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August 27, 1982

Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

Subject: Oconee Nuclear Station
Docket No. 50-287

Dear Mr. O'Reilly:

Please find attached Reportable Occurrence Report RO-287/82-06, Revision 2, which contains updated information about the Description of Occurrence, the Apparent Cause of Occurrence, and the Corrective Action. This report is submitted pursuant to Oconee Nuclear Station Technical Specification 6.6.2.1.a(9) which concerns the discovery of conditions not specifically considered in the safety analysis report or Technical Specifications that require corrective measures to prevent the existence or development of an unsafe condition, and describes an incident which is considered to be of no significance with respect to its effect on the health and safety of the public.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

JFN/php
Attachment

cc: Mr. John F. Stolz
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IE 22

cc: Records Center
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Mr. F. R. Burke, B&W

Duke Power Company
Oconee Nuclear Station
Unit 3

Report Number: RO-287/82-06, Revision 2

Report Date: August 27, 1982

Occurrence Date: April 30, 1982

Facility: Oconee Unit 3, Seneca, South Carolina

Identification of Occurrence: Steam Generator Internal Auxiliary Feedwater (AFW) headers deformed.

Conditions Prior to Occurrence: Refueling Shutdown

Description of Occurrence: Because of the discovery of damage to the OTSG Internal Auxiliary Feedwater (AFW) Headers at Davis Besse (Toledo Edison) and Rancho Seco (Sacramento Municipal Utility District) the decision was made to shut down Unit 3 on the evening of April 23, 1982 and begin a refueling outage earlier than planned. (Units 1 and 2 utilize an external AFW header and are not subject to this damage.) After Unit 3 was cooled and drained, a visual inspection was begun on the evening of April 29, 1982, and it was reported early the next day that damage had been discovered somewhat similar to that reported by Davis Besse and Rancho Seco.

Attachment 1 shows a longitudinal view of the Once Through Steam Generator (OTSG) and indicates the position of the internal AFW header. Attachment 2 shows a longitudinal view of the internal AFW header at the single AFW nozzle position. As indicated in these attachments the internal AFW header is mounted on top of the upper shroud between the 15th Tube Support Plate (TSP) and the Upper Tube Sheet (UTS). The internal AFW ring header is constructed of 3/8 inch carbon steel with a 13 inch x 5 inch rectangular cross-section. There is a single AFW nozzle injecting into the header to fill the header with water. The water flows into the steam generator tube bundle through sixty 1½ inch diameter holes located near the top of the header and equally spaced around it. The header rests on the top of the shroud and is attached to it by eight pairs of brackets which are equally spaced around the header. Each bracket (or Tab) measures 1½ inches wide x 2 3/8 inches long x 3/8 inch thick and is welded to the header. A 2 11/16 inch long x 3/4 inch diameter dowel pin is welded to the inner bracket and slip-fit through the shroud and the outer bracket to hold the header in place while allowing for differential thermal movement between the header and the shroud.

A detailed description of the visual inspection is included in Attachment 3.

Apparent Cause of Occurrence: Analysis indicates that the cause of the deformation of the internal auxiliary feedwater header is inadequate design to withstand the large pressure forces generated when cold auxiliary feedwater is injected into the header. During normal operation the header would be filled with dry super-heated steam as the header sits in the upper super-heat region of the OTSG. When cold auxiliary feedwater ($\sim 80^{\circ}F$) is injected into the rectangular header, very large local pressure differences can occur with large steam-water contact areas which cannot be locally compensated for quickly enough through the $1\frac{1}{2}$ inch diameter flow holes. Except for the extra strength weld areas the 3/8 inch plate walls are not reinforced and are inadequate for the loads generated under these conditions.

The extensive cracking found in the corners of the A header occurred at the interface of the top and bottom header plates and the weld of the vertical walls. Visual inspections and analyses of weld samples cut from the A header indicate poor quality welds during original construction of the A header. While construction drawings required a "V" shaped weld prep at the interface of the vertical and horizontal header walls, the analyses show that only the vertical walls were prepped which resulted in an inconsistent weld pattern with areas of lack of fusion and lack of full penetration when the fit-up was less than ideal. Those areas of these welds were simply inadequate to withstand the loads generated when the header was deformed as described above. A weld sample was cut from the B header and analysis revealed a weld of higher quality, although still not exactly as specified in the drawings. The higher quality sample is consistent with the weld inspections of A and B. The reason for the weld discrepancies with the construction drawings is not known, but the A header was the first internal AFW header constructed by Babcock and Wilcox. The higher quality weld on B may have been the result of experience gained in constructing the A header.

The cause of the holes in the headers (illustrated in Attachment 3) has not been definitely determined, but a laboratory analysis is being performed on the large hole and crack which were cut out of the A header. Preliminary analysis indicates a strong, localized corrosive attack occurred in this area. The corrosive agent has not been identified, but the material of the header does not contain unexpected impurities which would cause this corrosion. It is possible that a corrosive agent might have entered the headers at some time prior to installation into the steam generators. There is no known operational experience at Unit 3 which would explain such highly localized corrosion. However, since the headers are being removed from AFW delivery services, water will no longer be injected into the headers and the dry super-heated steam should not corrosively attack the headers.

Analysis of Occurrence: The unit was brought to safe shutdown as a precautionary measure using normal procedures and with no abnormal releases. The visual inspection showed that while the headers were deformed, each auxiliary feedwater nozzle was still aligned in the internal header hole and would still be able to fill the internal header with water. The holes discovered in both internal headers would have no significant effect on the capability to deliver AFW to the steam generators. Thus, although deformed, the AFW header would still have functionally provided AFW flow when required.

The visual inspections to date have not revealed any significant damage to any OTSG tubes at Unit 3. The possibility did exist that future AFW injections may have further deformed the header so as to damage tubes on the outer row.

The Inconel tubes can sustain considerable contact without significant damage, but if a tube leak had occurred before the unit was shut down, the operations procedure for control of secondary contamination and other operations procedures would have been used to protect the health and safety of the public.

Corrective Action: The internal AFW header will not be reused for AFW delivery, but will be stabilized in place and the existing AFW nozzle will be blank flanged. The internal header would serve then as an extension of the inner shroud and would maintain steam cross flow at the present distance above the 15th TSP.

To stabilize the internal header, six holes were drilled through the steam generator shell and shroud near each dowel pin and bracket location (except bracket numbers 2 and 3 which can be reached from the manway). The dowel pins and brackets were removed. The B internal header was welded to the shroud through the six holes and the existing manway.

Due to the extensive cracking found in the lower inner weld of the A header and the lesser cracking found in the upper inner and lower outer corner welds, the decision was made to take no credit for any corner weld in the A header stabilization. Thus, the four header walls had to be "attached" to each other prior to stabilizing the header to the shroud. To accomplish this an "L" section was cut out, a pair of bulkheads were welded on each side to the four walls and the trimmed "L" section was rewelded in place. The repair is being performed at fifteen locations around the header, as shown in Attachment 4. The header will then be welded to the shroud similar to B. Prior to welding to the shroud the A header will be rotated so that the corroded area of the header will be near the x axis manway for future inspections.

The six holes drilled in the steam generator shell and shroud for header stabilization work will also be used as points of injection for an external AFW ring header. The design of the external header system is very similar to the design utilized on Oconee 1 and 2. The design includes an external ring header with six J-pipe risers feeding into the steam generator through thermal sleeves, directly into the tube bundle. The main difference between the external AFW header system to be installed on Oconee 3 and the ones utilized on Oconee 1 and 2 is a new thermal sleeve design which should eliminate the thermal sleeve cracking problem experienced on the old design.