

**UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION**

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges:

**E. Roy Hawkens, Chair
Dr. Paul B. Abramson
Dr. Anthony J. Baratta**

In the Matter of:)	
)	May 27, 2008
AmerGen Energy Company, LLC)	
)	Docket No. 50-219
(License Renewal for Oyster Creek Nuclear)	
Generating Station))	
)	

AFFIDAVIT OF GARY STEVENS

1. My name is Gary Lance Stevens, and I am a Senior Associate at Structural Integrity Associates, Inc. (“SIA”). SIA is a contractor to AmerGen Energy Company, LLC (“AmerGen”).
2. My professional and educational experience is summarized in the *curriculum vitae* attached to this affidavit. Briefly summarized, I specialize in the application of finite element analysis, fracture mechanics, and structural and fatigue analyses to nuclear components. I have extensive experience in the application of ASME Code Sections III and XI methodology to fatigue and fracture analyses of reactor vessels and internals components. I was the Chairman of former ASME Section XI Task Group on Operating Plant Fatigue Assessments, am the Secretary of the ASME Section XI Working Group on Operating Plant Criteria, the Secretary of the ASME Section XI Subgroup on Evaluation Standards, and a member of the ASME Section XI Subcommittee on Nuclear Inservice Inspection.
3. I am familiar with the Nuclear Regulatory Commission’s (“NRC’s”) proposed generic

communication, Regulatory Issue Summary 2008-XX, “Fatigue Analysis of Nuclear Power Plant Components” (May 1, 2008) (“RIS 2008-XX”)¹, and Board Notification 2008-01, Notification of Information in the Matter of Oyster Creek Nuclear Generating Station License Renewal Application (Apr. 3, 2008) (“Commission Notification”), both of which present NRC Staff questions about the use of a methodology, known as a simplified Green’s Function methodology, to calculate projected cumulative usage factors (“CUF”) for fatigue analysis of nuclear power plant components. I am also familiar with AmerGen’s Response to a NRC Staff Request for Additional Information (“RAI”) on Metal Fatigue Analysis related to Oyster Creek Nuclear Generating Station (“OCNGS”) License Renewal Application (“LRA”), dated May 1, 2008 (“RAI Response”).

4. The purpose of this affidavit is to respond to the Licensing Board’s Order of May 21, 2008, by providing my expert opinion—“with particularity”—as to the significance of the RAI Response which was also submitted to the Commissioners via a letter from Alex S. Polonsky, Counsel for AmerGen, dated May 5, 2008. That RAI Response discusses the results of calculations of CUF (including environmentally assisted fatigue) of components at OCNGS performed by SIA.
5. My role with respect to the CUF calculations for OCNGS was to supervise the SIA technical staff involved in performing these calculations, to perform and review calculations as needed, and to provide expert technical consultation and review to all aspects of the work. I was the Project Manager for all of the CUF work initially completed for OCNGS in the 2005 time frame to support OCNGS’s LRA. I was also the Project Manager for the confirmatory fatigue analysis of the OCNGS recirculation outlet nozzle

¹ U.S. Federal Register, Vol. 73, No. 85, Thursday, May 1, 2008, Notices, p. 24094.

completed in 2008.

6. To answer the Licensing Board's question about the significance of the RAI Response, I offer the following. AmerGen's response directly addresses several technical issues associated with CUF evaluation for OCNGS. First, the RAI Response describes the results of a confirmatory analysis SIA performed for the OCNGS recirculation outlet nozzle that addresses all relevant technical issues described in NRC RIS 2008-XX. Second, AmerGen's Response specifically addresses the Staff's question as to whether the CUF evaluation originally performed for the recirculation outlet nozzle in the OCNGS LRA is conservative.
7. As to the first technical issue, RIS 2008-XX requested that recent license renewal applicants that have used a simplified Green's function methodology (using a single stress term) to evaluate CUF effects also perform confirmatory analyses (retaining all six stress components) to demonstrate that the simplified Green's function methodology analyses provide acceptable results. This request was based on the confirmatory analysis of one physical location (the nozzle corner) of a component performed to-date for a boiling-water reactor feedwater nozzle (not OCNGS) that led the Staff to conclude that use of a simplified Green's Function methodology that used a single stress term did not produce conservative results in the nozzle corner area when compared to the confirmatory analysis.
8. AmerGen requested SIA to perform a confirmatory analysis for the OCNGS recirculation outlet nozzle that would satisfy the technical issues raised in RIS 2008-XX. The recirculation outlet nozzle is the only component for OCNGS that utilized the methodology in question by NRC Staff in RIS 2008-XX. SIA performed such analysis for the OCNGS recirculation outlet nozzle and, since SIA also performed the confirmatory analysis for the

boiling water reactor feedwater nozzle identified in the RIS, we performed the OCNGS analysis in a consistent manner with that of the boiling water reactor feedwater nozzle. The results of the OCNGS confirmatory analysis, as well as key comparisons to the original CUF evaluation performed for the recirculation outlet nozzle in the OCNGS LRA, are described in the RAI Response.

9. As stated in the response to RAI 4.3.4-1, the OCNGS recirculation outlet nozzle confirmatory analysis addresses the concern identified in RIS 2008-XX for the following reasons: (1) the analysis was performed using ASME Code, Section III, Subsection NB-3200 methodology; (2) Green's Functions were not utilized in the confirmatory analysis; (3) all six stress components were retained and utilized in the confirmatory analysis; and (4) the results of the confirmatory analysis demonstrate that the results of the original CUF evaluation for the OCNGS recirculation outlet nozzle are conservative and remain acceptable.

