

September 14, 2007

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
AMERGEN ENERGY COMPANY, LLC	)	Docket No. 50-219-LR
	)	
(Oyster Creek Nuclear Generating Station)	)	

NRC STAFF RESPONSE TO REBUTTAL PRESENTATIONS

INTRODUCTION

Pursuant to "Memorandum and Order (Prehearing Conference Call Summary, Case Management Directives, and Final Scheduling Order)" (April 17, 2007) (unpublished) ("April 17 Order"), the Staff of the U.S. Nuclear Regulatory Commission ("Staff") hereby files this written reply and sur-rebuttal testimony. Appended to this filing is "NRC Staff Sur-Rebuttal Testimony of Hansraj G. Ashar, Dr. James A. Davis, Dr. Mark Hartzman, Timothy L. O'Hara, and Arthur D. Salomon" (September 14, 2007) ("Sur-Rebuttal Testimony") and three exhibits.<sup>1</sup> For the reasons set forth below and in the testimony filed herewith, the Staff maintains that Citizens' challenge to the AmerGen Energy Company, LLC ("AmerGen") application for renewal of the Oyster Creek operating license cannot be sustained.

DISCUSSION

I. Legal and Regulatory Requirements

The Staff has briefed the legal and regulatory requirements for this proceeding. See NRC Staff Initial Statement of Position on the Drywell Contention (July 20, 2007) (Staff Initial Statement"); NRC Staff Response to Initial Presentations and Response to Board Questions

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<sup>1</sup> Consistent with the Board's instructions, see Transcript of Pre-Hearing Conference (Sept. 5, 2007) (Tr. at 168-69), attached are additional Staff exhibits referenced in previously filed testimony.

(Aug. 17, 2007) ("Staff Rebuttal"). The Staff has also briefed the scope of this proceeding and the issue presented. See *id.* The scope of this proceeding is limited to "whether, in light of uncertainty regarding the existence *vel non* of a corrosive environment in the sand bed region and the correlative uncertainty regarding corrosion rates in that region, AmerGen's UT monitoring plan is sufficient to ensure adequate safety margins" during the period of extended operation. Memorandum and Order (Denying AmerGen's Motion for Summary Disposition) (June 19, 2007) (unpublished) ("SD Order"), at 2. Citizens are precluded from challenging Oyster Creek's current licensing basis ("CLB"), including arguments that the buckling criteria are not part of the CLB. See *Florida Power & Light Co.* (Turkey Point Nuclear Generating Plant, Units 3 & 4), CLI-01-17, 54 NRC 3, 7 (2001) (citing Final Rule, "Nuclear Power Plant License Renewal," 56 Fed. Reg. 64,943, 64,946 (Dec. 13, 1991)); Memorandum and Order (Denying Citizens' Motion for Leave to Add a Contention and Motion to Add a Contention) (Apr. 10, 2007) (unpublished) ("April 10 Order") at 3 n.6.

Citizens are also precluded from litigating previously rejected contentions, including contentions regarding derivation of the acceptance criteria. See LBP-06-22, 64 NRC 229, 237-40 (2006) (rejecting as non-timely Citizens' assertion that Oyster Creek's buckling acceptance criteria are inadequate); April 10 Order (rejecting, as non-timely, Citizens' challenge to the General Electric (GE) modeling underlying the acceptance criteria); SD Order at 2 n.4 (reiterating the inadmissibility of any challenge to "AmerGen's modeling for deriving acceptance criteria"); Memorandum and Order (Ruling on Motions in Limine and Clarification) (August 9, 2007) (unpublished) at 6 ("Citizens may not challenge the derivation of the acceptance criteria, or how the criteria are applied in the current licensing term.").

Further, Citizens are required to expunge portions of Dr. Hausler's pre-filed direct testimony and portions of Attachments 3 and 4 to that testimony that exceed the scope of this proceeding in accordance with "Memorandum and Order (Hearing Directives) (Sept. 12, 2007)

(unpublished) at 1-2, Attachment A.

