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April 7, 2008

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Duke Power Company LLC d/b/a Duke Energy Carolinas LLC (Duke)
Oconee Nuclear Station, Unit 1
Docket No: 50-269
Relief Request No. 08-ON-003
Relief Request from Immediate ASME Code Flaw Repair of Low Pressure Service Water Piping

Pursuant to Generic Letter 90-05 "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping" and 10 CFR 50.55a(g)(5)(iii), Duke requests relief from specific requirements of the 1998 Edition, through the 2000 Addenda, of the ASME Section XI Code on the basis that compliance with the specified requirements would be impractical.

Duke has determined that performing a code compliant repair/replacement activity at this time is impractical and wishes to defer the code repair/replacement until the upcoming Unit 1 EOC24 Refueling Outage. Per Generic Letter 90-05, specific written relief granted by the NRC is appropriate when performing the repair at the time of discovery is determined to be impractical.

Therefore, Duke Energy submits the attached Relief Request 08-ON-003, and requests that the NRC grant relief as authorized under 10 CFR 50.55a(g)(6)(i).

The NRC was informed of this issue by telephone conference call on January 30, 2008.

The attached relief request contains regulatory commitments as stated in the Proposed Alternative and Basis for Use sections of the request.

If there are any questions or further information is needed you may contact Corey Gray at (864) 886-6325,

Very truly yours,

Dave Baxter,
Site Vice President

Attachment

A047
NRR

xc w/att: Victor McCree
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D. W. Rich
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S. E. Jenkins, Section Manager,
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Columbia, SC 29201

Figure 4.1-2
Relief Request Review Form
(Add Additional Sheets as Necessary)

Page 1 of 1

Relief Request Serial Number: 08-ON-003 PIP Number(s): 0-08-0164

Station(s) (Check All that Apply):
- ☑ Oconee Unit(s): ☑ 1 ☐ 2 ☐ 3
- ☐ McGuire Unit(s): ☐ 1 ☐ 2
- ☐ Catawba Unit(s): ☐ 1 ☐ 2
- ☐ Other (List) Unit(s):

Subject: 1LPSW-21 Weld neck flange Pin hole leak

Prepared By (Print Name)	Group/Section	Signature	Date
Aaron Best	ONS / MCE / Civil	[signature]	3-13-08

Contributor(s) (Print Name)	Specific Sections/Portions Provided by Contributor(s) and Sources of All Information/Data Provided
Geary Armentrout	Enclosure 1 + Enclosure 2+3
Beau Abellana	Portions of Section 4

Checked By (Print Name)	Specific Sections/Portions Checked (All Sections/Portions must be checked)	Signature	Date
Dave Peltola	ALL SECTIONS OF RELIEF REQUEST (5 PAGES)	[signature]	3/17/2008
Dave Peltola	Enclosure 1	[signature]	3/31/2008
Jay Eaton, David Tucker	Enclosure 2	See Enclosure	See Encl.
Gary Moss, David Tucker	Enclosure 3	See Enclosure	See Encl.

Reviewed By (Print Name)	Group/Section	Signature	Date
Mark Ferlisi	SXIP/NGO	[signature]	3-18-08
MARK PYNE	Other (List)	[signature]	3-25-08

Approved By (Print Name)	Group/Section	Signature	Date
Andy Wells	ONS / MCE / CIVIL	[signature]	3-27-08

Final Review of Completed Submittal w/Cover Letter (Print Name)	Group/Section	Signature	Date
Aaron Best	ONS / MCE / Civil (RR Preparer)	[signature]	3-31-08
Andy Wells	ONS / MCE / CIVIL (RR Approver)	[signature]	3-27-08
Mark Ferlisi	SXIP/NGO	[signature]	3-19-08
	Other (List)		

Oconee Nuclear Station - Unit 1
Relief Request Number 08-ON-003

Relief Requested
In Accordance with 10 CFR 50.55a (g)(5)(iii)

Conformance with certain code requirements is impractical for this facility

1. **<u>ASME Code Component(s) Affected</u>**

   The component is an ASME Class 3, Duke Class F, carbon steel ASTM A 105, 8", 150 lb, weld-neck flange directly downstream of a butterfly valve (1LPSW-21) on the outlet of the 1B Reactor Building Cooling Unit (RBCU) cooling coils in the Low Pressure Service Water (LPSW) system.

   1LPSW-21 is the 1B RBCU LPSW (cooling water) return isolation. The valve is normally throttled during power operation. The design pressure is 100 psig and the design temperature is 193 °F for this section of piping per OFD-124B-1.2. The valve and flange are located outside containment in the Auxiliary Building. In an event, Engineering Safeguards (ES) actuation will open 1LPSW-21 and the corresponding valves in the other RBCU's to provide maximum flow of cooling water to facilitate containment heat removal.

2. **<u>Applicable Code Edition and Addenda</u>**

   ASME Section XI Code, 1998 Edition through the 2000 Addenda.

3. **<u>Applicable Code Requirement</u>**

   ASME Section XI Code, Subsection IWD, "Requirements for Class 3 Components of Light-Water Cooled Plants", Article IWD-3000, "Acceptance Standards". This section of the Code is in the course of preparation and the rules of IWB-3000 may be used. Duke Energy Corporation has chosen to apply the requirements of Subsection IWB, "Requirements for Class 1 Components of Light-Water Cooled Plants" for this component. The requirement of subparagraph IWB-3132.2, "Acceptance by Repair/Replacement Activity" applies when the component cannot be accepted by Volumetric or Surface Examination in accordance with IWB-3132.1 or when the component cannot be accepted by Analytical Evaluation in accordance with IWB-3132.3.

