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CORE SPRAY LINE DOWNCOMER REPAIR
SEISMIC REPORT SUMMARY
for
PEACH BOTTOM ATOMIC POWER STATION, UNIT 2

Modification P00335

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1. INTRODUCTION

1.1 Background

Peach Bottom Atomic Power Station Unit 2 has two Core Spray Lines (CSL) which enter the reactor pressure vessel (RPV) at the 120° and 240° azimuth locations. The CSL entering at 120° splits at its T-box with the downcomers at 7.5° and at 172.5° locations. The CLS entering at 240° splits at its T-box with the downcomers at 187.5° and at 352.5° locations. The welded joints in the CSL downcomers near the shroud penetration may be cracked and will require reinforcement if the cracks are found. The reinforcement is required to maintain the pipe alignment and to prevent a cracked joint for separating. This modification is of a bolted design utilizing clamps for attachment to the CSL.

The same type modification was used on Peach Bottom Atomic Power Station Unit 3 at the 172.5° downcomer location. The design and analysis used for the Peach Bottom 3 modification has been reviewed and the results are utilized where applicable.

1.2 Scope

The analysis covers the CSL from the thermal sleeve at the RPV to the CSL shroud penetration including the 90° elbow, but excluding the penetration sleeve. Two different cases were evaluated, one assuming the downcomer integrity was intact and the other assuming the propagation of the crack to 360 degrees which allowed rotational freedom at the crack location.

This report transmits the results of the CSL design stress analysis which assesses the effects of the proposed modification on the CSL. The purpose of the analysis is to demonstrate the seismic structural adequacy of the CSL with the downcomer modification installed at Peach Bottom Unit 2.. The analysis is contained in Design Record Files (DRF) B13-01800, B13-01732 and B11-00642.

2. CORE SPRAY LINE EVALUATION

2.1 Assumptions

The following assumptions are used in the CSL structural analysis.

1. The CSL downcomer sleeve/spigot assembly near the shroud penetration is assumed to have one or more 360° through wall cracks. No credit is taken for any

remaining ligament at the postulated crack location. Cracks may exist at one, two, three or all four downcomers.

2. The seismic analysis shall take into account both partial and complete cracking of the shroud welds. The degree of cracking assumed shall be the maximum crack length permitted without requiring shroud repair and complete cracking with the tie rod repair installed.

2.2 Seismic Evaluation

The seismic evaluation for the Peach Bottom 2 downcomer repair utilizes analyses from the shroud repair work and from previous downcomer repair work.. The applicable analysis are summarized below and can be found in DRF's B13-01800, B13-01732 and B11-00642.

a. The shroud repair seismic analysis predicts 1.2 inches for the maximum CLS anchor point displacements. The analysis assumes the shroud with 360° through wall cracks and with the tie rod repair installed.

b. Seismic analysis which assumes the shroud cracked to the maximum extent without requiring the tie rods installed predicts the maximum CSL anchor point to be 0.4 inches.

c. Confirming seismic analysis using Peach Bottom 2 fuel loads validate the used of the previous analysis for Peach Bottom 2 application.

2.3 CLS Stress Evaluation

A CSL structural analysis has been completed for the previous shroud repair work and additional analysis prepared for the previous downcomer repair. The Peach Bottom 3 analysis accounts for the repair brackets welded to T-box near the vessel inlet nozzle. The analysis applicable the Peach Bottom 2 downcomer repair are summarized below.

a. Core spray line analysis show acceptability of CSL in the non cracked condition.

b. Core spray line analysis shows acceptability assuming 360° through wall crack and with the downcomer repair hardware installed. The analytic model includes a pinned joint (no moment carrying ability) to represent the cracked pipe and additional mass to represent the repair hardware.

2.4 Summary of Results

The analyses summarized above show the piping stresses satisfy the requirements of Article NB-3600 of ASME Section III. A summary of the maximum stresses obtained by solution of Subarticle NB-3650 equations is shown in Table 1. Table 1 also includes the allowable stresses for each service level.

The analysis model used to calculate these stresses assumes a 360° through wall crack in one downcomer and no cracks in the other downcomer. With the exception of the thermal case, the higher stresses are found in the uncracked branch of the CSL. A cracked pipe section is unable to carry a moment and helps reduce the bending stresses. Cracks assumed in both branches of the CSL is not expected to increase the stresses in either branch.

The main contribution of the fatigue usage is due to the relative Operating Base Earthquake anchor displacements between the shroud penetration and the RPV nozzle (OBED). The value of relative displacement is 1.20" 0-peak, 2.4" peak to peak. This is the worst displacement condition calculated for 360° through wall cracks in the shroud with the tie rod repair installed. Twenty total cycles are assumed for this load condition.

Table 1
Maximum Stress Summary

Pipe Elbows and Components

Service Level	Calculated Stress Intensity (ksi)	Allowable Stress (ksi)
Normal/Upset (Primary)	10.5	1.5Sm = 25.4
Normal/Upset (Primary + Sec. excluding thermal bending)	5.5	3.0Sm = 50.8
Normal/Upset (Primary + Secondary)	286.0	N/A
Service Level C	10.6	2.25Sm = 38.14
Service Level D	13.9	3.0Sm = 50.8
Max. Cumulative Usage	0.71	1.0
Thermal Exp. (Eq. 12)	21.4	3.0Sm = 50.8