II. Staff Witnesses

The attached sur-rebuttal testimony presents the opinions of a panel of five qualified witnesses as follows: 1) Hansraj G. Ashar, a Senior Structural Engineer in the Division of Engineering, Office of Nuclear Reactor Regulation (NRR); 2) Dr. James A. Davis, a Senior Materials Engineer in the NRR Division of License Renewal; 3) Dr. Mark Hartzman, a Senior Mechanical Engineer in the NRR Division of Engineering; 4) Timothy L. O'Hara, a Reactor Inspector in the Division of Reactor Safety, NRC Region I Office; and 5) Arthur D. Salomon, a statistician in the Office of Nuclear Reactor Research. Sur-Rebuttal Testimony at 1-2. The professional qualifications of the witnesses were attached to either the Staff Initial Statement or the Staff Rebuttal. Each witness has signed an affidavit attesting to his statements.

The attached testimony rebuts statements made by the other parties in rebuttal testimony filed August 17, 2007.

III. Staff Sur-Rebuttal

A. Current Licensing Basis

Contrary to Citizens' assertion, Oyster Creek's local thickness acceptance criterion of 0.536 inch is part of Oyster Creek's current licensing basis. See Citizens' Rebuttal Regarding Relicensing of Oyster Creek Nuclear Generating Station (August 17, 2007) (Citizens' Rebuttal) at 5-9. CLB is defined in 10 C.F.R. § 54.3. As defined therein, a plant's CLB includes "plant-specific design-basis information defined in 10 CFR 50.2 as documented in the most recent final safety analysis report (FSAR) as required by 10 CFR 50.71." 10 C.F.R. § 54.3. Oyster Creek's updated final safety analysis report (UFSAR), which was submitted as part of its license renewal application, discusses the design of Oyster Creek's drywell and references GPU Technical Data Report, TDR No. 1108, "Summary of Corrective Actions Taken from Operating Cycle 12 through 14R" (Apr. 29, 1993) (AmerGen Exhibit 27), which describes the local wall thickness acceptance

criterion of 0.536 inch in a 12 inch by 12 inch area tapering to 0.736 inch over an additional 12 inches. See Sur-Rebuttal Testimony at A42. Thus, the local wall thickness acceptance criterion of 0.536 inch in a one square foot area with a one square foot transition area on all sides to 0.736 inch is part of Oyster Creek's current licensing basis and cannot be challenged in this proceeding. See, e.g., August 9 Order at 5-6.

B. Stability of the Drywell Shell

The Sandia study (Staff Exhibit 5) was performed to provide additional assurance that the Oyster Creek drywell shell can withstand the loads and load combinations specified in its FSAR. Sur-Rebuttal Testimony at A44. It conservatively assessed the ability of the drywell shell to withstand the postulated loads and load combinations in Oyster Creek's FSAR. Sur-Rebuttal Testimony at A44. Dr. Hausler overlooks a number of conservative aspects of the Sandia study, including use of exterior UT measurements, which were taken in the most corroded areas, and use of an unmodified capacity reduction factor. Sur-Rebuttal Testimony at A44. If Sandia had used more realistic parameters, the safety factor against buckling would have been higher than 2.15. Sur-Rebuttal Testimony at A44. Thus, contrary to Citizens' assertion, the Sandia study provides additional assurance regarding the ability of Oyster Creek's drywell shell to withstand the postulated loads. Sur-Rebuttal Testimony at A44.

A "factor of safety" is the ratio of the calculated loads acting on a structure which could cause failure to the calculated loads that could be imposed on the structure under postulated loading conditions. Sur-Rebuttal Testimony at A51. Failure occurs when the applied loads equal the failure loads of the structure. Sur-Rebuttal Testimony at A51. For the drywell shell, the *effective* factor of safety is the reduced buckling stress or load divided by the actual stress or load acting on the shell. Sur-Rebuttal Testimony at A53. ASME Code Cases N-284, N-284-1, and N-284-2 prescribe a minimum factor of safety of 2.0, for the design of shells under the compressive loads of normal operating conditions. Sur-Rebuttal Testimony at A52. The

prescribed factor of safety is based upon uncertainties at the design stage. Sur-Rebuttal Testimony at A53. Once the structure is built, a reduced required buckling factor of safety, based on smaller uncertainties than those associated with the factor of safety specified by the Code Cases, may be considered reasonable and acceptable. Sur-Rebuttal Testimony at A52.