4. **<u>Reason for Request</u>**

   Active leakage from 3 small pinhole defects located on the downstream weld neck flange of 1LPSW-21 was found. The one on the north side of the horizontal pipe (running east-west) was minor; misting and spattering. The 2 on the south side were approx. 1/2 inch apart and are misting & spattering (not a constant stream of flow). The two leak areas are 180 degrees apart at the same piping axial orientation. The pinhole on the north side is in the weld toe of the weld between the pipe-to-weld neck flange (flange side). The two adjacent pinholes on the south side are on the weld neck about 1 inch away from the flange ear.

Cause determination concluded cavitation wear as the pinhole leakage cause on the flange (audible cavitation noise present on downstream side of the valve). The cause of this cavitation is due to flow throttling at the butterfly valve.

Ultrasonic thickness measurements were taken of the weld-neck flange on a 0.5" by 0.5" grid and on downstream piping on a 1" by 1" grid to determine the extent of wall thinning caused by the cavitation. The results of these UT measurements showed that wall thinning in the area of the pinhole leaks was sufficient enough to create a risk of weld burn-though during welding that would be required to make an in-service Code repair.

Volumetric angle beam UT measurements of the weld neck flange are not feasible due to flange geometry. The flange has non-parallel inner and outer surfaces and bolting materials that would obstruct the volumetric UT process.

To replace the degraded flange during power operation, the affected RBCU will have to be isolated. Isolation of 1B RBCU would require entry in Technical Specification (TS) 3.6.5 action B.1, which allows 7 days in this condition. Systems Engineering and Operations have evaluated the isolation requirements to repair 1LPSW-21 and determined performing a Code repair/replacement activity to correct flaws that have such a minor leak rate (<0.001 gpm) would create impracticality based on the following overriding concerns:

- In order to replace the flange & piping, the affected component must be isolated, which will require the system to be drained. Operating experience has shown that draining the system could require opening vents and/or drains in the reactor building. This action will violate containment integrity (opening a vent/drain on LPSW system inside Containment provides direct pathway to outside Containment). TS 3.6.3, action C.1 must be entered to allow the vent/drain to be opened, which only allows 4 hours in this condition. If the 4 hours is exceeded, the unit must be in Mode 3 within 12 hours. Experience has shown that draining would take greater time than that allowed by TS 3.6.3 Action C.1. An opened containment isolation (in this case the drains) must be secured within 4 hrs after it has been opened. Draining the system would require multiple entries into TS 3.6.3 to preclude a forced unit shutdown.

- The uncertainty of the isolation valves to maintain leak tightness throughout the repair period could also pose a challenge. If during the course of repair the isolation valve were to leak, the weldment and restoration of the affect pipes could also challenge the allowed LCO time for the RBCU itself. Tech Spec 3.6.5 allows an RBCU to be taken out of service for up to 7 days. The isolation valves must maintain leak tightness throughout the repair period. If leak tightness is not obtained initially, then repairs can not be performed with the unit at power operations, because the next isolation valve would take all 3 RBCU's out of service. If leakage were to begin after the repair process had begun (piping cut), then the piping butt welds could not be completed with the unit at power operation due to water intrusion at the weld site. There is uncertainty that the LPSW valves can maintain leak tight isolation due to the fact that these valves operate in a raw water system where debris can collect on valve seating surfaces making a leak tight seal difficult to obtain. Past experience with the isolation valves has shown that some seat leakage is likely to occur and water intrusion at the weld site is possible. If repairs are attempted at power, there is real concern a forced unit shutdown would be required to complete the repairs.

- Refilling the system following completion of a repair/replacement activity must be completed in a very controlled manner to prevent a water hammer. Duke considers draining and refilling the system an unwarranted risk based upon the small amount of leakage and assured structural integrity, and one that need not be taken. During the restoration process cooling water must be re-introduced into the system in a controlled manner to minimize/eliminate water hammer. This process to restore the system will infringe on the allowed out of service time per TS 3.6.5.

No compensating increase in the level of quality and safety would be gained by immediate repair of the flaws. The evaluation in Enclosure 1 provides the basis that adequate margins exist in the pipe and flange remaining wall thickness down stream of valve 1LPSW-21 to prevent catastrophic failure. The system is capable of performing its design function through the end of the current fuel cycle.

5. **<u>Proposed Alternative and Basis for Use</u>**

<u>Alternative:</u> In lieu of the requirement of IWB-3132.2, Duke Energy Corporation proposes to accept the component by engineering evaluation as directed by GL 90-05, documented in Enclosure 1, contingent on performing the following actions:

1. Extent of Condition NDE has been performed on all other susceptible locations. This includes visual examinations to verify no other through wall flaws and UT thickness examinations to characterize wall thinning due to cavitation. These eight locations consist of the downstream flanges on valves 1LPSW-18 & 1LPSW-24 (cooling return line for 1A & 1C RBCU), as well as the downstream flanges on valves 2&3LPSW-18, - 21, & -24 on both Unit 2 & 3. No other through wall leaks were found and wall thinning was within acceptable tolerance.

2. Operations shall visually observe leakage once per shift to ensure early detection of an increased leak rate and to ensure the assumptions used in the operability evaluation remain valid.

3. Interim UT thickness measurements have been taken again on the leaking flange and downstream piping on March 4th to verify the projected wear rate as documented in the operability evaluation. Wear rates were within acceptable limits as shown in Enclosure 3.

4. A Code repair shall be performed during the next scheduled refueling outage, 1EOC24 RFO, which is currently scheduled to begin April 12, 2008. If a condition leads to a forced outage of sufficient duration as per GL 90-05 (30 days) before 1EOC24 RFO, the repair will be performed during this forced outage.

Basis: The station has evaluated the actions required to perform a code repair and has determined that a code repair cannot be completed within the LCO window allowed by Tech Specs. A unit shutdown would be required to facilitate the repair.

