PB ECR 95-4972 REV Ø
ATTACHMENT PAGE 73 OF
DWG #
SHT # REV

GENE-771-01-1295
DRF No. B13-01800
SHEET 1

CORE SPRAY LINE DOWNCOMER REPAIR HARDWARE
STRESS ASSESSMENT REPORT
for
PEACH BOTTOM ATOMIC POWER STATION UNIT 2
Modification P000335

Prepared By: T E Gleason 12/22/95
T. E. Gleason, Principal Engineer
Mechanical Design Engineering

Reviewed By: Alfred Galestian
A. Galestian, PE, Consulting Senior Engineer

Approved By:
D. W. Smith, Program Manager

1. INTRODUCTION

1.1 **Core Spray Sparger Downcomer Welds**. Each CSS (upper and lower) includes two 6 NPS schedule 40 inlet pipes which penetrate the shroud. An elbow and vertical pipe spool are connected to these inlet pipes outside the shroud; the assembly of this elbow and the vertical pipe spool will be referred to as the CSS downcomer. Drawing 104R941G001, Reactor Assembly and drawing 886D499, Reactor Vessel show the details described below.

The core spray lines (CSL) connect to the CSS downcomer pipes at the approximate elevation of the top of the shroud. The field welded connection between the CSL downcomer and the CSS downcomer pipe is shown at zone B-16, sheet 1 on reactor assembly drawing. The semi-circular CSL is a 304 stainless steel pipe run internal to the reactor. Its purpose is to carry the core spray system flow from the core spray nozzle thermal sleeve (located at 484.5 inches elevation above vessel zero, at azimuth 120° (N5A), and at azimuth 240° (N5B), to two of the CSS downcomers. The 6-inch CSL laterals are welded to an 7.93 inch outside diameter T-box as shown on the reactor assembly drawing. The CSL T-box connection with the core spray nozzle thermal sleeve is a reactor assembly weld as shown on sheet 1, zone B-15 of the reactor assembly drawing. Each horizontal section of the CSL is supported from the vessel wall by a CSL bracket which is welded to the vessel 20 inches from the nozzle, and a CSL clamp, located at 15°, 165°, 195°, and 345°.

1.2 **CCS Downcomer Modification** Special core spray sparger inspections done in response to IE Bulletin 80-13 have located defects in these structures , which seem to be with some of the original fabrication and installation welds. Figure 1 identifies the downcomer welds and shows a typical defect. A repair (by modification) will be designed to address the potential for cracking in the downcomer pipe from below weld 1 through weld 4.

1.3 **Modification Concept**. The CSS downcomer modification includes an external clamp assembly which will be mechanically attached to the CSS downcomer at the defect area. The clamp is placed on the CSL downcomer above the junction with the CSS downcomer pipe, as shown in Figure 2. A lower clamp is placed at the location of the pipe to lower elbow weld (weld #4). This clamp encircles 360 degrees of the weld. To provide lateral stability at weld locations 1 through 3, the upper clamp is extended downward past these welds. This downward extension encircles the pipe below weld number 3 with an open cage type design which allows for variations in pipe alignment from top to bottom of the joint area and will maintain the pipe alignment in the event of crack growth to 360 degrees. The upper clamp is joined by a U-bolt to the elbow to provide vertical structural continuity across the defect area

Figure 2 shows the clamp arrangement as installed on the longer downcomer pipes at locations 7.5° and 172.5°. The downcomers located at 187.5° and 352.5° are somewhat shorter and the functional requirements can be achieved with the upper and lower clamps integrated into a single assembly.

2. PURPOSE

This report transmits the results of the design stress analysis which addresses the effects of the core spray system operational cycles and shroud stabilizer effects on the modification hardware. Also included are the results of the core spray system leakage analysis. The analysis is contained in Design Record File (DRF) B13-01800.

3. SUMMARY AND CONCLUSIONS

3.1 Scope This report covers only the modific ution hardware and localized stresses, if any, imposed on the core spray line. For the purpose of this analysis, the structural integrity at weld locations other than the crack locations is considered to be complete. At the crack locations, crack propagation to 360° is considered for both stress and leakage evaluation.

