

Allen, William

From: Allen, William
Sent: Monday, April 22, 2013 11:51 AM
To: 'Sarah Marshall'
Cc: Bob Vaughan; Sampson, Michele
Subject: RE: Safkeg-HS - RAI 2.1 - Structural - Stress margins

Submitting the RAI responses on 4/23 is acceptable. If something comes up and the responses are delayed further, please keep me informed.

I briefly discussed your proposal to reword Section 2 of the SAR with the structural reviewer and they have no problems with your suggested approach.

I didn't directly discuss submission of the cork data with them. Therefore, I suggest you hold onto that data until it is determined that submitting the information will be helpful.

Chris

From: Sarah Marshall [mailto:sarah.marshall@croftltd.com]
Sent: Monday, April 22, 2013 8:16 AM
To: Allen, William
Cc: Bob Vaughan
Subject: FW: Safkeg-HS - RAI 2.1 - Structural - Stress margins

Dear Chris

I have pretty much completed the responses to all the RAI and I was hoping to submit today, however I am awaiting on some help with 2.1 from the NRC (the email below was sent last Wednesday, did you receive it?) and I am also waiting on someone here to fill out one RAI response. Should they not be able to complete it today would it be sufficient to submit tomorrow?

Thank you,
Sarah

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From: Sarah Marshall
Sent: 17 April 2013 13:58
To: 'Allen, William'
Subject: FW: Safkeg-HS - RAI 2.1 - Structural - Stress margins

Re RAI 2.1 - Structural - Stress margins

We note the comments on alternative approaches to justifying that the CV of the Safkeg-HS package performs satisfactorily under NCT and HAC.

We also note the discussion we had in our telconf of March 28 and this email addresses the approach discussed.

We propose that the justification be based primarily on the drop test evidence [3 9m drops were conducted on the same package in one series without opening the package between drops].

We recognize that the FEA we had performed had a number of approximations and approaches that were not ideal but we believed they were conservative. We would like to tune these calculations but the FEA specialist who carried out the original calculations is no longer available to us and the cost of repeating and improving the calculations would be excessive. The key new data that we present is for the cork stiffness.

In the FEA calculations in Arcadis/Vectra report L20008/1/R1, Rev 0B the cork stiffness was set to 1 GPa in order to enable the calculation to terminate successfully. However, the modulus of the cork is between 28 MPa (-29°C) and 1.63 MPa (100°C). Clearly the model used for the FEA resulted in a more severe loading condition for the containment vessel than would apply in reality. However, numerical justification for this position is difficult and perhaps unnecessary as the high stresses [Design Margin were >1 for positions and conditions of importance to safety].

However, we propose that we reword Section 2 of the SARP to rely primarily on the drop test information. We propose to leave the FEA analysis in the SARP more or less as current [to remove it would leave large gaps] but give some discussion as to the limitation of the analysis and just reference it as indicative and very conservative.

Would this approach be acceptable?

In the teleconference of March 28 an explanation was mentioned that we did not properly record – perhaps we can discuss this by teleconf to ensure that our response is acceptable to the reviewer.

Regards

Sarah

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**RAI 2.1 - Structural - Stress margins**

Demonstrate that the justification cited for the negative stress margins exhibited by the containment vessel is reasonably conservative. The justification provided by the applicant for the negative stress margins is as follows:

- 1) Most of the high stresses are not in the sealing area.
- 2) The analytical cork model had 1000 times the stiffness of the actual cork. This resulted in a more severe loading condition for the containment vessel.
- 3) The drop tests indicated no actual change in the containment vessel dimensions, demonstrating no deformation

This justification is incomplete for the purposes of rendering a safety determination. Furthermore, the finite element methodology, while expedient, is not consistent with best practices with respect to quasi-static or dynamic analyses. The staff requests, at a minimum, that a sensitivity analysis be performed for a range of cork stiffness such that a trend in containment vessel stresses can be observed with respect to overall damage. The applicant should provide a discussion of the results.

Alternatively, the staff prefers a simulation more consistent with an actual drop test which would include an initial velocity equivalent to that of the keg just prior to striking an unyielding surface, with a simulated impact into that

surface. The simulation would also be considered a sensitivity study as only one or two simulations would be necessary to demonstrate that the quasi-static methodology used is reasonably accurate. This fully dynamic simulation would allow for realistic material properties to be used for the cork and the results would simulate realistic structural behavior. Absent this type of analysis, staff would consider the testing as the primary means for certification and would disallow much of the finite element analysis in making a safety determination because of flawed or unsubstantiated methodology.

This information is necessary to determine compliance with 10 CFR 71.71 and 10 CFR 71.73.

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