The station has also evaluated the impact and operability that will be affected by the degraded condition with regard to system function and event mitigation per guidance in Generic Letter 90-05. The potential functions affected that must be addressed due to the condition are:

- The ability of the piping to maintain structural integrity for all design basis loadings.
- The effect the leak will have on the required RBCU performance (Ref TS 3.6.5.)
- The effect the leak will have on containment integrity (Ref TS 3.6.3)
- The effect the leak will have on other equipment required for safety (water spray and flooding)

Engineering has physically observed the leak, which is localized. UT data on the upstream piping in the Reactor Building has confirmed that there are no significant corrosion concerns beyond the local area. Structural integrity of the piping has been evaluated per the flaw evaluation methodology in GL 90-05. This evaluation is attached in Enclosure 1.

The flow rate through the piping containing 1LPSW-21 is approximately 1,000 gpm. As stated earlier, the leakage rate is very small, such that the loss of fluid has no impact on the LPSW system's ability to supply cooling water for Containment heat removal to the 1B RBCU.

The pinhole leak is outside the Reactor Building and the piping inside containment is completely intact, so containment integrity is not compromised. Flooding is not a concern due to the small leak rate, and the fact that the piping will maintain structural integrity, even during a seismic event. There are no safety-related components sensitive to water spray in the immediate area around and beneath the pinhole leakage. Additionally, the leakage is being captured by a funnel and routed to a catchment. Based on the conditions that currently exist, there is a reasonable expectation of continued operability and system integrity.

Please reference Enclosure 1, "Operability Evaluation - 1LPSW-21 Weld-neck Flange" as the basis for considering the flange and piping Operable But Degraded/Non-conforming to ASME Section XI requirements. The Operability Evaluation and its referenced documents, provided as attachments, present the basis for the requested relief from Code requirements.

6. Duration of Proposed Alternative

The requested Code relief shall be used until Code repair/replacement activities are performed on the flange either during 1EOC24 RFO (April-May 2008) or during a forced outage of sufficient duration before 1EOC24 RFO.

Enclosure 1

1LPSW-21 weld neck flange pin hole leaks Operability Evaluation

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PIP O-08-0164 Operability Evaluation Revision 1 (Geary Armentrout MCE/Civil Engineering)

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THIS EVALUATION HAS BEEN UPDATED DUE TO MORE DETAILED UT RESULTS

1. Statement of Problem

This PIP documents the Generic Letter 90-05 evaluation of the pinhole leaks in the 8 inch carbon steel (CS) weld-neck flange downstream of ONS1 LPSW valve 1LPSW-21 (discharge side of 1B RBCU). There are three pinholes (2 in one localized area). The one on the north side of the horizontal pipe (running east-west) was minor; misting and spattering. The 2 on the south side were approx. 1/2 inch apart and are misting & spattering (not a constant stream flow). The two leak areas are 180 degrees apart at the same piping axial orientation. The pinhole on the north side is in the weld toe for the weld between the pipe-to-weld neck flange (flange side). The two adjacent pinholes on the south side are on the weld neck about 1 inch away from the flange ear. As of 1/22/08 the cumulative leak rate from common collection hose was 1 drop/sec (i.e., 0.001 gal/min) per the Fluid Leak Management Database

The purpose of this calculation is to determine if these pit type flaws meets the requirements of the "Through-Wall Flaw" approach as specified in NRC Generic Letter 90-05.

2. Relation to QA Condition

QA Condition 1. The subject Low Pressure Service Water (LPSW) piping and components are safety related (Duke Class F, ISI Class C) designed for pressure, dead weight, thermal, seismic and any applicable static or dynamic loading. The design temperature and pressure are 193°F and 100 psig, respectively, which are shown on OFD-124B-1.2. The piping is analyzed and qualified in stress calculation OSC-396.

3. Applicable codes, Standards, Regulations

3.1 USAS Code for Pressure Piping, Section B31.1 (1967)

3.2 USAS Nuclear Piping Code, Section B31.7 (February 1968 including Errata of June 1968)

4. Evaluation Inputs/Methods Used

Qualitative engineering judgement / experience along with review of the piping analysis computer program SUPERPIPE output within calculation OSC-396. The NRC Generic Letter 90-05 evaluation will be performed using EXCEL spreadsheets and a hand held calculator. The section properties at the pit sites were determined using an EXCEL Visual Basic Macro (DMSDATA). The verification of this visual basic macro is documented in calculation CNC-1206.02-84-0034 (See reference 8.6).

5. Other Evaluation Criteria

None

6. Applicable Licensing References

6.1 UFSAR Chapter 9.2.2.2.3 Low Pressure Service Water (LPSW)
6.2 SLC 16.9.11a, Auxiliary Building Flood Protection Measures
6.3 Tech Spec 3.6.5, Reactor Building Spray and Cooling Systems
6.4 Tech Spec 3.6.3, Containment Isolation Valves
6.5 NEI White Paper, Treatment of Operational Leakage from ASME Class 2 and 3 Components, Revision 2, dated May 2007
6.6 NRC Regulatory Issue Summary (RIS) 2005-20: Revision to Guidance Formerly Contained in NRC Generic Letter 91-18, "Information to Licensees Regarding two NRC Inspection Manual Sections on Resolution of Degraded and Nonconforming Conditions and on Operability"
6.7 NRC Generic Letter (GL) 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Code 1, 2, and 3 Piping"
6.8 Memorandum from Elmo E Collins, NRC, dated June 22, 2007 on the subject of "Inspection Manual Part 9900 Operability Guidance Involving Structural Integrity of ASME Code Class 2 and 3 Piping" which supports the NEI White Paper (ref. 6.5 above); herein, referred to as the "NRC Interim Guidance"

