Discussion of Some RAIs for the 380-B Package, Docket 71-9370

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April 12, 2017

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Purpose

- RAIs for the 380-B were issued by NRC 3/16/17
- The applicant would like to discuss some of the RAIs
- The purpose of this document is to summarize the discussion points
- The RAIs to discuss are:
  - Co-1, Co-3
  - M-1, M-2, M-3, M-4, M-8, M-9, M-11, M-12, M-13
  - Th-3, Th-4, Th-6

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Co-1(a)

- *The RAI requests an explanation of how the energy deposition was calculated.*
- **The 6th paragraph on page 5.5.4-2 states: "Energy deposition is calculated in MCNP using an F6 tally."**
- **Does this answer the question?**
- **Would it be helpful to add this fact to a footnote to Table 5-6?**

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Co-1(c)

- ***The RAI requests an explanation of how the minimum void volumes were calculated.***
- **Section 5.5.4 discusses the void volume in the context of hydrogen concentration and is summarized below.**
  - **The purpose of the section was to find if there would be enough void volume in the cask cavity to ensure that the maximum amount of H_2 that could be generated by radiolysis would not exceed 5%.**
  - **The void volume in the cask is not known explicitly, but will never be less than the volume of the gap between the inner cover and the lid. This is the minimum void volume.**
  - **Conservatively, the entire volume (except of the device itself) was assumed to be wood. A large device would have less wood, and a small device would have more wood.**
  - ***continued...***

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Co-1(c), continued

- Three trials were made of different sizes: a lead spherical radius of 8 cm, 16 cm, or 24 cm. An activity of Co-60 was determined that created 200 mrem/hr on the surface for each case. The 24 cm sphere contained the maximum contents.
- For each case, the maximum amount of H_2 was calculated, and the corresponding minimum void volume was calculated to make a 5% mixture with these quantities of H_2.
- The minimum void volume above the inner cover was always larger than required by more than a factor of 10. Thus, the concentration of H_2 could never exceed 5% by a large margin.
- In other words, *the greatest irradiation of the greatest volume of wood could not produce enough H_2 to create greater than 5% concentration in the smallest void volume*.

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Co-3

- ***The RAI requests to know why the maintenance/periodic leakage rate tests may be performed as an option to the pre-shipment leakage rate tests.***
- **The intent of the SAR text is to permit the cask user to perform a maintenance/periodic leakage rate test as a pre-shipment test, not to rely on a previously performed maintenance/periodic test to take the place of a pre-shipment test.**
- **Should the SAR requirements be clarified to this effect?**

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M-1

- *The RAI concerns tolerances on the drawings.*
- **The SAR drawings actually do include tolerances, primarily using a general tolerance block at the bottom of the first sheet of each drawing (as allowed by NUREG/CR-5502). Every dimension has a specified tolerance.**
- **Tolerances are used for critical evaluations. See the O-ring compression evaluation in Section 4.1.3.**
- **Often it is difficult to include tolerances because it is not clear which combination of max/min tolerances yields the worst case in a complex part.**
- **Tolerances are very small compared to the part dimensions and would not affect the margins of safety significantly, especially considering the conservative analysis approaches used.**
- ***continued…***

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M-1, continued

- Plate material is taken as nominal because the minimum thickness is typically only 0.010 inches less than the nominal, so plates are analyzed at essentially minimum thickness.
- The use of NE-4220 relates only to the applicability of Code Case N-284 buckling analysis method. To ensure the applicability of N-284, NE-4220 tolerances are observed. It is not intended to perform any other function.
- Are there specific evaluations that should include the effect of tolerances?

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M-2

- *The RAI concerns weld joint details and NDE methods.*
- **It is not clear why the type of weld preparation groove is relevant to the safety of the package. The welds are all specified as "complete joint penetration" type. This means that the entire thickness of the plate must be welded. This is confirmed by AWS 2.4:2007, Section 6.2.8, "Joint Geometry Not Specified, Complete Joint Penetration".**
- **The weld configuration is left open so that the fabricator can choose the best configuration for his specific processes. However, any fabricator must meet the CJP and inspection requirements.**
- **The longitudinal weld is present in the SAR drawing, governed by flag note 26, and mentioned in Section 2.3.2.**
- ***continued…***

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M-2, continued

- Section 2.3.1 states that all welds are “fabricated in accordance with the requirements” of the SAR drawings. The SAR drawings clearly state the weld type and NDE for each weld.
- Sheet 4 of SAR drawing 1916-02-02-SAR shows that all containment and structural welds are CJP. The lower, inner weld is radiograph inspected, and the upper, inner weld is ultrasonically inspected. Both outer shell welds are ultrasonically inspected. All inspections are performed according to the ASME Code as stated in flag notes 27 and 28.
- Section 2.3.2, paragraph 3, states clearly what the NDE for each of these welds must be.

