From: "Hessheimer, Michael" <mfhessh@sandia.gov>
To: <DJA1@nrc.gov>
Date: 02/09/2007 12:57:53 PM
Subject: Comments on Buckling Limits for the Oyster Creek Drywell

Donnie,

I'd like to clarify a few points regarding our design analysis of the Oyster Creek drywell shell documented in SAND-2007-0055 which were discussed at the ACRS meeting on February 1. Our views on these issues differ somewhat from the opinions presented by the licensee and the Staff. In the event we are called upon to explain our views in the future, I thought it was important to explain them to you first.

First, my comments below not withstanding, I would like to reiterate that the fundamental conclusion in our report is still valid: Based on our analysis of the 'best estimate' of the actual condition of the degraded drywell shell during the extended license period, subject to the assumptions stated in the report, the margins of safety for the prescribed design loads satisfy the requirements of Subsection NE and Code Case N-284 of the ASME B&PV code.

The emphasis by the licensee and others on determining the minimum uniform thickness in the sandbed region at the various ACRS meetings has tended to obscure this conclusion. We believe that it is important to understand the subtle distinction that the minimum uniform thickness across the entire sandbed region is not equivalent to the minimum thickness anywhere across the sandbed region. The minimum uniform thickness in the sandbed region should not be used to determine compliance with the Code requirements. Since we cannot determine a priori the location and extent of any future reduction in the shell wall thickness, it is only meaningful and appropriate use the minimum uniform thickness in the context of establishing a threshold for ongoing surveillance, which might trigger a re-evaluation of the vessel. There may be more appropriate threshold values on wall thickness which could be established, however, we have not investigated this under the scope of our current Work Order.

In the Staff's presentation to the ACRS on February 1, regarding the stability or buckling limits, statements were made that the Sandia analysis "did not include the effect of hoop tension in determining the minimum shell thickness" in the sandbed region. The implication was that we should have used an increased capacity reduction factor in determining this value.

While we did not apply the increase in the capacity reduction factor due to the presence of hoop tension (resulting from internal pressure) allowed by ASME B&PV Code Case N-284, the theoretical buckling load determined by the linear elastic finite element analysis, to which the capacity reduction factor is applied, does, in fact, explicitly account for the hoop tension which develops in the shell. This is evidenced by the 'double-lobe' shape of the buckling mode in the sand bed region illustrated in Figure 4.4 of our report. In the absence of hoop tension in this area, we would expect a 'single-lobe' buckled shape to occur at a lower theoretical buckling load. Therefore, we do not think it is appropriate to take additional credit for the presence of hoop tension (whether a result of internal pressure or arising from deformation of the shell under the action of vertical loading).

We do not agree that the application of the increased capacity reduction factor to our analysis, as presented to the ACRS by both the licensee and the Staff, to determine the minimum uniform thickness in the sandbed region is correct.

It may be helpful to offer a discussion of the provisions of Code Case N-284 in the context of the current investigation to further explain the basis for our position. The Code Case recognizes that constructed shells exhibit lower buckling strengths, due to geometric and material imperfections, than the theoretical capacity computed for idealized geometries. The capacity reduction factors specified in the Code Case reflects the important work by Dr. Miller and others to quantify this effect for shells constructed within the tolerances specified by the B&PV code. As he described at the ACRS meeting, the presence of membrane tension may reduce the effect of initial geometric imperfections and justify an increase in the capacity reduction factor, i.e. allow a higher buckling load.

However, these empirically based reduction factors are presumed to be conservative when used in conjunction with the analytic procedures (i.e. by formula) described in N-284 without distinction for the complex geometries and boundary conditions present in constructed vessels. The capacity reduction factors in the Code Case does not distinguish between determination of theoretical buckling via the prescribed analytic methods or by more rigorous numerical (finite element) methods which explicitly account for the biaxial stress state. (It is arguable whether this presumption of conservatism for the reduction factors is valid for shells which exhibit deformations from many years of operational loading and environmentally induced degradation which may further exacerbate the effect of initial imperfections.)

I hope this discussion clarifies some possible misunderstanding of Sandia's analysis and the implications of the results. I've reviewed these concerns with other members of our technical staff who are recognized for their expertise in computational structural mechanics and they concur with the positions stated. If you have any questions or would like discuss any of these points further, please let me know.

-Mike

Michael F. Hessheimer, P.E.

Manager, Systems & Structures, Dept. 6764
Sandia National Laboratories
PO Box 5800
Albuquerque, New Mexico 87185-0744

Tel: (505) 844-6229
Fax: (505) 844-2829
Cell: (505) 228-4153

e-mail: mfhessh@sandia.gov

For express mail deliveries:

Sandia National Laboratories, MS-0744
1515 Eubank SE
Albuquerque, New Mexico 87123

CC: "Noel Dudley" <NFD@nrc.gov>, <SKS3@nrc.gov>, "Ashar, Hans" <HGA@nrc.gov>, "Petti, Jason P" <jppetti@sandia.gov>, "Walck, Marianne" <mcwalck@sandia.gov>

Mail Envelope Properties (45CCB613.EE2 : 20 : 7906)

Subject:	Comments on Buckling Limits for the Oyster Creek Drywell
Creation Date	02/09/2007 12:57:22 PM
From:	"Hessheimer, Michael" <mfhessh@sandia.gov>
Created By:	mfhessh@sandia.gov

Recipients

nrc.gov
OWGWPO01.HQGWDO01
HGA CC (Hansraj Ashar)
DJA1 (D. Ashley)

nrc.gov
OWGWPO03.HQGWDO01
NFD CC (Noel Dudley)

sandia.gov
mcwalck CC (Marianne Walck)
jppetti CC (Jason P Petti)

nrc.gov
TWGWPO02.HQGWDO01
SKS3 CC (Sujit Samaddar)

Post Office	**Route**
OWGWPO01.HQGWDO01	nrc.gov
OWGWPO03.HQGWDO01	nrc.gov
	sandia.gov
TWGWPO02.HQGWDO01	nrc.gov

Files	**Size**	**Date & Time**
MESSAGE	5816	09 February, 2007 12:57:22 PM
Mime.822	8251	

Options

Expiration Date:	None
Priority:	Standard
ReplyRequested:	No
Return Notification:	None
Concealed Subject:	No
Security:	Standard

Junk Mail Handling Evaluation Results
Message is eligible for Junk Mail handling
This message was not classified as Junk Mail

Junk Mail settings when this message was delivered
Junk Mail handling disabled by User
Junk Mail handling disabled by Administrator
Junk List is not enabled
Junk Mail using personal address books is not enabled
Block List is not enabled