

Attachment 4

Westinghouse Electric Company LLC

**Calculation Note CN-CI-02-56 Rev. 00
Section XI Flaw Evaluation of Florida Power and Light Units 1 & 2 Hot Leg
Instrumentation Nozzles – J Weld
(Non-Proprietary Version)
(7 Pages)**

**Calculation Note CN-CI-02-56 Rev. 00
Section XI Flaw Evaluation of Florida Power and Light Units 1 & 2 Hot Leg
Instrumentation Nozzles – J Weld
(Proprietary Version)
(180 Pages)**

Westinghouse Non-Proprietary Class 3

WESTINGHOUSE ELECTRIC COMPANY LLC

Calculation Note Number	Revision	Charge Number	Page
CN-CI-02-55-NP	000	110658	1
Project	Releasable (Y/N)	Shop Order Number	Microfiche Attached (Y/N)
FP&L/Westinghouse Alloy 600 Program	Y		
			Total No. Pages
			7

Title: Section XI Flaw Evaluation of Florida Power and Light
Units 1 and 2 Hot Leg Instrumentation Nozzles J-Weld

Author(s) Name(s)

R. S. Watson

C.R. Schmidt

J. Ghergurovich

Verifier(s) Name(s)

T.D. Hammel

Manager Name

Bruce Hinton

Signature / Date

Robert S. Watson 9/6/02

Jim Schmidt for CES 9/6/02

Jim Ghergurovich 9/6/02

Signature / Date

Thomas D. Hammel 9/6/02

Signature/Date

Bruce Hinton 9/6/02

For Pages

All except B

App B

All

For Pages

All

©2002 Westinghouse Electric Company LLC



Westinghouse

Error! No text of specified style in document.
WESTINGHOUSE ELECTRIC COMPANY LLC

Calculation Note Number CN-CI-02-56-NP	Revision 000	Page 2
---	-----------------	-----------

Record of Revisions

[illegible]

Error! No text of specified style in document.
WESTINGHOUSE ELECTRIC COMPANY LLC

Calculation Note Number CN-CI-02-56-NP	Revision 000	Page 3
---	-----------------	-----------

Table Of Contents

1.0	Introduction.....	5
1.1	Background / Purpose	
1.2	Limits of Applicability.....	
2.0	Summary of Results and Conclusions	6
2.1	Maximum Allowable Flaw Size	
2.2	Normal and Upset Conditions	
2.3	Emergency and Faulted Conditions	
2.4	Primary Stresses.....	
3.0	Assumptions and Open Items.....	6
3.1	Discussion of Major Assumptions	
3.2	Open Items	
4.0	Acceptance Criteria	6
5.0	Computer Codes Used In Calculation.....	6
6.0	Calculations	6
6.1	Method Discussion.....	
6.1.1	ASME CODE ANALYTICAL PROCEDURE.....	
6.1.2	EXPECTED END-OF-LIFE FLAW SIZE.....	
6.1.3	MAXIMUM ALLOWABLE FLAW SIZE.....	
6.2	Input.....	
6.2.1	NOZZLE GEOMETRIES	
6.2.2	LOADING CONDITIONS, TRANSIENTS AND CYCLES.....	
6.2.3	MATERIAL PROPERTIES.....	
6.3	Evaluations, Analysis, Detailed Calculations and Results	
6.3.1	CONFIGURATION OF ANALYZED FLAW	
6.3.2	COMPONENT STRESSES	
6.3.2.1	Pressure stress.....	
6.3.2.2	Thermal stress	
6.3.2.3	Residual Stress Considerations	
6.3.3	STRESS INTENSIFICATION FACTOR, K_t	
6.3.4	CALCULATION OF FATIGUE CRACK GROWTH	
6.3.5	EMERGENCY AND FAULTED CONDITIONS.....	