The actual effective factor of safety for the Oyster Creek drywell shell is most likely greater than 2.0 because the Oyster Creek drywell shell is not uniformly thinned to 0.736 inch. Sur-Rebuttal Testimony at A47. The GE analysis determined that the effective factor of safety against buckling of a postulated *uniformly* degraded drywell shell with wall thickness of 0.736 inch would be 2.0. Sur-Rebuttal Testimony at A47. Uniformly degraded means that the thickness of the entire drywell shell in the sand bed region (totally approximately 720 square feet) has been reduced to a thickness of 0.736 inch. Sur-Rebuttal Testimony at A47. As long as the mean thickness is not less than 0.736 inch, the actual effective factor of safety will not be less than 2.0. Sur-Rebuttal Testimony at A47.

In addition, GE performed analyses where a portion of the uniformly thinned drywell shell is less than 0.736 inch, *i.e.*, the idealized “tray” configuration. Sur-Rebuttal Testimony at A49. In his Rebuttal Testimony at A6, Dr. Hausler does not mention that, because of symmetry, the 6 inch by 12 inch and 1.5 feet by 3 feet areas modeled by GE actually analyze a 12 inch by 12 inch and 3 foot by 3 foot areas, respectively. Sur-Rebuttal Testimony at A48.

C. Corrosion

The Staff estimates that, based on a linear interpolation of the reduction in the thickness of the drywell, the rate of corrosion on the exterior surface of the drywell shell in the sand bed region between 1986 and 2006 was approximately 0.002 inch per year. Sur-Rebuttal Testimony at A45. However, most of the corrosion probably occurred between 1986 and 1992, before the sand was removed and the epoxy coating applied. Sur-rebuttal Testimony at A45. Therefore, the corrosion rate between 1992 and 2006 is probably significantly less than 0.002 inch per

year. Sur-Rebuttal Testimony at A45.

D. Epoxy Coating

Dr. Hausler's rebuttal testimony contains a number of misstatements about the epoxy coating used at Oyster Creek. See Sur-Rebuttal Testimony at A56 and A57. First, Dr. Hausler's statements that the epoxy could spontaneously become brittle, contract, and crack are unsubstantiated and generally untrue. Sur-Rebuttal Testimony at A56. Second, Dr. Hausler's statement that the slow diffusion of water and oxygen through the epoxy coating could cause the formation of a thin layer of oxide on the surface of the metal and destroy the epoxy's adherence properties is incorrect. Sur-Rebuttal Testimony at A57. Because disbonding was a problem in the past, fillers have been developed that prevent moisture from permeating the epoxy and causing disbonding of the coating from the metal. Sur-Rebuttal Testimony at A57. Coatings developed for immersion (underwater) service, such as those used at Oyster Creek, contain fillers that block moisture. Sur-Rebuttal Testimony at A57; Rebuttal Testimony at A35.

While Dr. Hausler lists the correct densities for iron oxide (Hematite) and hydrated iron oxide (rust), Dr. Hausler's implication that if iron oxide and rust have a lower density than steel, they will not be noticeable under the coating is not correct. Sur-Rebuttal Testimony at A58. Lower density means higher volume. Sur-Rebuttal Testimony at A58. One cubic inch of iron produces 1.77 cubic inches of iron oxide. Sur-Rebuttal Testimony at A58. Thus any rust that forms on the drywell shell will have a greater volume than the original metal and will be visible. Sur-Rebuttal Testimony at A58.

Available information regarding the condition of Oyster Creek's drywell shell, AmerGen's corrective actions, the predicted corrosion rate, and the corrosion monitoring interval under AmerGen's enhanced Aging Management Program, are sufficient to provide reasonable assurance that corrosion of the drywell shell will be managed such that the drywell can perform

its intended function during the period of extended operation. Sur-Rebuttal Testimony at A59.

CONCLUSION

For the reasons discussed above, AmerGen's UT monitoring frequency is sufficient to maintain an adequate safety margin in accordance with NRC requirements during the period of extended operation.

Respectfully submitted,

**/RA/**

Mitzi A. Young  
Counsel for NRC Staff

**/RA/**

Mary C. Baty  
Counsel for NRC Staff

Dated at Rockville, Maryland  
this 14th day of September, 2007

September 14, 2007

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NRC STAFF SUR-REBUTTAL TESTIMONY OF  
HANSRAJ G. ASHAR, DR. JAMES A. DAVIS,  
DR. MARK HARTZMAN, TIMOTHY L. O'HARA, AND ARTHUR D. SALOMON

Q1. Please state your name, occupation, and by whom you are employed.

