From: Cayetano Santos RES
To: Bill Shack; Gery Wilkowski; Paul Williams; Randy Nanstad; Richard Bass
Date: 9/13/02 2:13PM
Subject: Davis Besse Cladding Cracks

Over the last couple of days we (MEB) have been brainstorming and discussing possible analyses and experiments which could be done in light of the cracks discovered in the Davis Besse Cladding. The attached file lists the various ideas we came up with. We would be very interested to know any thoughts/comments/questions/suggestions any of you may have on any of these things. As you will see the list is broken up into 2 sections. The first describes variious analyses that could be done and the second section focuses on experimental work.

Thanks,
Tanny Santos

CC: Deborah Jackson; Jeffrey Hixon; Mark Kirk; Robert Tregoning; Shah Malik; William Cullen

H-7

From: Robert Tregoning *RES*
To: Jeannette Torres
Date: 11/27/02 8:26AM
Subject: Fwd: Davis Besse Cladding Cracks

From: Cayetano Santos RES
To: Bill Shack; Gery Wilkowski; Paul Williams; Randy Nanstad; Richard Bass
Date: 9/13/02 2:13PM
Subject: Davis Besse Cladding Cracks

Over the last couple of days we (MEB) have been brainstorming and discussing possible analyses and experiments which could be done in light of the cracks discovered in the Davis Besse Cladding. The attached file lists the various ideas we came up with. We would be very interested to know any thoughts/comments/questions/suggestions any of you may have on any of these things. As you will see the list is broken up into 2 sections. The first describes variious analyses that could be done and the second section focuses on experimental work.

Thanks,
Tanny Santos

CC: Deborah Jackson; Jeffrey Hixon; Mark Kirk; Robert Tregoning; Shah Malik; William Cullen

A: Analyses of Flawed Cladding (Davis Besse)

1. Estimate cladding strains induced from thru-thickness thermal gradients of 600 F to 250 F by performing finite element analyses of flat plates made of cladding material. Results of this analysis will be used to determine if the thru-thickness temperature gradient should be modeled in further tasks or included in any experiments.

2. Estimate cladding residual strains induced from residual stresses assuming a stress-free temperature of 1100 F (the stress-relief temperature) and an operating temperature of 600 F.

3. Estimate the burst pressure for unflawed cladding flat plate, after including the clad residual stresses in item 2, and with or without the thru-thickness thermal-gradient in the clad plate (item 1).

4. Estimate crack driving forces as a function of flaw size and applied membrane stress in cladding by performing elastic-plastic finite element analyses of sharp surface breaking flaws in flat plates under biaxial tension. The flaw depths could from 5%, 25% and 50% of the clad thickness. The flaw lengths could vary from 3/8", 1" and 2". The applied stresses would be representative of the membrane stresses at the center of the wastage area cavity. Also, a flaw geometry simulating the actual DB flaw should be evaluated once this is determined. The J-integral calculated from these analyses could then be compared to appropriate JR curves for the cladding material.

5. Estimate the plastic collapse as a function of flaw size and applied membrane stress in cladding by performing elastic-plastic finite element analyses of a finite root tip (blunted) surface breaking flaws in flat plates under biaxial tension. The flaw depths could vary from 5%, 25% and 50% of the clad thickness. The flaw lengths could be varied from 3/8", 1" and 2". The applied stresses would be representative of the membrane stresses at the center of the wastage area cavity.

6. Similar to 4 except that instead of a flat plate geometry, the finite element model of the flaw could be driven by the submodel of the wastage area cavity which in turn will be driven by the global model of the full RPV head and closure flange.

7. Similar to 5 except that instead of a flat plate geometry, the finite element model of the flaw could be driven by the submodel of the wastage area cavity which in turn will be driven by the global model of the full RPV head and closure flange.

8. Same as the Item 4, but including a thru-thickness temperature gradient is imposed. The internal surface would be roughly at 600F while the outer surface temperature would be 250F. The J-integral calculated from these analyses shall be compared to appropriate JR curves for the cladding material.

9. Same as the Item 5, but including a thru-thickness temperature gradient is imposed. The internal surface is would be roughly 600F while the outer surface temperature would be 250F.

3. Triplicate fracture(J-r curve) toughness tests in the L-S orientation should be performed at 300F and 600F. These results could be utilized within the numerical predictions to simulate failure. Other mechanical tests as required by cladding material specifications should also be performed to ensure that the material meets minimum requirements.