Many similarities exist between this modification and the modification at the 172.5° location on the Peach Bottom 3 core spray line. The major differences are:

a. Cracks are assumed at all downcomer locations and the repair hardware is assumed to be applied to all the downcomers. The repair hardware at the 7.5° and 172.5° locations is the same as that used for the 172.5° location in Peach Bottom 3. The repair hardware for the 178.5° and 352.5° downcomers is modified to account for the different axial geometry at these locations.

b. The fuel loads used for the seismic analysis are slightly different.

The analysis for the Peach Bottom 3 modification has been reviewed and the results used where applicable.

3.2 ASME III Code Compliance's The clamp stresses satisfy the requirements of the ASME Code, Section III, Subsection NG. A summary of the results obtained by solution of Sub-section NG equations for all significant locations is contained in Appendix A of the stress analysis located in DRF B13-01800 for both clamp designs and contained herein as Appendix A. The stresses reported herein are the maxima for each classification.

The U-bolt section stresses are evaluated to the requirements of paragraph NG3222 for both repairs designs. The preload imposed on the U-bolts at installation is greater than the cyclical loadings and as a result, the maximum usage factor for the U-bolt is 0. The

maximum primary plus bending stress is 5,370 psi compared to an allowable stress of 44,175 psi and occurs in the curve section of the bolt.

Threaded fastener stresses are evaluated to the requirements of paragraph NG3232. The maximum primary membrane plus secondary membrane including preload stress is 22,370 psi compared to an allowable of 29,400 psi and occurs in the cross sectional area of the 0.75 inch bolt. The preload imposed on the bolting exceeds the cyclical loadings and as a result, the fastener maximum fatigue usage is 0.001.

Although the LOCA event is considered a Service Level C condition, the Service Level A and B allowables are easily met for all load conditions as shown in the Appendix.

3.3 **Leakage** Evaluation of possible leakage is based on the assumption that the identified crack propagates to 360° with another potential crack existing also for 360° within the connector regions. Upon the activation of the core spray system, the core spray line is assumed to contract. The contraction results in a 0.062 inch wide crack in the "A" loop and a 0.041 inch wide crack in the "B" loop. The "A" loop contraction is greater because of the longer clap geometry. Due to possible misalignment of the isolated pipe segment preventing crack closure upon temperature equilibrium, the gaps are assumed to remain constant. The normal system leakage through the CLS vent when added to the connector region crack leakage amounts to 658 gpm for the "A" loop and 445 GPM for the "B" loop in steady state condition.

APPENDIX A - STRESS SUMMARY

U-Bolt Stresses

Service Level	Calculated Stress Intensity (ksi)	Allowable Stress (ksi)
Normal/Upset (Primary Membrane)	2.5	Sm = 29.5
Normal/Upset (Primary Membrane + Primary Bending)	5.37	1.5 Sm = 44.2
Normal/Upset (Secondary)	2.5	3Sm = 88.4
Service Level C - Pm Pm + Pb	2.5 5.37	1.5Sm = 44.2 2.25Sm = 38.25
Service Level D Pm / Pm + Pb	2.5/5.37	Sy = 32.7/.7Su = 62.9
Max. Cumulative Usage	0.0	1.0

Fastener Stresses

Service Level	Category	Calculated Stress Intensity (ksi)	Allowable Stress (ksi)
Normal/Upset (Primary Membrane + Secondary Membrane including Preload)	Shank or Threads Thread Shear Bearing Shank or Threads	22.37 6.43 7.66	.9Sy = 29.4 .6Sy = 19.6 2.7Sy = 88.2 1.0Sm = 29.5
Normal/Upset (Primary Membrane and Bending + Secondary Membrane and Bending)	Shank or Threads	22.37	1.2Sy = 39.2
Service Level C - Primary Membrane	U-bolt-elbow contact	22.37	1.5Sm = 44.2
Service Level C - Primary Membrane + Primary Bending		22.37	2.25Sm = 38.25
Service Level D Pm		22.37	Sy = 32.7
Max. Cumulative Usage		.001	1.0

7.5° and 172° Clamp Stresses

Service Level	Calculated Stress Intensity (ksi)	Allowable Stress (ksi)
Normal/Upset (Primary Membrane)	2.2	Sm = 16.95
Normal/Upset (Primary Membrane + Primary Bending)	2.9	1.5Sm = 25.4
Normal/Upset (Secondary)	42.8	3Sm = 50.8
Service Level C - Pm Pm + Pb	2.4 3.1	1.5Sm = 25.4 2.25Sm = 38.1
Service Level D Pm Pm + Pb	4.7 5.8	Sy = 18.05 .7Su = 44.45
Max. Cumulative Usage	0.31	1.0