7. Assumptions

7.1 This evaluation assumed the crack length of 1/2 inch (i.e., distance between adjacent pinhole leaks).

8. References

8.1 Flow Diagram OFD-124B-1.2
8.2 Piping Analysis Calculation OSC-396, LOW PRESSURE SERVICE WATER (LPSW) DISCHARGE THROUGH PENETRATIONS AND INCLUDING L.P. COOLER "1A" DISCHARGE PROBLEM 1-14-04

8.3 Superpipe Analysis from above, microfiche Att. M18, Date: 9-29-04, Time: 18:15:51
8.4 Specification OS-027B.00-00-0001 "Specification for Class A, B, C, D, E, F, G and H Piping Analysis for Code Compliance"
8.5 Ultrasonic Test (UT) data dated 01/11/08 [1 inch grids with only one band of UT data (i.e., col. "A") on the 1LPSW-21 flange side of the weld using a 1/2 inch transducer], which is stored in the CHECWORKS database as part of the Service Water Corrosion Piping Inspection Program (inspection ID C1LPS040)
8.6 CNC-1206.02-84-0034 Procedure for the Evaluation of Structural Integrity of the RN System Due to Corrosion, (DMSDATA)
8.7 EPRI Document No. 1011231, "Recommendations for Controlling Cavitation, Flashing, Liquid Droplet Impingement, and Solid Particle Erosion in Nuclear Power Plant Piping Systems", Nov 2004
8.8 Ultrasonic Test (UT) data dated 02/06/08 [1/2 inch grids; 4 bands; on 1LPSW-21 flange only using 1/2 inch dual-transducer], which will be stored in calculation OSC 9240 (Service Water Corrosion Piping Inspection Program inspection ID C1LPS040F)
8.9 ANSI B16.5 -1973, "Steel Pipe Flanges, Flanged Valves and Fittings"
8.10 Ultrasonic Test (UT) data dated 2/07/08 on the 1LPSW-18 and 1LPSW-24 flanges using 1/2 inch dual-transducer], which will be stored in calculation OSC 9240 (Service Water Corrosion Piping Inspection Program inspection IDs C1LPS041F and C1LPS042F)
8.11 Ultrasonic Test (UT) data dated 2/08/08 on the 2LPSW-18, 2LPSW-21, 2LPSW-24, 3LPSW-18, 3LPSW-21 and 3LPSW-24 flanges using 1/2 inch dual-transducer], which will be stored in calculation OSC 9240 (Service Water Corrosion Piping Inspection Program inspection IDs C2LPS031F, C2LPS032F, C2LPS033F, C3LPS035F, C3LPS036F and C3LPS037F)
8.12 Oconee Procedure SM/0/B/8530/002, "Periodic Inspection For Corrosion Induced Wall Thinning"

9. Calculation/Evaluation

9.1 Flaw Geometry

Based on a review of the UT results (ref. 8.8), the pinhole flaws are non-planar pit type flaws (i.e., no general degradation/cracks). Per the UT results, the minimum average band thickness on the flange is 0.374 inch, which is greater than the nominal thickness of 0.322 inch of the 8 inch Sch 40 pipe within the OSC-396 analysis. The minimum thickness was 0.095 inch, which is in the vicinity of the two adjacent leaks (thickness at the leaks was 0.101 inch). The minimum thickness at the single leak is 0.210 inch. This UT data was based on 1/2 inch grids around the flange using a 1/2 inch dual-transducer.

It should be noted that there were a few obstructions restricting data gathering but UT measurements were able to be taken around the pinholes.

9.2 Single versus Multiple Flaws

Based on a review of Section 3c of Generic Letter 90-05 (Single versus Multiple Flaws) the two adjacent flaws may be considered as multiple flaws. Based on this criteria, the minimum separation distance (S) [ref. Figure 3b] to consider wall flaws is 2 times the deepest flaw or 2 times the greatest depth below tmin. For through-wall flaws, the depth is equal to tmin, which is 0.035 inch (see Section 9.4 in this evaluation). The subject two flaws are approx. 1/2 inch apart at the surface; hence, (S) can be considered as 1/2 inch, which far exceeds 2 x 0.035 inch and this criteria has been meet. However, this evaluation assumed the crack length of 1/2 inch (i.e., distance between adjacent pinhole leaks)

9.3 Superpipe Analysis

Based on a review of this calculation, the latest as-built Superpipe analysis (revision 30) is contained in microfiche attachment M18 (See reference 8.3). Based on a review of the piping analysis isometric drawings (OSC-396 pg 76.1), the closest DCP is 44, SUPERPIPE pg. 540. The results listed below were taken from microfiche attachment M18.

ASME Code Eq.	SOP / DCP	Allowable Stress (psi)	Computed Stress (psi)	Stress Ratio
8	140L / 44	15000	704	0.047
9	140L / 44	18000	1437	0.080
9F	140L / 44	35000	2161	0.062
10	140L / 44	22500	385	0.017

9.4 Flaw Evaluation Method

The flaw will be evaluated using Generic Letter 90-05 ("Through-Wall Flaw" Approach). Per NRC Interim Guidance or NSD 203, App. F Item 14, moderate energy Class 3 piping (maximum operating temperature less than 200 degrees F and a maximum operating pressure less than 275 psig) may be evaluated using Generic Letter 90-05. Per section C, part 3, of generic letter 90-05, the structural integrity of a through wall or non through-wall crack like flaw may be evaluated using, part 3.a ("Through-Wall Flaw" Approach). Based on engineering experience it would be conservative to evaluate these pit type flaws using the fracture mechanics approach of 90-05.

Using an EXCEL spreadsheet, the minimum required wall thickness "tmin", 0.035 inch, is based on the as-built stress analysis results from OSC-396 (i.e., longitudinal bending stresses as well as longitudinal pressure), which control over circumferential (hoop) pressure required thickness of 0.029 inch.

The maximum allowable flaw was then determined using the following equations.