A1(a). My name is Hansraj G. Ashar ("Ashar").<sup>1</sup> I am employed as a Senior Structural Engineer in the Division of Engineering, Office of Nuclear Reactor Regulation ("NRR"), U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached to prefiled testimony I provided on July 20, 2007.

A1(b). My name is Dr. James A. Davis ("Davis"). I am employed by the NRC as a Senior Materials Engineer in the Office of Nuclear Reactor Regulation ("NRR"), Division of License Renewal. A statement of my professional qualifications is attached to prefiled testimony I provided on July 20, 2007.

A1(c). My name is Dr. Mark Hartzman ("Hartzman"). I am employed by the NRC as a Senior Mechanical Engineer in the Division of Engineering, Office of Nuclear Reactor Regulation ("NRR"). A statement of my professional qualifications is attached to prefiled testimony I provided on July 20, 2007.

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<sup>1</sup> In this testimony, the sponsors of each numbered response are identified by their last name; no such designation is provided for paragraphs which are sponsored by all witnesses.

A1(d). My name is Timothy L. O'Hara ("O'Hara"). I am employed by the NRC as a Reactor Inspector in the Division of Reactor Safety, Region I Office. A statement of my professional qualifications is attached to prefiled testimony I provided on July 20, 2007.

A1(e). My name is Arthur D. Salomon ("Salomon"). I am employed by the NRC as a Research (Mathematical) Statistician. A statement of my professional qualifications is attached to prefiled rebuttal testimony I provided on August 17, 2007.

Q41. What is the purpose of your testimony?

A41. The purpose of this testimony is to rebut statements made in rebuttal testimony filed August 17, 2007 in response to the "NRC Staff Testimony of Hansraj G. Ashar, Dr. James A. Davis, Dr. Mark Hartzman, and Timothy O'Hara Concerning Drywell Contention" (July 20, 2007) ("Staff Initial Testimony").

Q42. Dr. Hausler discusses the criteria for accepting locally thin areas of the drywell shell in A6 of his Rebuttal Testimony. Are the acceptance criteria for the drywell shell part of Oyster Creek's current licensing basis?

A42. Yes. The current licensing basis (CLB) for the design of the Oyster Creek drywell shell is described, in part, in the Updated Final Safety Analysis Report ("UFSAR") submitted with the license renewal application ("LRA"). The UFSAR references GPUN Technical Data Report, TDR No. 1108, "Summary Report of Corrective Action Taken from Operating Cycle 12 through 14R" (Apr. 28, 1993) (AmerGen Exhibit 27), which discusses the General Wall Acceptance Criterion of 0.736 inch and a Local Wall Acceptance Criterion of 0.536 inch a 12 inch by 12 inch area in the sand bed region, tapering to the 0.736 inch thickness over an additional 12 inches. See UFSAR Update 10 (AmerGen Exhibit 38) at 3.8-45, 3.8-61 to 3.8-62, 3.8-118. Reference 44 on UFSAR page 3.8-118 is TDR No. 1108 and the drywell wall thickness acceptance criteria are discussed on pages 16-17 of 45 of that TDR. TDR No. 1108, at 5 of 45, also references the General Electric ("GE") Letter Report,

“Sandbed Local Thinning and Raising the Fixity Height Analysis (Line Items 1 and 2 In Contract #PC-0391407)” (Dec. 11, 1992) (AmerGen Exhibit 39), evaluated locally thin areas in the drywell shell. GE’s local thinning analysis formed the basis for the acceptance criteria discussed in Calculation-24, Revisions 0 and 1 (AmerGen Exhibits 17 and 18).

Q43. In his Rebuttal Testimony at A10, Dr. Hausler suggests that the Staff Initial Testimony (at A22) accepted the 95% confidence limit for assessing the future drywell shell wall thicknesses. Do you agree?

A43. (Ashar) Yes. For the evaluation of the grid UT measurements taken from inside of the drywell shell, as noted in the SER (Staff Exhibit 1 at 4-59 to 4-60), the Staff has accepted the 95% confidence level for assessing the trend of future corrosion.