187.5° and 352.5° Clamp Stresses

Service Level	Calculated Stress Intensity (ksi)	Allowable Stress (ksi)
Normal/Upset (Primary Membrane)	4.95	Sm = 16.95
Normal/Upset (Primary Membrane + Primary Bending)	7.14	1.5Sm = 25.4
Normal/Upset (Secondary)	44.0	3Sm = 50.8
Service Level C - Pm Pm + Pb	0.85 3.20	1.5Sm = 25.4 2.25Sm = 38.1
Service Level D Pm Pm + Pb	0.85 3.20	Sy = 18.05 .7Su = 44.45
Max. Cumulative Usage	.31	1

Leakage

System Operation	Flowrate (gpm) w/leakage (Based on 6250 gpm Design Flow)	Required Flowrate (gpm)
LOCA. LOOP "A"	5805	5000
LOCA. LOOP "B"	5592	5000

PB ECR 95-4972 REV Ø
ATTACHMENT PAGE 79 OF ____
DWG # ____
SHT # ____ REV ____

GENE -771-01-1295
DRF No. B13-01800
SHEET 7

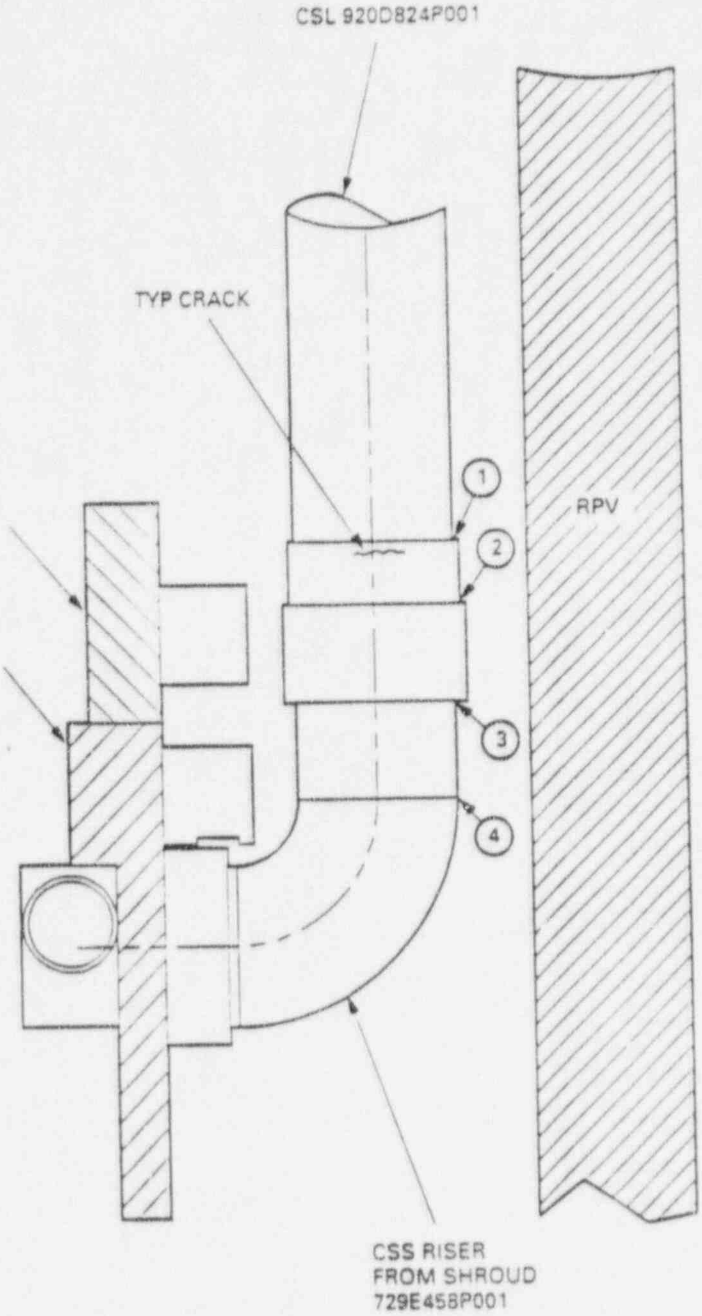

Figure 1. Core Spray Sparger Riser/Downcomer

PB ECR 95-4972 REV Ø
ATTACHMENT PAGE 30 OF ____
DWG # ____
SHT # ____ REV ____

GENE-771-01-1295
DRF No. B13-01800
SHEET 8

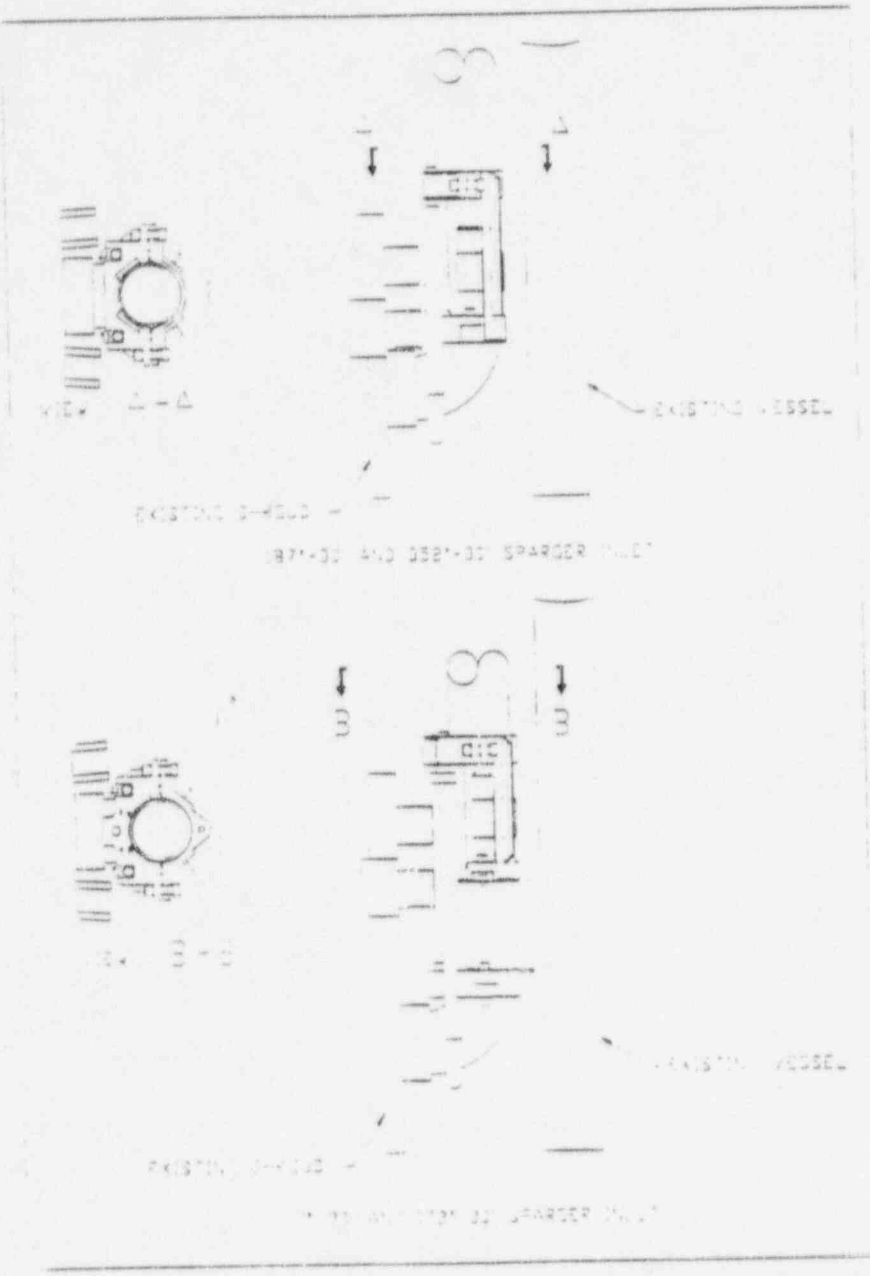

FIGURE 2
DOWNCOMER MODIFICATION