The results of AmerGen's confirmatory evaluation of the recirculation outlet nozzle showed that the maximum CUF with environmental effects included ("CUF_{en}") is 0.1366 for 60 years of operation, compared to a conservative value of 0.9781 reported in the initial evaluation that was documented in the OCNGS LRA. Therefore, AmerGen's fatigue evaluations for purposes of license renewal provide reasonable assurance that components will not operate beyond their allowable metal fatigue limits during the proposed period of extended operation.

10. The confirmatory analysis performed for the OCNGS recirculation outlet nozzle produced a CUF_{en} that was approximately a factor of seven lower than the original evaluation performed for this component (0.1366 vs. 0.9781). There were several differences in the

two analyses, including the elimination of Green's Functions and the use of all six stress components, as previously described. These differences, as well as the reasons for the significant decrease in CUF, were described in AmerGen's RAI response, specifically in Items 1-4 of the response to RAI 4.3.4-1. The single most significant contributor to the significant decrease in CUF was that in the original analysis for the OCNGS recirculation outlet nozzle, stresses were conservatively extracted on the stainless steel cladding surface and were evaluated using the carbon steel fatigue curve, which provided very conservative fatigue usage results. In the confirmatory analysis, the stainless steel nozzle cladding was considered absent for the fatigue calculation, as permitted in NB-3122.3 of Section III of the ASME Code, and the low alloy steel base metal was evaluated for both stresses and fatigue usage using the carbon steel fatigue curve. This difference accounted for essentially all of the change in CUF, and is a source of significant conservatism in the original OCNGS analysis.

11. As to the second technical issue, the results of AmerGen's confirmatory analysis for the recirculation outlet nozzle, as discussed in paragraph 6 above and documented in the RAI Response, demonstrates that the original CUF evaluation performed for the OCNGS recirculation outlet nozzle is conservative and the nozzle has significant margin with respect to allowable. It therefore directly addresses the Staff question as to whether the original analysis was conservative.
12. The RAI Response also confirms that the OCNGS recirculation outlet nozzle was the only location where the methodology called into question in RIS 2008-XX was used. All other locations were evaluated and certified under accordance with ASME Code, Section III, methodology.

In accordance with 28 U.S.C. § 1746, I state under penalty of perjury that the factual statements and opinions I express in this affidavit are true and correct to the best of my personal knowledge and belief:

Mary L. Stevens

Gary Stevens

5/27/2008

Date

Gary L. Stevens, P. E.
Senior Associate

Education

MS, Mechanical Engineering, San Jose State University (1991)
BS, Mechanical Engineering, California Polytechnic State University (1981)

Professional Associations

Registered Professional Mechanical Engineer, State of California
Registered Professional Mechanical Engineer, State of Colorado

Professional Experience

1999 to present	Structural Integrity Associates, Inc., Centennial, CO Senior Associate
1996 to 1999	Structural Integrity Associates, Inc., San Jose, CA Associate
1995 to 1996	Structural Integrity Associates, Inc., San Jose, CA Senior Consultant
1981 to 1995	GE Nuclear Energy San Jose, CA

Summary

Mr. Stevens has 25 years of technical and supervisory experience in the nuclear energy field. His experience includes ASME Code stress and fatigue analysis, fracture mechanics analysis, analytical computer applications, and on-line fatigue monitoring of critical plant components. Mr. Stevens has achieved a significant amount of business management experience and skill, which includes technical project management, extensive technical proposal preparation and related customer interface, hardware design interface, and computer application development and management. He is currently SI's Product Lead for BWR License Renewal Services, BWR Fatigue Monitoring, and BWR Pressure-Temperature Curves.

At Structural Integrity Associates, Mr. Stevens has been responsible for a variety of projects for both PWR and BWR systems. These include the development of Class 1 fatigue management programs for plant license renewal applications (including environmental fatigue-related issues), the management, development, and installation of on-line fatigue and fatigue crack growth

monitoring systems, finite element model stress and fatigue analyses, and a variety of fracture mechanics applications including limit load and linear elastic fracture mechanics methodologies. Mr. Stevens has authored several technical papers enveloping all of these areas, has been an active member and participant in ASME Code Section XI Task Groups, Working Groups, Subgroups and Subcommittee, and has provided selected technical training to customers in the areas of fatigue and fracture mechanics. Mr. Stevens has developed an extensive working knowledge of the stress, fatigue and fracture mechanics areas through this experience.

Mr. Stevens is actively involved with the SI team developing nuclear plant Class 1 fatigue management programs. In particular, he has supported the development and deployment of the **FatiguePro** system, which is an on-line fatigue-damage monitoring system for power plants and other thermo-mechanical systems, at many plants world-wide. He has also been involved with various feedwater nozzle analyses throughout his career, and he continues to be a key contributor to the fracture mechanics work related to BWR internals, which is being studied by the BWR Vessel and Internals Project (BWRVIP).

At GE, Mr. Stevens began his career as a participant in the Edison Engineering Training Program, which provided three rotating work assignments before participants accepted a permanent position. This rotational work experience included nuclear fuel channel design, computer program design and development, spare parts, document database development, and structural analysis and design. After selecting a permanent position in March 1983, Mr. Stevens spent over 12 years performing ASME Code stress and fatigue analyses and various fracture mechanics evaluations for BWR vessel, piping, and vessel internals components. He was a key participant on most BWR vessel internals structural issues from the first significant incidences of detected cracking in 1993. During his tenure at GE, Mr. Stevens became recognized as a structural analysis expert for BWR services.

While at GE, Mr. Stevens received the prestigious “Young Engineer Award” for his contributions in the structural analysis area, as well as the “Product Application - Service Engineering Award” for his successful implementation of thermal cycle monitoring in Japan.

Over the years, Mr. Stevens has gained related computer experience in several computer environments (C, FORTRAN, BASIC, UNIX, and HP BASIC). In addition, he has extensive past experience in the use and application of the ANSYS finite element computer code.