Q44. In his Rebuttal Testimony at A11, Dr. Hausler states that the Sandia National Laboratories Report SAND2007-0055 (Jan. 2007) (“Sandia Report”) does not provide assurance that the drywell shell currently meets safety requirements. Do you agree?

A44. (Ashar) No. The Sandia Report (Staff Exhibit 6) was performed to provide additional assurance that the Oyster Creek degraded drywell shell can withstand the postulated loads and load combinations specified in the plant’s FSAR. Because Dr. Hausler is not a structural engineer, he fails to consider a number of conservatively biased aspects of Sandia’s analysis: 1) Sandia did not use the minimum drywell shell thicknesses from the 1992 UT measurements taken from the inside the shell, but instead used shell thicknesses from the exterior UT measurements (highly corroded areas) as depicted in Calculation-24, Revision 0 (AmerGen Exhibit 17); 2) Sandia evaluated thicknesses for the two locally thin areas (18” x 30”) in Bays 1 and 13 using the lowest thicknesses reported in those two bays; and 3) Sandia did not use the modified capacity reduction factor in calculating the buckling safety factor for the load case involving the refueling water load, the design basis seismic load, and the external pressure of 2.0 psig. Staff Exhibit 6 at 47-50, 67. If Sandia had used the more realistic average

thicknesses from the inside grids, and a moderate increase in the capacity reduction factor to account for the circumferential tensile stresses developed in the shell, the safety factor against buckling would have been higher than 2.15. Based on the listed considerations, the Staff views the Sandia study as a bounding analysis of the ability of drywell shell to withstand the postulated loads, satisfying the acceptance criteria Section III, Code Case N-284 (AmerGen Exhibit 42).

Q45. In his Rebuttal Testimony at A19 (as revised 08/24/07), Dr. Hausler notes that the NRC acknowledges that a corrosion rate of approximately 0.002 inch per year occurred between 1986 and 2006 as evident from the UT data taken in the trenches. Do you agree?

A45. (Ashar) Yes. The Staff's estimate of a 2 mils per year corrosion rate on the exterior surface of the drywell shell in the sand bed region (Staff Initial Testimony at A11) is based on the linear interpolation of the thickness reduction of 0.038 inches due to corrosion on the exterior of the drywell shell reported in AmerGen's December 3, 2006 letter (AmerGen Exhibit 12). It is reasonable to assume that most of the exterior corrosion took place between 1986 and 1992, when the exterior surface of the drywell shell in the sand bed region had wet sand present and was not protected by the three-layer epoxy coating. The corrosion rate between 1992 and 2006 would likely be significantly lower than 2 mils per year.

Q46. In his Rebuttal Testimony at A6 and A11, Dr. Hausler refers to "downcomers" in the drywell shell. Is this correct?

A46. (Hartzman) No. Dr. Hausler does not appear to be familiar with the structural configuration of the drywell. There are no downcomers in the drywell shell. Downcomers are located inside the torus. The drywell has a vent line in each bay. The vent lines extend to the vent line header inside the torus.

Q47. In his Rebuttal Testimony at A6, Dr. Hausler refers to GE's determination of a 2.0 factor of safety against buckling. Do you have opinion regarding the factor of safety against buckling for the Oyster Creek drywell shell?

A47. (Hartzman) Yes. Based on the ultrasonic testing (UT) data taken from 1992 to 2006 (see AmerGen Exhibit 20 at 6 of 55), the actual wall thickness of the Oyster Creek drywell shell is not uniformly degraded to 0.736 inch, as assumed in the GE analysis. Uniformly degraded means that the entire wall thickness, 360 degrees around the circumference of the sand bed region and covering about 720 square feet of the sand bed shell, has corroded at the same rate throughout the shell from the initial thickness of 1.15 inches to a thickness of 0.736 inch. Thus, the GE analysis is an idealized model, since measured wall thicknesses to date indicate that the shell is not uniformly corroded (*i.e.*, the wall thicknesses throughout the shell are generally considerably thicker than the assumed uniform wall thickness of 0.736 inch, thus permitting load redistribution to the thicker walls). As long as the mean wall thickness has not decreased below 0.736 inch, the actual effective factor-of-safety for the Oyster Creek shell is most likely greater than 2.0.

