CEOG COMBUSTION ENGINEERING OWNERS GROUP

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July 24, 2001
CEOG-01-199

NRC Project 692

Document Control Desk
US Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Subject: Response to Staff Request for Information Concerning CE NPSD-1198-P (CONTAINS PROPRIETARY INFORMATION)

Reference: CEOG Letter, R. Bernier to NRC, "Request for Review of CE Owners Group Report CE NPSD-1198-P, "Low-Alloy Steel Component Corrosion Analysis Supporting Small-Diameter Alloy 600/690 Nozzle Repair/Replacement Programs," CEOG-01-052, 2/15/2001.

The Reference letter transmitted topical report CE NPSD-1198-P for staff review and approval. The purpose of this letter is to submit responses to staff questions, two requested references, and revisions to several report pages for NRC use in completing the review of the subject report. Two copies of the proprietary and non-proprietary submittals are provided; please forward one copy to the Document Control Desk for entry into ADAMS.

Westinghouse has determined that certain information contained in this response is proprietary in nature. It is requested that this information be withheld from public disclosure in accordance with the provisions of 10 CFR 2.790 and be appropriately safeguarded. The reasons for the classification of this information as proprietary are delineated in the enclosed affidavit.

Please do not hesitate to contact me at 623-393-5882 or Gordon Bischoff, CEOG Project Office, at 860-731-6200 if you have any questions.

Sincerely,

Richard A. Bernier

Richard A. Bernier, Chairman
CE Owners Group

Attachment: (1) Proprietary Affidavit;
(2) Revised report pages;
(3) Responses to staff questions;
(4) Requested reference material.

D047

cc (with attachments):
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Attachment 1

Proprietary Affidavit

I, Philip W. Richardson, depose and say that I am the Licensing Project Manager of Westinghouse Electric Company, LLC (Westinghouse), duly authorized to make this affidavit, and have reviewed or caused to have reviewed the information which is identified as proprietary and described below.

I am submitting this affidavit in conformance with the provisions of 10 CFR 2.790 of the Commission's regulations for withholding this information. I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged, or as confidential commercial or financial information.

The information for which proprietary treatment is sought, and which documents have been appropriately designated as proprietary, is contained in the following:

- *Calculation A-GEN-PS-0003, Rev 00, "Evaluation of Fatigue Crack Growth Associated with Small Diameter Nozzles in CEOG Plants," May 09, 2000.*
- *Calculation A-CEOG-9449-1242, Rev 00, "Evaluation of the Corrosion Allowance for Reinforcement and Effective Weld to Support Small Alloy 600 Nozzle Repairs," June 12, 2000.*
- *Responses to staff questions on CE NPSD-1198-P.*

Pursuant to the provisions of Section 2.790(b)(4) of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information included in the documents listed above should be withheld from public disclosure.

i. The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse. It consists of calculational details, data, and methodology for justifying the corrosion rate of carbon steel materials associated with small-diameter Alloy 600 nozzle repairs.

ii. The information consists of test data or other similar data concerning a process, method or component, the application of which results in substantial competitive advantage to Westinghouse.

iii. The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public.

iv. The information is being transmitted to the Commission in confidence pursuant to 10 CFR 2.790 with the understanding that it is to be received in confidence by the Commission.

v. The information, to the best of my knowledge and belief, is not available in public sources, and any disclosure to third parties has been made pursuant to regulatory provisions or proprietary agreements that provide for maintenance of the information in confidence.

vi. Public disclosure of the information is likely to cause substantial harm to the competitive position of Westinghouse because:

   a. A similar product is manufactured and sold by major competitors of Westinghouse.

   b. Development of this information by Westinghouse required tens of thousands of dollars and hundreds of manhours of effort. In order to acquire equivalent information, a competitor would need to invest considerable time, expense and inconvenience to develop, verify and secure regulatory approval of the subject methodology.

c. The information consists of calculational methodology and evaluation results, the application of which provides Westinghouse a competitive economic advantage. The availability of such information to competitors would enable them to design their product to better compete with Westinghouse, take marketing or other actions to improve their product's position or impair the position of Westinghouse's product, and avoid developing similar technical analysis in support of their processes, methods or apparatus.

d. In pricing Westinghouse's products and services, significant research, development, engineering, analytical, manufacturing, licensing, quality assurance and other costs and expenses must be included. The ability of Westinghouse's competitors to utilize such information without similar expenditure of resources may enable them to sell at prices reflecting significantly lower costs.

e. Use of the information by competitors in the international marketplace would increase their ability to market services by reducing the costs associated with their technology development. In addition, disclosure would have an adverse economic impact on Westinghouse's potential for obtaining or maintaining foreign licenses.

Philip W. Richardson
Licensing Project Manager

Sworn to before me this 23rd day of July 2001.