Flaw length = 2a, = 1/2 inch, a = 0.25 inch

Maximum Flaw Length = smaller of 3 inches or 15 percent of the length of the pipe circumference [i.e., 4.06 inches] = 3 inches is greater than 1/2 inch; therefore, it is acceptable to use "Through-Wall Flaw" Approach per GL 90-05

Per GL 90-05, for flaw stability, linear elastic fracture mechanics methodology specifies the stress intensity factor, "K", to be less than the critical stress intensity factor which represents the fracture toughness of the material. Since the piping is carbon steel the allowable stress intensity per GL 90-05 is 35 KSI in^0.5. The flaw evaluation is performed in an EXCEL spreadsheet. The stress intensity factor "K" is 17.84 KSI in^0.5 and is well below the allowable stress intensity value. Therefore, the through-wall flaw is acceptable per GL 90-05.

9.5 Determination of Section Properties

The section-modulus, cross-sectional area, and moment-of-inertia used in the 90-05 evaluation were determined using the program DMSDATA (See reference 8.9) and the UT data. To account for the 1/2 inch assumed flaw length (distance between the two adjacent leaks), the thickness for a 1/2 inch long section of circumference will be set as zero; conservative (note, this one missing piece is judged to adequately address the lone leak location as well). The average "band" thickness of 0.374 inch was used for the remainder of the piping band containing the pits. Based on the results of the DMSDATA run the minimum cross sectional area, section modulus and moment of inertia are as follows (Note: since flanges are thicker than connecting piping, even with a section removed, the properties exceed those of an 8 inch Sch. 40 pipe).

Minimum Cross-sectional Area, Amin = 9.515 in^2

Minimum Section Modulus, Zmin = 18.083 in^3

Minimum Moment of Inertia, Imin = 79.3898 in^4

These properties were conservatively used to calculate the stress applied in the flaw evaluation.

9.6 Evaluation of Existing Stress for the Flawed Condition

The flaw evaluation in section 9.4 proved that a crack like flaw would remain stable. The stresses at leak site will be evaluated by using the section properties calculated in section 9.5. This evaluation will consist of calculating the following ratios.

Ratio = Un-cracked Pipe Section Modulus / Cracked Flange Section Modulus = 0.9298

Ratio = Un-cracked Pipe Area / Cracked Flange Area = 0.8827

The greater of these two ratios will be used to factor the existing stress ratios. If the factored ratios are less than 1.0 the ASME Code Equations have been satisfied. This evaluation was performed in an EXCEL spreadsheet. A review of this evaluation indicates that all of the adjusted ASME Code Equations ratios are all less than 0.100 and meet all Code Requirements.

9.7 Apparent Cause of Failure

Based on field observations, the degradation causing the pinhole leaks is induced by cavitation erosion (audible noise detected at the leak site just downstream of valve 1LPSW-21 is indicative of cavitation) and since the leak sites are on the flange sides 180° apart (in the restricted flow stream of the throttled butterfly valve;1LPSW-21). Ref. 8.7 states: "Damage caused by cavitation is normally rapid and localized". It notes that cavitation problems are caused by improper types of valves being used to control flow (e.g. butterfly valves).

The possibility of raw water general corrosion and/or MIC (Microbiologically Induced Corrosion) was considered. When this is present, it generally can be found throughout the piping system for a given flow regime. The measured data supports that no presence of significant corrosion (rusting) pitting exists. Per available UT data (C1LPS027) on the upstream piping in the Reactor Building, there are no significant corrosion concerns.

Based on the UT exams there is sufficient pipe wall thickness coupled with low stresses to preclude a catastrophic failure due to material loss from the localized cavitation erosion.

Flooding/Spray

Existing leakage is very minor (only a few gallons per day). Since structural integrity has been assured by the evaluation above, flooding of safety-related equipment in the AB is not an issue. Additionally, the East Penetration Room is designed for a Main Feedwater pipe rupture (24 inch line), which would envelope a catastrophic failure of this 8 inch LPSW line.

Water leaking from these pinholes is not impacting any safety-related equipment (no sensitive targets below/nearby this leak).

Loss of Flow

As stated above and in the operability assessment, the amount of water leaking from these pinholes is very minor, and does not impact the ability of the LPSW piping to perform its system function of supplying cooling to the 1B RBCU.

Containment Integrity

As stated in the operability assessment, this pinhole leakage is outside the RB, so it has no impact on Containment integrity.

9.9 Extent of Condition

Using Ultrasonic Testing, thickness measurements were taken on the downstream flanges for the other butterfly valves downstream of the RBCUs *. The results are tabulated below along with those for the 1LPSW-21 flange for comparison purposes.

Valve No.	UT Code #	Min Band Average (in)	Min Thickness (in)
1LPSW-18	C1LPS041	0.422	0.267
1LPSW-21	*C1LPS040*	*0.374*	*0.095*
1LPSW-24	C1LPS042	0.422	0.191
2LPSW-18	C2LPS031	0.447	0.245
2LPSW-21	C2LPS032	0.484	0.490
2LPSW-24	C2LPS033	0.447	0.322
3LPSW-18	C3LPS035	0.363	0.281
3LPSW-21	C3LPS036	0.398	0.321
3LPSW-24	C3LPS037	0.384	0.338

The minimum band averages are all greater than the nominal thickness of 0.322 inch for an 8 inch Sch 40 pipe; hence, there are no structural integrity concerns for the other eight flanges. In addition, based on the measured data , there are no immediate pinhole leak risks either. See discussion below

It should be noted that there are areas that thickness data could not physically be obtained due to obstructions such as the flange bolts and support/restraints (one major area each). The largest major obstruction area is approx. 1 1/2 inch wide from the flange ear and approx. 20% of the circumference. The potential cavitation regions would be 90 and 270 degrees from the valve operator orientation (restricted flow path). The obstruction areas were reviewed to determine if they are away from the potential cavitation regions (see table below).