Q48. (Hartzman) Dr. Hausler (Rebuttal Testimony at A6) lists the dimensions used by GE for the analysis of the "tray shape" configuration? Is he correct?

A48. No. The dimensions he references only represent half of the configuration GE analyzed in its local thinning analysis (AmerGen Exhibit 39). It is not clear whether Dr. Hausler understands that by reason of symmetry, the GE model includes the mirror image of the modeled tray configuration. Thus, the 6" x 12" and 1.5' x 3' areas modeled actually equate to 12" x 12" and 3' x 3' tray areas, respectively. See AmerGen Exhibit 39 at Fig. 1a. GE invoked the symmetry about the middle plane of a bay between two vent lines to reduce the size of the analysis for performing the reduced wall thickness calculations. Symmetry considerations are commonly invoked in structural analysis to reduce the magnitude of an analytical problem and make it more amenable to solution. It is also not clear whether Dr. Hausler understands that the analysis of a 36 degree pie slice of the drywell shell applies to each bay of the shell (*i.e.*, the analysis of a 36 degree slice is equivalent to postulating a tray configuration in each bay in the

sand bed region). This is also a conservative aspect of the GE analysis because locally thin areas have only been identified in a few bays.

Q49. Dr. Hausler (Rebuttal Testimony at A6) states that AmerGen “adopted a conservative criterion . . . because the mean thickness of some of the bays is approaching 0.736 inches, so that a reduction of 3.9% in buckling capacity is potentially significant.” Does a 0.736 inch thickness equal a 3.9% reduction in the buckling capability of the drywell shell?

A49. (Hartzman) No. The 3.9% reduction is associated with a locally thin area less than 0.736 inch, but greater than 0.636 inch in a 3 foot x 3 foot tray area embedded in a shell uniformly thinned to 0.736 inch. Dr. Hausler does not appear to understand the GE analysis and does not explain how approaching a mean thickness of 0.736 inch reduces the buckling capacity by 3.9%.

Q50. Dr. Hausler uses the terms “factor of safety” or “safety factor” in his testimony. Does he define those terms?

A50. (Hartzman) No. Dr. Hausler has not included a definition in his testimony.

Q51. What is a “factor of safety”?

A51. (Hartzman) A factor of safety is the ratio of the calculated loads acting on a structure at which failure may occur to the calculated internal loads that may be imposed on the structure, under postulated applied loading conditions. Failure of a structure occurs when the structure is no longer able to perform the function for which it was designed (*i.e.*, when the applied loads equal the failure loads of the structure). The calculated minimum factor-of-safety then equals 1.0. However, minimum factors of safety greater than 1.0 are prescribed during the design process of the structure to accommodate uncertainties in calculating the actual failure loads of the structure and the actual internal loads, which depend on the design geometry, how well the material properties are known and how well the actual loads acting on the structure are known (type, magnitude, and probability of application). These uncertainties are ordinarily

difficult to quantify and highly subjective.

Q52. Is a reduced buckling factor of safety acceptable for the drywell shell?

A52. (Hartzman, Ashar) Yes. The ASME Section III Code Cases N-284, N284-1 and N284-2 prescribe a minimum factor of safety of 2.0, applicable to the design of general shells under compressive loads that exist under normal operating and other service level conditions. As noted in A51, above, this factor-of-safety is based on uncertainties at the design stage regarding the shell geometry, material properties, and loading conditions. However, for the as-built drywell vessel under refueling conditions, reduced uncertainties from those at the design stage may be acceptable because the as-built geometry is well known, the model used for analyzing the vessel is conservative compared with the as-built geometry, the method used for the analysis is highly refined, the material properties are known conservatively, and the loading is conservatively and reasonably well defined. Therefore, for the as-built drywell shell under the refueling loading condition loads, a reduced required buckling factor of safety, based on smaller uncertainties than those associated with the factor-of-safety specified by the Code Case, may be considered reasonable and acceptable.

Q53. What is the definition of the effective factor of safety for the drywell shell?

A53. (Hartzman) For shell type structures, the effective factor-of-safety is defined as the reduced buckling stress or load divided by the actual stress or load acting on the shell. Due to various construction uncertainties, known as initial imperfections, the calculated elastic theoretical buckling capacity is reduced by capacity reduction factors (obtained empirically) which may be as large as 80%. The capacity is reduced further by inelastic reduction factors if the reduced elastic buckling stress exceeds the yield stress of the material.

