From: Douglas Pickett NRR
To: NRR Allen Hansen; Anthony Mendiola; Bill Bateman; Bxb@ornl.gov; gwilkows@columbus.rr.com; Keith Wichman; Stephanie Coffin; Steven Bloom; Steven Long; Wallace Norris; William Cullen
Date: 6/20/02 12:27PM
Subject: Davis Besse Telecon

I have arranged a telecon for 1:30 p.m. EST this afternoon to discuss the Davis-Besse draft response to questions on the Safety Significance Assessment. Our questions are attached.

Please dial in at 800-638-8081 with passcode [redacted] Ex 2

NRC participants should gather in room 16B6.

Doug

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NRC STAFF COMMENTS AND QUESTIONS ON DAVIS-BESSE SAFETY SIGNIFICANCE ASSESSMENT (SIA-W-DB-01Q-301) SUBMITTED APRIL 8, 2002

FAILURE CRITERION

(1) What is the technical basis of the failure criterion (e.g., strain exceeding 11.15%) used to determine the failure conditions of the cladding layer? Provide specific technical references in the literature that support the failure criterion used in this evaluation.

(2) How does the failure criterion (e.g., based on ultimate strain in a uniaxial tensile test) account for the effects of biaxial loading in the cladding, or triaxial loading in the cladding at the edges of the degradation cavity?

(3) The failure criterion applied in SIA report W-DB-01Q-301 (e.g., the minimum cross-sectional strain exceeding the failure strain of 11.15%) allows the strain levels in the cladding to exceed the critical strain value entirely through the thickness, leading to very large strains at the surface of the cladding, up to 49% in Table 5 of the SIA report. What is the technical basis for this approach, as opposed to the average cross-sectional strain, or the maximum cross-sectional strain?

(4) Did you explore a continuum damage mechanics analysis to give guidance of the failure criterion once the strains exceed the critical strain where necking/void growth starts? If not, provide the technical basis for not using a continuum damage mechanics analysis. [Poisson's ratio of 0.5 no longer applies once this critical strain level is exceeded, so the analysis is strictly not valid. (Poisson's ratio is continuously changing as the voids grow at the strains beyond the start of necking.) This results in a stress redistribution that is not accounted for in a standard elastic-plastic analysis.]

(5) How would the strain values change if the stress free temperature was assumed to be the stress relief temperature instead of 70°F, and the analysis accounted for the differential thermal expansion of the cladding and head steel at the operating temperature of 605°F?

GEOMETRY/MESHING

(A) Does the size of the degradation cavity and the transition from the cladding thickness to the head thickness that was used in the SIA report reflect current knowledge regarding the cavity geometry, in particular the undercut area described in Figure 13 on page 103 of the Davis-Besse Root Cause Analysis Report (CR2002-0891), dated April 15, 2002? What is the transition geometry assumed in the analyses?

(B) Is there sufficient mesh refinement through the cladding thickness to adequately capture the bending and shear strains at the edge of the cavity? Describe any sensitivity studies used to demonstrate the adequacy of the mesh refinement.

(C) Was the cladding deposited by weld wire? Do the thinner cladding thickness measurements from UT coincide with the locations of weld bead toes? In what direction do the cladding weld beads run relative to the long axis of the degradation cavity?