Error! No text of specified style in document.
WESTINGHOUSE ELECTRIC COMPANY LLC

Calculation Note Number CN-CI-02-56-NP	Revision 000	Page 4
---	-----------------	-----------

6.3.6 PRIMARY STRESS CRITERIA	
7.0 References	6

Error! No text of specified style in document.
WESTINGHOUSE ELECTRIC COMPANY LLC

Calculation Note Number CN-CI-02-56-NP	Revision 000	Page 5
--	------------------------	------------------

1.0 Introduction

1.1 Background / Purpose

Typical small-bore nozzles are fabricated from Alloy 600 material and are attached to the piping and vessels with 82/182-weld material. This material is subject to Pressurized Water Stress Corrosion Cracking (PWSCC) and often results in cracks and leaks in these nozzle assemblies. Identified nozzle leaks must be addressed and several techniques are available such as Mechanical Nozzle Seal Assemblies (MNSAs) and half-nozzle repairs. The nature of these repairs is such that it is convenient to leave the crack in place, if it can be demonstrated that the crack and any potential future growth of the crack is acceptable.

The objective of this calculation is to present the results of an ASME Code Section XI Appendix A flaw evaluation for the Alloy 600 small bore nozzle J-welds in the Hot Leg piping of St. Lucie Units 1 & 2. This evaluation considers an assumed double-sided crack that has propagated through the J-Weld and is beginning to encroach on the carbon steel material that comprises the pressure boundary. Since the intent is to not repair this flaw if found, the flaw configuration must be evaluated in accordance with ASME Code Section XI to demonstrate continued integrity of the pressure boundary during plant operation for the postulated plant life.

Error! No text of specified style in document.
WESTINGHOUSE ELECTRIC COMPANY LLC

Calculation Note Number CN-CI-02-56-NP	Revision 000	Page 6
---	-----------------	-----------

2.0 Summary of Results and Conclusions

Information for Sections 2.0 – 2.4 is proprietary to Westinghouse Electric.

3.0 Assumptions and Open Items

Information for Sections 3.0 – 3.1 is proprietary to Westinghouse Electric.

4.0 Acceptance Criteria

Information for Section 4.0 is proprietary to Westinghouse Electric.

5.0 Computer Codes Used In Calculation

Information for Section 5.0 is proprietary to Westinghouse Electric.

6.0 Calculations

Information for Sections 6.0 – 6.3 is proprietary to Westinghouse Electric.

7.0 References

1. []
2. ASME Boiler and Pressure Vessel Code, Section XI, 1989 edition.
3. []
4. []
5. British Standards Institute, BS 7910-1999 incorporating Amendment 1, *Guide on Methods for Assessing the Acceptability of Flaws in Metallic Structures*, October 2000.
6. []
7. Theory of Elasticity, third edition, S.P. Timoshenko, McGraw-Hill, Inc.
8. Letter LTR-SST-01-94 to ANSYS Users from Michael J. Fisher of Systems and Software Technology, "Release of ANSYS 5.7.1 on NT 4.0, HP-UX 11 & Solaris 2.8," 10/5/01
9. []
10. Mathcad 2001i, Professional
11. []
12. []

Error! No text of specified style in document.
WESTINGHOUSE ELECTRIC COMPANY LLC

Calculation Note Number CN-CI-02-56-NP	Revision 000	Page 7
--	------------------------	------------------

13. W.H. Bamford and A.J. Bush, "Effect of Cladding on Fracture Analysis," ASME Pressure Vessel and Piping, Fatigue, Environmental Factors, and New Materials, Vol. 374 pp. 47-59, 1998.
14. Warren C. Young, *Roark's Formulas for Stress and Strain* Sixth Edition
15. []
16. []
17. J. C. Newman Jr. and I. S. Raju, *Stress Intensity Factor Equations for Cracks in Three-Dimensional Bodies Subjected to Tension and Bending Loads*, NASA Technical Memorandum 85793, April 1984.
18. Rlgo Perez, Alten F. Grandt Jr., and Charles R. Saff, "Tabulated Stress-Intensity Factors for Corner Cracks at Holes Under Stress Gradients" pp. 49-62 of ASTM STP1060, *Surface-Crack Growth: Models, Experiments and Structures*.