The Oyster Creek drywell accommodates the loads (refueling pool water weight, external pressure, dead weight and potential earthquake loading equivalent to an SSE) acting during the refueling loading condition. This was found to be the limiting loading condition. The

governing failure mode of the as-built drywell shell was determined as elastic buckling in the sand bed region. The reduced buckling stress is based on a capacity reduction factor of approximately 68%. No inelastic reduction factor was applied since the reduced buckling stress did not exceed the yield stress.

Q54. What are the effective factors of safety associated with the load factor reductions cited by Dr. Hausler in his Rebuttal Testimony at A6?

A54. (Hartzman) The reduction in the buckling capacity by 3.9% and 9.8% cited by Dr. Hausler equate to an effective factor-of-safety of approximately 1.93 and 1.81, respectively. These reductions in capacities were based on the "tray" configuration embedded in a uniformly degraded sand bed shell thickness of 0.736 inches, which did not consider that the actual thickness of the shell outside the "tray" shaped configurations might be greater than 0.736 inch and thus permit load redistribution to the thicker walls. Therefore the actual factors of safety could be 2.0 or greater. In addition, as shown in A55, above, these factors of safety are acceptable since the uncertainties are also smaller than those associated with a factor of safety of 2.0. On this basis, and other considerations such as the limited extent of the degradation, the Staff considers the factors of safety of 1.81 and 1.93 as reasonable and acceptable, in lieu of the ASME Section III Code Case minimum factor-of-safety of 2.0.

Q55. On page 6 of Citizens' Exhibit 39, Dr. Hausler states "The 95% confidence limits embrace 95% of all data belonging to a specific family of data, which have been experimentally determined." Is he correct?

A55. (Salomon) No. The 95% confidence limits (of the mean as used in most of AmerGen's calculations) place "bounds" on the sample mean for a specified sample size. It does not place limits on the data, itself.

Q56. On page 17 of Citizens' Exhibit 39, Dr. Hausler states, "Once the coating (or cast) has hardened is it commonly assumed that the reactions have terminated. In fact,

unreacted functionalities keep (sic) reaction for a long time, even when the product has become solid. Granted these solid state reactions are excruciatingly slow, but the [sic] contribute to the product's becoming brittle with time, contracting, and cracking. These processes are slow and the results can be spontaneous." Do you agree with these statements?

A56. (Davis) No. These statements are unsubstantiated and are not generally true. Epoxy coatings generally consist of three main components, a resin, a hardener, and fillers. For a given epoxy coating, the ratio of resin to hardener is critical and must follow the manufacturer's recommendations. Fillers are used for a variety of purposes, such as providing a color to the coating, improving resistance to ultraviolet radiation, improving resistance to oxidation, reducing the rate of moisture penetration through the coating, and increasing or decreasing the hardness and abrasion resistance of the coating.

Q57. On page 18 of Citizens' Exhibit 39, Dr. Hausler states, "However, the slow diffusion of water and oxygen through the coating can cause formation of a thin oxide layer on the surface of the metal, which destroys the coating's adherence properties." Do you agree with this statement?

A57. (Davis) No. Bell Laboratories conducted a lot of research in this area in the late 1970s and early 1980's because some epoxy coatings were discovered to disbond in the presence of moisture that permeated through the coatings. Fillers were developed that blocked the permeation of moisture through the coatings and eliminated the disbonding of coatings in the presence of moisture. Coatings developed for immersion service have fillers added to block permeation of moisture in these coatings.

Q58. On page 18 of his August 16 Memorandum, Dr. Hausler states, "A quick search in the Handbook of Chemistry and Physics teaches that iron has a density of 7.9 gm/cc (depending on the specific alloy) while iron oxide (Hematite) has a density of 5.24, and the hydrated iron oxide (rust) has a density of about 3.6." Do you agree with this statement?

