CP&L

Carolina Power & Light Company

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SHEARON HARRIS NUCLEAR PROJECT
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APR 18 1986

File Number: SHF/10-13510
Letter Number: HO-860285(O) NRC-439

Dr. J. Nelson Grace
United States Nuclear Regulatory Commission
Region II
101 Marietta Street, Northwest (Suite 2900)
Atlanta, Georgia 30323

CAROLINA POWER & LIGHT COMPANY
SHEARON HARRIS NUCLEAR POWER PLANT
1986 - 900,000 KW - Unit 1
MAIN FEEDWATER ISOLATION VALVES,
ITEM 227

Dear Dr. Grace:

Attached is an interim report on the subject item, which was deemed reportable per the provisions of 10CFR50.55(e) and 10CFR, Part 21 on March 20, 1986. CP&L is pursuing this matter, and it is currently projected that corrective action and submission of the final report will be accomplished by April 29, 1986.

Thank you for your consideration in this matter.

Yours very truly,

R. A. Watson
Vice President
Harris Nuclear Project

RAW/ajj

Attachment

cc: Messrs. G. Maxwell (NRC-SHNPP)
J. M. Taylor (NRC)

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CAROLINA POWER & LIGHT COMPANY

SHEARON HARRIS NUCLEAR POWER PLANT

UNIT 1

INTERIM REPORT

MAIN FEEDWATER ISOLATION VALVES

ITEM 227

APRIL 11, 1986

REPORTABLE UNDER 10CFR50.55(E) & 10CFR21

SUBJECT: 10CFR50.55(e) and 10CFR21 reportable item Shearon Harris Nuclear Power Plant Unit 1 main feedwater isolation valve operator piston rod failures.

ITEM: Main feedwater isolation valves
2FW-V28SAB-1 and 2FW-V27SAB-1

SUPPLIED BY: Borg-Warner Fluid Controls

NATURE OF DEFICIENCY: During stroke testing of the above referenced feedwater valves the operator piston rods failed (snapped in two).

DATE PROBLEMS IDENTIFIED: 2FW-V28SAB-1 August 8, 1985
2FW-V27SAB-1 March 17, 1986

DATE PROBLEM REPORTED: On March 20, 1986, CP&L (Mr. K. V. Hate') notified the NRC (Mr. P. Fredrickson) that this was reportable per the provisions of 10CFR50.55(e) and 10CFR21.

SOURCE OF PROBLEM: Examination of the piston rod and hub on valve 2FW-V28SAB-1 indicated several areas of concern:

1. Ultimate Tensile Strength

   Three tensile specimens were removed from the mid-radius of the 4" diameter section of stem and tested for tensile strength. The ultimate tensile strength of each sample was approximately 138 ksi. This value is less than the 160-180 ksi ultimate tensile strength assumed by Borg-Warner for this material.

   Also, Charpy V-notch tests were performed on the material. Charpy impact values for the test specimens ranged from 16-20 ft-lbs. A brittle fracture appearance was observed for each specimen.

2. Radius at Stem-to-Hub Junction

   The actual radius at this junction could not be measured since the fracture occurred right at the radius. However, the radius was measured at the point where the stem steps from a 3" to a 4" diameter. This radius was found to be 0.008". Assuming the radii are comparable, the stem-to-hub junction becomes subject to a

SOURCE OF PROBLEM: (Cont'd)

significant stress concentration. According to Stress Concentration Factors (Peterson, 1974), the stress concentration factor based on netsection stress, for this geometric configuration and radius can be in the range of 7-10. Application of this factor results in a situation in which this area of the stem is overstressed during operation of the valve. It was also noted the Peterson data is for a stepped shaft. As such, it represents a conservatively low estimate of stress concentration for this stem configuration.

The design radius for the stem-to-hub junction per Borg-Warner drawing is 0.015" - 0.030". Even with a radius of 0.030", however, the stress concentration factor remains greater than 3.

3. Hub Thickness

Measurements taken of the hub show the thickness is not uniform. The minimum thickness measured from the upper hub surface to the lower is 0.63"; the maximum is 0.72". In addition, the distance from the upper surface to the lower surface of the raised center area on the bottom of the hub is 0.85".

Using these dimensions and the expected operating loads on the stem, CP&L computed the expected stress levels in the stem utilizing the flat plate model (Roark, 5th Ed., Case 1L) for the stem, considering this a better representation of stem configuration than the stepped shaft model.

Assuming a total load on the stem/piston rod of 250,000 lbs (corresponding to 2515 psi hydraulic pressure and 0 psi nitrogen pressure), we computed the stresses listed below for the indicated thicknesses. We also computed the stresses for a total load of 320,000 lbs (3200 psi hydraulic pressure, 0 psi nitrogen pressure). This case was considered because Borg-Warner had stated the piston rod/stem is designed to withstand the forces generated by this 3200 psi differential.

Hub Thickness (in.)	Stress (psi) (250,000 lb load)	Stress (psi) (320,000 lb load)
0.63	184,000	236,000
0.72	141,000	180,000
0.85	101,000	130,000

SOURCE OF PROBLEM: (Cont'd)

These figures indicate a strong possibility the stem hub area is overstressed during valve operation. Also, it should be noted the above stress values do not account for the stress concentration due to the sharp radius at the stem-to-hub junction.

4. Crack Indication on the Piston Head

Examination of the piston rod showed a crack had developed in the 10" section of the rod head approximately 1/8" from the junction with the 4" diameter stem. The crack circles the 4" stem for approximately 270°. The Metallurgy unit analyzed a wedge shape piece from the piston rod head and perform a detailed analysis of the crack. It was determined that the crack was in a nonstructural seal weld that had been machined too thin.

5. Coupling Deformation

Dimensional data taken from the coupling indicates the shoulder of the coupling, which holds the stem hub, was deformed upwards approximately 0.010" - 0.015".

SAFETY IMPLICATIONS:

Failure of these piston rods would result in loss of control of the main feedwater isolation valves.

REASON DEFICIENCY IS REPORTABLE:

This condition would eliminate the ability to isolate the feedwater pipelines entering containment.

CORRECTIVE ACTION:

Borg-Warner has redesigned, manufactured and supplied replacement piston rods and couplings. The replacement piston rod material is ASTM A304 Gr. 4340H, heat treated to a tensile strength of 180-200 ksi. In addition the radii of the piston rod groove has been increased to 0.090 - 0.095 inches. The groove diameter has been increased from 3.000/3.040 inches to 3.250 inches and the groove width has been enlarged to 0.640 - 0.650 inches. The rod hub thickness is now 0.840-0 - 0.850. The groove and hub surfaces are shot peened to an intensity of 0.012 - 0.016. Analysis of the modified piston rod end has shown that the resultant stresses are within allowable limits. Borg-Warner is confident that this new design has eliminated the repeat of the type of failure noted above.

CORRECTIVE ACTION: (Cont'd)

Replacement with these new piston rods and couplings is currently underway for the two subject valves and valve 2FW-V26SAB-1 (which has yet to fail). Completion is estimated by April 29, 1986.