Joan C. Hastings
Notary Public

My Commission expires: JOAN C. HASTINGS
NOTARY PUBLIC
MY COMMISSION EXPIRES SEP. 30, 2002

INFORMATION IN THIS DOCUMENT IS NON-PROPRIETARY

Title: **Evaluation of Fatigue Crack Growth Associated with Small Diameter Nozzles in CEOG Plants**

Document Number: A-GEN-PS-0003 Revision Number: 00

1. **Verification Status:**

☒ Complete ☐ Not Required ☐ Complete w/ contingencies/Assumptions

2. **Approval of Completed Analysis**

This Design Analysis is complete and verified. Management authorizes the use of its results and attests to the qualification of the Cognizant Engineer(s), Mentor and Independent Reviewer(s).

	Printed Name	Signature	Date
Cognizant Engineer(s)	T. D. Hammel		05/09/00
	A. V. Bauer (Appendix B)		5/10/00
Mentor ☐ **None**	J. Ghergurovich		5/10/00
Independent Reviewer(s)	C. L. Hoffman		5/10/00
	A. M. Bauer (Appendix A)		5/10/00
	B. M. Barishpolsky (Appendix B)		5/10/00
Management Approval	K. H. Haslinger	Karl H. Haslinger	5/10/00

3. **Package Contents** (this section may be completed after Management approval):

Total page count, including body, appendicies, attachments, etc. 10

List associated CD-ROM disk Volume Numbers and path names: ☐ **None**

CD-ROM Volume Numbers	Path Names (to lowest directory which uniquely applies to this document)
	/a_gen_ps/0003r00

Other attachments (specify):

RECORD OF REVISIONS

Rev	Issue Date	Sections Affected	Author	Management Approver
00	05/10/00	Original	T. D. Hammel	K.H. Haslinger

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1.0 INTRODUCTION

1.1 Objective

Small diameter Alloy 600 nozzles in CE designed plants, such as hot leg piping RTD and sampling nozzles and pressurizer instrumentation nozzles and heater sleeves, have developed leaks or part-through-wall cracks as a result of primary water stress corrosion cracking (PWSCC). Residual stresses caused by the partial-penetration welds between the nozzles and the low alloy (or carbon steel) components are the driving force for crack initiation and propagation.

After a repair of a cracked nozzle, the residual stresses from the original welding will remain and could propagate existing cracks or initiate and propagate new cracks. These cracks could grow, as a result of stress corrosion cracking, through the nozzle and weld materials to the carbon or low alloy steel. These cracks could continue to grow into the component wall through a fatigue crack growth mechanism.

This calculation addresses the potential for fatigue crack propagation in the carbon steel components of the pressurizers, hot leg and cold leg piping, and steam generators, in the vicinity of small diameter Alloy 600 nozzles in CEOG plants. A stress corrosion crack that extends through the nozzle, weld, and weld butter materials to the carbon steel component could initiate a fatigue crack that could propagate as a result of cyclic stresses associated with heat-up/cooldown cycles and other operational conditions.

Therefore, the objective of this analysis is to demonstrate that the cracks remaining in the pressurizer shell, steam generator shell, and hot and cold leg piping bounding cases meet the ASME Code Section XI requirements.

1.2 Assessment of Significant Design Changes

The functions of the existing nozzles are no longer required due to the repair methods applied. The design changes created by the repairs are not the scope of this calculation. Therefore, there are no design changes that affect this evaluation.

2.0 REFERENCES

2.1.

2.2 ASME Boiler and Pressure Vessel Code, 1992 Edition, no addenda.

2.3

2.4

2.5 Fracture Mechanics, H.L. Ewalds, R.J.H. Wanhill, Edward Arnold Publishers, Ltd., 1985.

2.6

2.7 Theory of Elasticity, Third Edition, S.P. Timoshenko, McGraw-Hill, Inc.

2.8

2.9 SA/FoU Report 91/01, "A Procedure for Safety Assessment of Components with Cracks – Handbook", December 1991.

2.10 Microsoft EXCEL 97 SR-2

2.11 Perez, R., Grandt, A. F., Jr. and Saff, C. R., "Tabulated Stress-Intensity Factors for Corner Cracks at Holes Under Stress Gradients," Surface-Crack Growth: Models, Experiments, and Structures, ASTM STP 1060, W. G. Reuter, J. H. Underwood, and J. C. Newman, Jr., Eds., American Society for Testing and Materials, Philadelphia, 1990, pp. 49-62.

2.12

2.13

2.14 ANSYS Engineering Analysis System Computer Code, Revision 5.5.

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3.0 METHODOLOGY

Information in Sections 3.0 - 3.4 is proprietary to CENP.

4.0 SUMMARY OF RESULTS

Information in Sections 4.0 - 4.3 is proprietary to CENP.

