1981, and lower in Unit 2 in 1982 and 1983. The only major chemical transient which could have impacted IGSCC was reported in Unit 1, and the dissolved oxygen levels in the reactor water were abnormally low in both units.

Finally, an extensive review of the current UT data and baseline radiography for Unit 2 was performed. The review confirms the high incidence of cracking in shop (versus field) welds, and the fact that the majority of these indications are at the counterbore locations.

ANALYSES AND REPAIRS

By letter dated May 26, 1983, GPC provided NRC Region II with a listing of welds for which corrective action in the form of repairs, analysis, or replacement is being conducted.

NUTECH has been contracted by GPC to perform the necessary analyses, as appropriate, for the affected piping welds.

Twenty-six (26) Recirculation System riser piping and manifold piping welds are currently scheduled to be repaired by means of weld overlay. They are as follows:

12AR-F-2	12BR-A-3	22AM-1	22BM-1
-3	-B-2	-4	
-G-2	-3		
-3	-4		
-H-2	-C-2		
-3	-3		
-J-2	-4		
-3	-D-2		
-4	-3		
-K-2	-E-3		
-3	-3A		
	-4		

Reportedly, five (5) of the twenty-six welds being repaired by weld overlay are field welds with the remainder being shop welds. The field welds being repaired are 12AR-J-4, 12BR-B-4, 12BR-C-4, 12BR-E-3A, and 12BR-E-4. All of those field welds are pipe-to-safe end welds with the exception of 12BR-E-3A which is a pipe-to-pipe weld.

A crack growth analysis will be performed by NUTECH on several large diameter stainless steel piping welds to justify operation without repairs at this time. The analysis will show that the as-characterized UT indications will not grow to the Code-allowable size (refer to proposed IWB-3640 of ASME Section XI Code) for at least one cycle. The welds are as follows:

Recirculation System	RHR System
28A-3	20-RS-2
-4	-3
-7	24-B-R-11
-10	
28B-3	
-7	
-8	
-10	
-15	

In accordance with the request of Mr. W. S. Hazelton (NRC-MTEB), enclosed herein as Attachments 2 and 3 are the preliminary results and input data of the NUTECH evaluation of the two largest UT indications in the large-diameter Recirculation System piping at Plant Hatch Unit 2. The welds used in the evaluation were 28B-10 and 28B-15 with indications estimated to be 20% and 23% through wall, respectively. These very conservative crack growth evaluations show that the UT indications in the subject welds will not grow to the Code allowable size for at least 26 months.

Replacement of one of the Recirculation System manifold end caps, weld 22BM-4, is in progress. Although replacement of the subject end cap was not required and weld overlay repair could have been performed, GPC management elected to replace the end cap. Heat sink welding is tentatively planned to be used during the installation of the new end cap. A sample of the cracked weld area from the old end cap will be provided to NRC NRR for their information and analysis. NRC NRR has made arrangements with Argonne National Laboratory to analyze the sample.

Several welds as noted in the response to NRC I&E Bulletin 83-02 were observed to have indications not indicative of IGSCC or in the weld heat affected zone. Based on the recommendations of the inservice inspection contractor, it is the intention of GPC to monitor these welds during future outages. The welds are as follows:

Recirculation System	RHR System
22AM-1BC-1	20-RS-1
-1BC-2	24-B-R-12
-2	
-3	
-3BC-1	
-3BC-2	
22BM-1BC-1	
-2	
-3	
-3BC-1	
-3BC-2	
28A-6	
-15	
-16	
28B-4	
-13	
-16	

GPC will not install any additional leakage detection system as a result of observing unacceptable indications in the Recirculation and RHR systems. In lieu of installing additional leak detection equipment, GPC commits to augment existing reactor coolant leakage technical specifications for the unit. Enclosed as Attachment 4 is our letter dated May 25, 1983 which commits to the upgraded surveillance and details the changes committed to.

As stated in our May 26, 1983 letter, GPC will submit to NRC NRR details of the analyses and repairs. Enclosed for your review as Attachment 5 to this submittal is a rough draft of the NUTECH design report for the weld overlay repairs and flaw evaluations. The draft is incomplete since weld overlay repairs and analyses are still being performed. The final version of the NUTECH design report will be submitted for your review upon its completion.

FUTURE INSPECTIONS

To increase the assurance of the integrity of the Recirculation System and stainless steel RHR System piping at Plant Hatch Unit 2, the following welds, contingent upon radiation levels, will be examined during the next scheduled refueling outage.

1. The six remaining ASME Category B-F welds which were not examined during this outage.

2. The twenty-six overlay repaired welds.

3. The nine Recirculation System and three RHR System welds having indications which were not repaired.

4. The nineteen welds having indications not indicative of IGSCC or not located in the weld heat affected zone.

5. One hundred percent of the remaining stainless steel RHR system welds.

6. Fifty percent of the remaining 12" and 28" Recirculation System welds.

Stainless steel welds in other systems will be examined in accordance with the guidance of NUREG-0313, Revision 1 as stated in our letter to the NRC dated June 29, 1981.

MODIFICATIONS/REPLACEMENTS

Modifications and/or replacements are under consideration. There are no firm plans at this time. Because nonconforming material (as defined in NUREG-0313, Revision 1) is utilized at Plant Hatch Unit 2, GPC has committed to NRC by letter dated June 29, 1981, to perform augmented inservice inspection in accordance with the guidance of NUREG-0313, Revision 1. In addition, it was further committed that in the event that replacement of nonconforming material is required, at such time the affected component will be replaced with conforming material and processed in accordance with Section III of NUREG-0313, Revision 1.

GPC management has authorized the formation of a task force to address cracking of stainless steel piping at the two Hatch units. The task force will investigate all available countermeasures to IGSCC and make recommendations to GPC management for resolution of the stainless steel pipe cracking issue.

Upon completion of all necessary weld overlay repairs and analyses, replacement of the one end cap, acceptable results from the nondestructive examination of the repaired welds, and hydrostatic test, it is our intention to return Plant Hatch Unit 2 to power operation. We believe that the results of the inspection and the repair program provide an adequate basis for safe operation of the unit.

Georgia Power

During a telephone conversation on May 25, 1983, with Mr. G. Rivenbark (NRR Hatch Project Manager), a meeting was scheduled by GPC tentatively for June 1, 1983, at 1:30 p.m. in Bethesda for a presentation of the information contained herein to the appropriate NRC staff personnel. Assisting in the GPC presentation to the staff will be NUTECH, Structural Integrity Associates, and Southern Company Services personnel, as appropriate.

A copy of this submittal will be provided concurrently to the NRC regional office so they may assist in the review of the analyses and repairs at Plant Hatch Unit 2.

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

Sincerely yours,

J. T. Beckham, Jr.

JAE/mb

Attachments

xc: H. C. Nix, Jr.
J. P. O'Reilly (NRC- Region II)
Senior Resident Inspector