A58. (Davis) Yes. I agree that the densities stated are correct. The implication of Dr. Hausler's statement is that if iron oxide and rust have a lower density, they will not be noticeable under the coating. Actually the opposite is true, a lower density means that the iron oxide or rust will have a higher volume, not a lower volume. In "Corrosion Engineering," by Fontana and Green, they discuss the Pilling-Bedford Ratio which is the volume ratio of oxide to metal, which for iron is 1.77. This means that 1 cubic inch of iron will produce 1.77 cubic inches of iron oxide. What this says is for iron to oxidize to iron oxide, the volume almost doubles. When iron forms rust, it is in the form of hydrated iron hydroxide, which occupies 7 to 10 times the original volume of the iron. Therefore, the Staff's statement that any rust that forms will have a greater volume than the original iron and, hence will be readily visible, is correct.

Q59. Does the information discussed in the rebuttal presentation of the other parties change the Staff's conclusion regarding the adequacy of the frequency of drywell monitoring?

A59. No. Based on the information known about the condition of the drywell shell, the corrective actions taken by AmerGen, and the projected corrosion rate, AmerGen's corrosion monitoring interval under the enhanced aging management program is sufficient to provide reasonable assurance that the corrosion will be managed such that the drywell can perform its intended function (and maintain structural integrity) throughout the renewal period.

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AFFIDAVIT OF HANSRAJ G. ASHAR

I, Hansraj G. Ashar, do hereby declare under penalty of perjury that my statements in the foregoing sur-rebuttal testimony are true and correct to the best of my knowledge and belief.

***/Original signed by/***

\_\_\_\_\_  
Hansraj G. Ashar

Executed at Rockville, MD  
this 14th day of September, 2007

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AFFIDAVIT OF JAMES A. DAVIS, PH.D

I, James A. Davis, do hereby declare under penalty of perjury that my statements in the foregoing sur-rebuttal testimony are true and correct to the best of my knowledge and belief.

***/Original signed by/***

\_\_\_\_\_  
James A. Davis, Ph. D

Executed at Rockville, MD  
this 14th day of September, 2007

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
AMERGEN ENERGY COMPANY, LLC	)	Docket No. 50-219-LR
	)	
(Oyster Creek Nuclear Generating Station)	)	

AFFIDAVIT OF MARK HARTZMAN, PH. D

I, Mark Hartzman, do hereby declare under penalty of perjury that my statements in the foregoing sur-rebuttal testimony are true and correct to the best of my knowledge and belief.

***/Original signed by/***

\_\_\_\_\_  
Mark Hartzman, Ph. D

Executed at Rockville, MD  
this 14th day of September, 2007

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
AMERGEN ENERGY COMPANY, LLC	)	Docket No. 50-219-LR
	)	
(Oyster Creek Nuclear Generating Station)	)	

AFFIDAVIT OF TIMOTHY L. O'HARA

I, Timothy O'Hara, do hereby declare under penalty of perjury that my statements in the foregoing sur-rebuttal testimony are true and correct to the best of my knowledge and belief.

***/Original signed by/***

\_\_\_\_\_  
Timothy L. O'Hara

Executed at Medford, NJ  
this 14th day of September, 2007

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
AMERGEN ENERGY COMPANY, LLC	)	Docket No. 50-219-LR
	)	
(Oyster Creek Nuclear Generating Station)	)	

AFFIDAVIT OF ARTHUR D. SALOMON

I, Arthur D. Salomon, do hereby declare under penalty of perjury that my statements in the foregoing sur-rebuttal testimony and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

***/Original signed by/***

\_\_\_\_\_  
Arthur D. Salomon

Executed at Rockville, MD  
this 14th day of September, 2007

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
AMERGEN ENERGY COMPANY, LLC	)	Docket No. 50-219-LR
	)	
(Oyster Creek Nuclear Generating Station)	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of the "NRC STAFF RESPONSE TO REBUTTAL PRESENTATIONS" and "NRC STAFF SURREBUTTAL TESTIMONY OF HANSRAJ G. ASHAR, DR. JAMES A. DAVIS, DR. MARK HARTZMAN, TIMOTHY O'HARA, AND ARTHUR SALOMON AND RESPONSE TO BOARD QUESTIONS", and AFFIDAVITS of Hansraj G. Ashar, Mark Hartzman, James A. Davis, Timothy O'Hara, and Arthur Salomon in the above-captioned proceeding have been served on the following by electronic mail with copies by deposit in the NRC's internal mail system or as indicated by an asterisk, by electronic mail, with copies by U.S mail, first class, this 14th day of September, 2007.

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