5.0 DATA AND ASSUMPTIONS

Information in Sections 5.0 - 5.5 is proprietary to CENP.

6.0 DETAILED ANALYSIS

Information in Sections 6.0 - 6.2 is proprietary to CENP.

APPENDIX A - Pressurizer Data

Information in this appendix is proprietary to CENP.

APPENDIX B - Hot Leg Data

Information in this appendix is proprietary to CENP.

APPENDIX C - Verification of Spreadsheet Files for the Determination of Geometry Functions f_{ij} for the "Crack at a Hole" Case of Reference 2.9

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APPENDIX D - K_I at Corner Crack in a Nozzle

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APPENDIX E - ANSYS Input Files

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EVALUATION OF THE CORROSION ALLOWANCE FOR REINFORCEMENT AND EFFECTIVE WELD TO SUPPORT SMALL ALLOY 600 NOZZLE REPAIRS

A-CEOG-9449-1242 REV. 00

(TASK 1131)

Quality Class: QC-1 (Safety-Related)

Contingencies: None

PURPOSE: To determine the maximum allowable corroded hole diameter for small Alloy 600 partial penetration welded nozzles to support the half-nozzle repair.

This Design Analysis is complete and verified. Management authorizes the use of its results.

PREPARED BY: B. A. Bell B. A. Bell DATE: 6/12/2000

VERIFICATION STATUS: COMPLETE

The Safety-Related design information contained in this document has been verified to be correct by means of Design Review using the Checklist in QP-3.4 of QPM-101.

Name J. G. Thakkar Signature J. G. Thakkar Date: 6/13/2000
Independent Reviewer

APPROVED BY: D. P. Siska Thomas Taylor for DATE: 6/13/2000

CE NUCLEAR POWER, LLC
CHATTANOOGA, TENNESSEE

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RECORD OF REVISIONS

NUMBER	DATE	PAGE(s) INVOLVED	PREPARED BY	INDEPENDENT REVIEWER	APPROVED BY
0	6/12/2000	Original Issue	B. A. Bell B. A. Bell 6/12/2000	J. G. Thakkar J. G. Thakkar 6/13/2000	D. P. Siska [illegible] for 6/13/00

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Attachment 1: Detailed Calculations for Section 6.2

1.0 OBJECTIVE OF THE DESIGN ANALYSIS

Small diameter Alloy 600 (NiCrFe) nozzles, such as hot leg piping RTD and sampling nozzles and pressurizer instrumentation nozzles and heater sleeves, in Combustion Engineering designed plants have developed leaks or part-through-wall cracks as a result of primary water stress corrosion cracking (PWSCC). The residual stresses imposed by the partial-penetration welds between the nozzles and the low alloy or carbon steel components are the driving force for crack initiation and propagation.

Two currently used repair techniques for cracked nozzles are the half-nozzle weld repair and the mechanical nozzle seal assembly (MNSA). In the former technique, leaking or cracked nozzles are cut outboard of the partial-penetration welds and replaced with short sections (half-nozzles) of Alloy 690 material that are welded to the component outside surfaces. With the MNSA approach, a leak or a potential leak is mechanically sealed on the outer diameter of the component.

The half-nozzle repair has a small gap (1/8 inch or less) between the existing nozzle remnant and the new half-nozzle. This repair technique permits borated water to enter the crevice between a nozzle and the component wall. There is no cladding in the crevice region; thus, the carbon or low alloy steel wall will be exposed to primary coolant under conditions where

The purpose of the analysis is to examine how much corrosion is acceptable on the small nozzle bores in the pressurizer, hot and cold leg piping, and steam generator primary side for the member plants in this CEOG Task 1131. The calculations in this analysis will provide a bounding case for the amount of maximum allowable material degradation that can be lost because of corrosion in the crevice region in accordance with the ASME Code rules. The scope of this calculation will consider:

1. The reduction in the effective weld shear area.
2. The required area of reinforcement for the opening.

The bounding case will be addressed for each of the small nozzle bores in the pressurizer, hot leg piping and steam generator primary side.

It is not the objective of this calculation to qualify either the half-nozzle or MNSA repair methods.

2.0 ASSESSMENT OF SIGNIFICANT DESIGN CHANGES

There are no significant design changes that affect this evaluation.

3.0 ANALYTICAL TECHNIQUES

Information in this section is proprietary to CENP.

4.0 SELECTION OF DESIGN INPUTS

Information in this section is proprietary to CENP.

5.0 ASSUMPTIONS

Information in this section is proprietary to CENP.

6.0 DETAILED ANALYSIS

Information in this section is proprietary to CENP.

7.0 RESULTS / CONCLUSIONS

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8.0 REFERENCES

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ATTACHMENT 1 - DETAILED CALCULATIONS FOR SECTION 6.2

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