Valve No.	Piping Orientation	Flow Direction	Valve Operator Orientation	Cavitation Region (Potential)	Obstr. Area
1LPSW-18	Horizontal	North	West	Top/Bottom	Side
1LPSW-21	Horizontal	East	Vert. Up	Sides	Top
1LPSW-24	Horizontal	East	Vert. Up	Sides	Side
2LPSW-18	Horizontal	East	Vert. Up	Sides	Top
2LPSW-21	Vertical	Up	South	East/West	South
2LPSW-24	Vertical	Vert. Up	East	North/South	East
3LPSW-18	Horizontal	East	South	Top/Bottom	Side
3LPSW-21	Vertical	Vert. Up	South	East/West	South
3LPSW-24	Vertical	Vert. Up	South	East/West	West

There are obstructed areas in potential cavitation regions for 1LPSW-24 and 3LPSW-24.

UT data at the 2 adjacent pinhole leaks on the 1LSPW-21 flange hub measured a thickness of only 0.100 inch, but the weld-neck flange thickness adjacent to the pipe weld (axially downstream from the leak) was approx. 0.25 inch. Measured thickness at the other eight flanges (adjacent to pipe-to-flange weld) directly infront (axially downstream) of the obstructed areas were approximately 0.40 inch. Since the measured thickness at the pipe-to-flange weld for the eight flanges greatly exceeds that of 1LPSW-21, there is reasonable basis to conclude adequate thickness exists in the obstructed areas such that pinhole leakage is not imminent.

The carbon steel flanges downstream of valves 1LPSW-18, 1LPSW-21 and 1LPSW-24 will be replaced by stainless steel by Engineering Change OE-102080 during the 1EOC24 refueling outage (April 2008). This activity will be tracked by PIP O-08-00164, Corrective Action #4.

Activities to address the other LPSW flanges downstream of the RBCUs will be tracked by PIP O-08-00164, Corrective Action #3.

* PIP O-08-00164, Corrective Action #5 created for the LPSW System Engineer to identify all throttled valves (potential cavitation locations) in LPSW system and generate a corrective action for the Service Water Piping Inspection Program Engineer to determine the wall thicknesses of the downstream piping/components by Ultrasonic Testing.

10. Compensatory Actions Required for Operability

None

11. Conclusion

The piping remains well within the Code allowable stress limits. Assurance of piping structural integrity has been determined above. The through-wall flaw (1/2 inch diameter) has been evaluated using the criteria in GL 90-05, and determined to be acceptable. The methodology in GL 90-05 is endorsed by NSD 203, Appendix F, Item 14 as well as NRC Interim Guidance.

The pinhole leaks do not challenge the functionality of the LPSW system, nor any nearby equipment. Therefore, the LPSW piping is OPERABLE, But Degraded / Non-Conforming (OBD/NCI) because a pinhole leak (through-wall flaw) does not comply with the ASME Section XI Code.

As a conservative measure, it is recommended that leakage rates continue to be observed at least once per shift until repairs are completed. NRC GL 90-05 requires that a "qualitative assessment of leakage through the temporary non-code repair [doing nothing is considered a non-code repair] should be performed at least every week during plant walkdown inspections to determine any degradation of structural integrity". The Oconee Unit 1 leakage rates will continue to be observed by Operations at least once per shift.

GL 90-05 further states "the licensee should perform an engineering evaluation to assess the rate and extent of the degradation to determine what remedial measures are required. A temporary non-code repair is no longer valid if the structural integrity is not assured". The subject flange was added when the butterfly valves (1LPSW-18, -21 & -24) were installed in September 1991 by NSM ON-12806 (ref. WO 01364141). Per discussion with the LPSW system engineer, these valves have been throttled to some degree since their installation; however, they have only been significantly throttled since 1EOC22 (i.e., the last 3 years). Per review of the UT data, band D has the largest delta between the maximum and minimum wall thicknesses. Therefore, assuming that all the wear occurred within this 3 year window, the wear rate is (0.731 - 0.130)/3 = 0.200 inch/yr. At this rate, tmin will be reached in 3 months (i.e., 12(0.095-0.035)/0.2=3.6). The flange shall be re-inspected by UT to confirm wear rate being experienced**. WR 00945510 generated. This flange will be replaced by Engineering Change OE-102080 during the 1EOC24 outage which starts in April 2008.

** Since Data was gathered during Week 6 and the outage starts during week 15 (April 12, 2008), a work order is needed to gather data during week 10 or 11 (early March 2008) to monitor the cavitation wear rates.

Enclosure 2

1LPSW-21 weld neck flange pin hole leaks UT thickness data report

ER/CR INSPECTION FORM

REV 2

PLANT: ONS Unit#: 1

COMPONENT ID: C1LPS040

CONFIGURATION (TEE, PIPE, ELBOW, REDUCER...) FLANGE SIDE

INSPECTOR: [signature] LEVEL: III DATE: 2/6/08

INSPECTOR: [signature] LEVEL: II DATE: 6 Feb 08

EROSION OR CORROSION (CIRCLE ONE)

* STARTING REFERENCE POINT (TOP, OUTSIDE RADIUS, ETC.): TOP OF PIPE

* INDIVIDUAL GRID SIZES ARE 1/2 INCHES IN SIZE.

* LETTERS RUN FROM A TO D IN THE UPS DIRECTION. (UPS, DS, CW, CCW.) OF WELD

* NUMBERS RUN FROM 1 TO 54 IN THE CCW DIRECTION. (UPS, DS, CW, CCW.) WITH FLOW

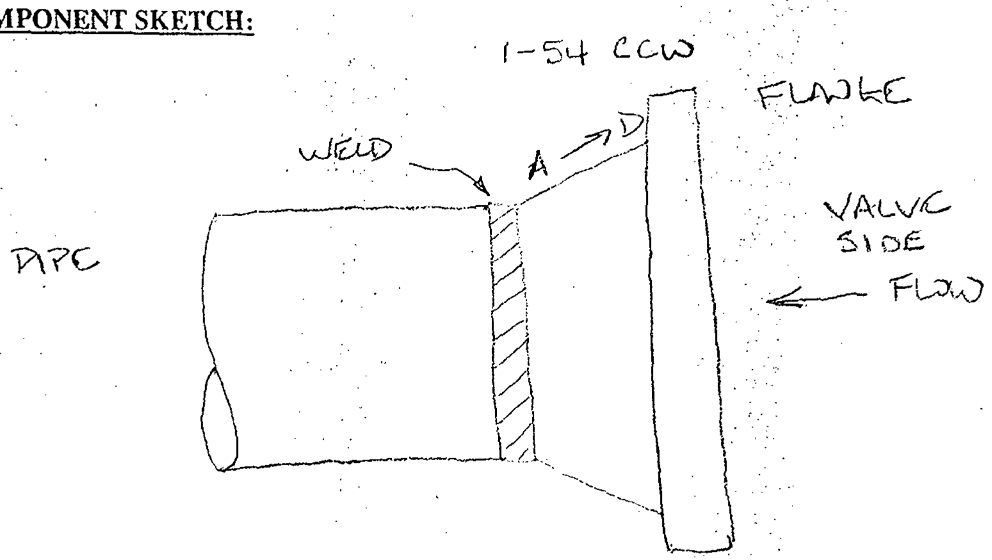
HIGH / LOW THICKNESS READINGS

LOWEST READING FOUND: SEE ATTACHED REPORT

HIGHEST READING FOUND: SEE ATTACHED REPORT

COMMENTS:

COMPONENT SKETCH:



C1LPS-040 (Valve 1LPSW-21) Flange UT
1/2" Dual Transducer 02/06/08

	A	B	C	D
1	Obstr	Obstr	Obstr	Obstr
2	0.425	Obstr	Obstr	Obstr
3	0.463	Obstr	Obstr	Obstr
4	0.461	Obstr	Obstr	Obstr
5	0.452	Obstr	Obstr	Obstr
6	0.443	0.494	0.564	Obstr
7	0.427	0.497	0.561	0.693
8	0.437	0.501	0.578	0.731
9	0.427	0.451	0.487	0.730
10	0.342	0.334	0.571	Obstr
11	0.396	0.474	0.563	Obstr
12	0.433	0.473	0.634	Obstr
13	0.412	0.526	0.625	0.631
14	0.416	0.488	0.598	0.628
15	0.414	0.475	0.589	0.681
16	0.409	0.475	0.583	0.679
17	0.380	0.480	0.604	Obstr

Legend

Less than 87.5% Nom (8" Sch 40)

Less than 66.7% Nom (8" Sch 40)

Col. A Pipe Side

Col. D Flange Side

Row 1 top dead center

Looking from piping towards 1LPS-21, numbers are CW (CCW direction of flow)

Single Leak adjacent to weld at Row 19

Double Leak 1" from weld at Rows 42/43

Circles identify locations of proposed 1" half-couplings for leak repair

III 2/6/08

II 6 Feb 08

18	0.382	0.461	0.553	Obstr
19	0.210	0.419	0.573	0.658
20	0.206	0.454	0.679	0.662
21	0.400	0.497	0.598	0.702
22	0.409	0.497	0.627	0.715
23	0.408	0.505	0.573	0.642
24	0.422	0.519	0.573	Obstr
25	0.409	0.500	0.605	Obstr
26	0.411	0.513	0.588	0.718
27	0.422	0.501	0.589	0.674
28	0.411	0.514	0.593	0.687
29	0.413	0.517	0.609	0.678
30	0.413	0.508	0.609	0.657
31	0.416	0.456	Obstr	Obstr
32	0.412	0.367	0.505	Obstr
33	0.396	0.406	0.477	0.212
34	0.391	0.387	0.210	0.190
35	0.349	0.306	0.199	0.175
36	0.348	0.282	0.173	0.166

III 2/6/08

II 8 Feb 08

37	0.254	0.113	0.160	0.176
38	0.252	0.112	0.154	Obstr
39	0.258	0.148	0.141	0.130
40	0.239	0.119	0.095	0.209
41	0.220	0.100	0.102	Obstr
42	0.237	0.101	0.104	0.410
43	0.241	0.182	0.171	0.171
44	0.294	0.173	0.220	0.179
45	0.275	0.246	0.133	0.220
46	0.312	0.286	0.163	Obstr
47	0.353	0.146	0.260	0.366
48	0.318	0.364	0.210	0.445
49	0.409	0.437	Obstr	Obstr
50	0.433	0.442	Obstr	Obstr
51	0.421	0.505	Obstr	Obstr
52	0.465	Obstr	Obstr	Obstr
53	0.428	Obstr	Obstr	Obstr
54	0.429	0.485	Obstr	Obstr
Band Averages	0.374	0.388	0.433	0.487
Min	0.206	0.100	0.095	0.130
Max	0.465	0.526	0.679	0.731
Difference	0.259	0.426	0.584	0.601

III 2/6/08
II 6 Feb 08

Enclosure 3

1LPSW-21 weld neck flange pin hole Leaks UT thickness data report Follow up UT

ER/CR INSPECTION FORM REV 2

PLANT: ONS Unit#: 1

COMPONENT ID: C1LPS040

CONFIGURATION (TEE, PIPE, ELBOW, REDUCER...) FLANGE SIDE

INSPECTOR: Gary J Moss LEVEL: II DATE: 3-4-08

INSPECTOR: [signature] LEVEL: II DATE: 3-4-08

EROSION OR CORROSION (CIRCLE ONE)

* STARTING REFERENCE POINT (TOP, OUTSIDE RADIUS, ETC.): TOP OF PIPE

* INDIVIDUAL GRID SIZES ARE 1/2 INCHES IN SIZE.

* LETTERS RUN FROM A TO D IN THE UPS DIRECTION. (UPS, DS, CW, CCW.) OF WELD

* NUMBERS RUN FROM 1 TO 54 IN THE CCW DIRECTION. (UPS, DS, CW, CCW.) WITH FLOW

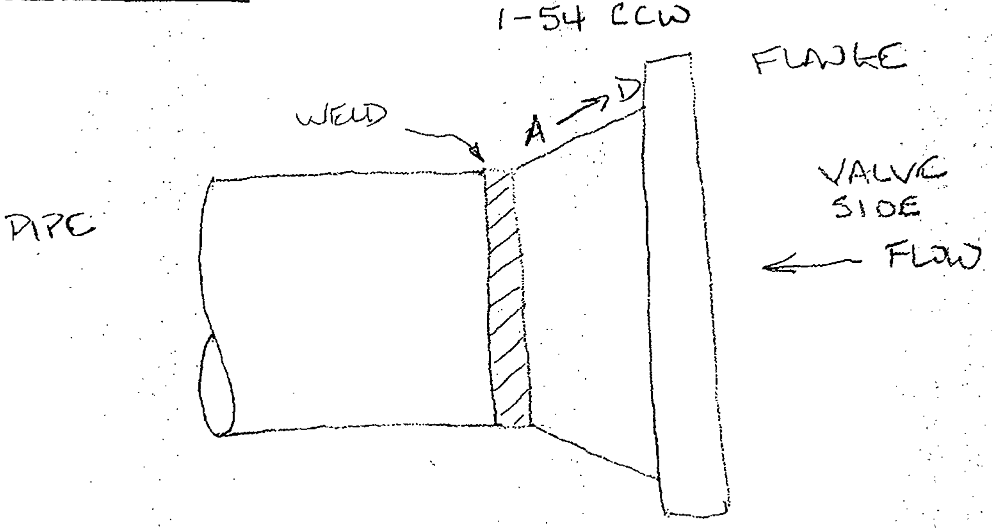
HIGH / LOW THICKNESS READINGS

LOWEST READING FOUND: SEE ATTACHED REPORT

HIGHEST READING FOUND: SEE ATTACHED REPORT

COMMENTS:

COMPONENT SKETCH:



C1LPS-040 (Valve 1LPSW-21) Flange UT
1/4" Dual Transducer 03/04/08

DTM 3-4-08
[illegible] 4Mar08

	A	B	C	D
1	Obstr	Obstr	Obstr	Obstr
2	0.420	Obstr	Obstr	Obstr
3	0.431	Obstr	Obstr	Obstr
4	0.420	Obstr	Obstr	Obstr
5	0.443	Obstr	Obstr	Obstr
6	0.430	0.529	0.595	Obstr
7	0.425	0.501	0.600	0.693
8	0.415	0.495	0.632	0.732
9	0.423	0.485	0.624	0.735
10	0.330	0.334	0.530	Obstr
11	0.286	0.470	0.622	0.754
12	0.406	0.476	0.609	Obstr
13	0.442	0.493	0.603	0.731
14	0.412	0.493	0.606	0.732
15	0.423	0.495	0.609	0.719
16	0.420	0.493	0.621	0.719
17	0.457	0.498	0.612	0.720

Legend

Less than 87.5% Nom (8" Sch 40)

Less than 66.7% Nom (8" Sch 40)

Col. A Pipe Side

Col. D Flange Side

Row 1 top dead center

Looking from piping towards 1LPS-21, numbers are CW (CCW direction of flow)

Single Leak adjacent to weld at Row 19

Double Leak 1" from weld at Rows 42/43

Circles identify locations of proposed 1" half-couplings for leak repair

Sjm 3-4-08
DKT 4 Mar 08

18	0.397	0.471	0.607	0.741
19	0.320	0.483	0.606	Obstr
20	0.212	0.523	0.518	0.709
21	0.225	0.433	0.530	0.719
22	0.413	0.520	0.625	0.726
23	0.422	0.537	0.611	0.721
24	0.420	0.513	0.620	0.722
25	0.419	0.514	0.631	Obstr
26	0.423	0.542	0.628	0.735
27	0.411	0.530	0.632	0.732
28	0.411	0.522	0.625	0.725
29	0.419	0.498	0.609	0.715
30	0.422	0.519	0.638	0.735
31	0.425	0.533	0.635	0.750
32	0.419	0.529	0.642	Obstr
33	0.415	0.450	0.472	Obstr
34	0.389	0.342	0.241	0.401
35	0.397	0.363	0.195	0.292
36	0.363	0.359	0.167	0.415

SJM 3-4-08
DKT 4 Mar 08

37	0.367	0.305	0.220	0.426
38	0.330	0.212	0.205	0.423
39	0.275	0.117	0.166	0.130
40	0.283	0.167	0.137	0.460
41	0.267	0.100	0.122	0.409
42	0.249	0.136	0.197	0.338
43	0.270	0.100	0.239	0.390
44	0.358	0.168	0.108	Obstr
45	0.348	0.209	0.203	Obstr
46	0.361	0.267	0.219	0.397
47	0.386	0.339	0.289	0.474
48	0.390	0.381	0.354	0.486
49	0.411	0.386	0.316	Obstr
50	0.439	0.440	Obstr	Obstr
51	0.429	0.498	Obstr	Obstr
52	0.438	Obstr	Obstr	Obstr
53	0.481	Obstr	Obstr	Obstr
54	0.429	0.485	Obstr	Obstr
Band Averages	0.385	0.410	0.461	0.597
Min	0.212	0.100	0.108	0.130
Max	0.481	0.542	0.642	0.754
Difference	0.269	0.442	0.534	0.624