M-3

- *The RAI concerns weld symbols.*
- **It is unclear why our weld symbols are not consistent with AWS A2.4. Section 6.2.8 of AWS A2.4:2007 illustrates the symbols used in the application.**

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M-4

- ***The RAI requests a schematic of the contents.*** **Since the configuration is not generally known, would a generic schematic of a device and its shoring be acceptable?**
- ***The RAI requests the materials and moisture content of the contents.*** **Does this include the shielded devices themselves? Would a list of the typical materials of construction of the devices suffice?**
  - **Note that the materials of the shoring/dunnage are already listed: metal, polyurethane foam, and wood.**
- ***continued…***

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M-4, continued

- ***The RAI requests to know how positive clearances are maintained.*** **Note that a lodgment is not used in the 380-B. Instead, shoring/blocking is used. It is generally not possible to determine the clearance with generic shoring/blocking. Can you discuss your main concern?**
- **Note that the effect of moisture in generating pressure from both temperature and radiolysis is already evaluated and included in the SAR:**
  - **Section 3.3.2 bounds the maximum possible thermal contribution of wood moisture to the MNOP for NCT.**
  - **Section 3.4.3.1 bounds the maximum possible thermal contribution of wood moisture to the internal pressure for HAC.**
  - **Section 5.5.4 bounds the maximum possible contribution of wood moisture to MNOP and H_2 for NCT by radiolysis.**

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M-8 (and M-13)

- *The RAI concerns max. allowable temperature of closure bolts.*
- **Section II, Part D, Table 4, for the bolting material includes note G2, which indicates a reduction in toughness at RT after exposure for about 5,000 hr at 600 °F. Note:**
  - **The 649 °F peak temperature reported in the SAR is for the closure lid, and bounds the maximum bolt temperature of approx. 550 °F (not separately reported). The next hottest bolts have a peak temperature of approx. 450 °F, and the other closure bolts have much lower peak temperatures.**
  - **The bolt is at elevated temperature for only approximately one hour, which is much less than 5,000 hr and cannot embrittle the bolt. The Table 4 restriction is for continuous service temperature. The HAC fire is not continuous service.**
  - **The toughness loss can make the bolt fail under shock loading. However, subsequent to the HAC fire, there is no shock loading.**
- **Thus, the allowable temperature from Table Y-1 of 800 °F is acceptable for the closure bolt application.**

M-9

- *The RAI requests a revision of the bolting analysis.*
- **The applicant has used NUREG-6007 as a guide in performing the analysis of the closure bolts as delineated in SAR Table 2.1-1. Use of NUREG-6007 in lieu of NB-3232.1 is appropriate since the bolts are part of a transportation cask, not a stamped NB pressure vessel.**
- **NUREG-6007 is recommended by NRC in the Standard Review Plan to promote consistency in the analysis of closure bolts.**
- **The allowable stresses of NUREG-6007 should be used, consistent with the stress analysis methodology recommended in the NUREG.**
- **It is inappropriate in principle to use allowable stress from a different methodology than the one used in the evaluation.**
- ***continued…***

M-9, continued

- Of note, the differences in stress allowable are negligible:
  - NUREG-6007 specifies 2/3 of S_y for the allowable stress. NB-3232.1 specifies twice the design stress intensity from Section II, Part D, which is essentially 1/3 of S_y, or a total of 2/3 S_y.
  - At the design temperature of 150 °F, 2/3S_y = 73,767 psi. Twice the design stress intensity of 36,850 psi is 73,700 psi. The difference is 67 psi, which is negligible.
- Thus, use of 2/3 S_y as a basis for the bolting stress allowable is appropriate.

M-11

- *The RAI requests material properties as a function of temperature for the ASTM B16 brass vent port plug.*
- **This material has been used for threaded port plugs on NRC-licensed packages for several years.**
- **The material does not appear in Section II, Part D, so properties at temperature are not readily available.**
- **But since there is no reason to perform a stress analysis of a small (3/8-16 UNC) threaded part, it is not clear why this information is needed.**
- **Table 2.2-5 gives the reference for the basic yield and ultimate strengths.**

M-12

- *The RAI requests information regarding UT testing procedures and equipment.*
- **The explanatory material in the RAI indicates that the concern relates primarily to cast austenitic stainless steel due to the wide range of grain sizes commonly present.**
- **Since several fabricators have told us they prefer forged material, we find the cast material can be eliminated as an option. Would this RAI be answered by eliminating the cast option?**

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M-13

- *The RAI concerns max. allowable temperature of closure bolts*
- **See the discussion for RAI M-8.**

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Th-3

- *The RAI requests inclusion in the SAR of a table from a reference.*
- **Since the table is taken from a copyrighted source (Marks Standard Handbook), AFS cannot include the table in the SAR.**
- **Marks Handbook is a very common reference. In other editions, the table number for saturated water may be different, but the saturation pressure vs. temperature of water is a very common item of physical data and can be confirmed from a number of sources.**
- **AFS can send a pdf of the table, if the reviewer would like to see it.**

Th-4

- ***The RAI poses several questions about the thermal effect of polyurethane foam in the HAC fire.***
- **Th-4(a):**
  - **What is meant by the phrase, "…to reflect the feature in the HAC 30-minute fire"?**
  - **The applicant believes that the maximum foam regression of 2.7 inches has been adequately justified by the material given in Section 3.5.4 of the application. Can we discuss your thoughts on Section 3.5.4?**
- ***continued…***

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Th-4, continued

- **Th-4(b): The applicant proposes the following response:**
  - **If it were not known the extent to which the foam would decompose (regress) in the fire, then to maintain conservativism it would be necessary to maximize heat input during the fire by assuming full decomposition, followed by an assumption of virgin foam after the fire to minimize heat loss.**
  - **However, the extent of foam decomposition is well established and justified in Section 3.5.3.5.**
  - **Since foam regression is determinate, it is not necessary to utilize the bounding assumptions above to achieve conservatism.**
  - **For the same reason, it is not necessary or valid to posit a different amount of foam loss than has been utilized in the analysis.**

Th-6

- *The RAI requests demonstration that the solar absorptivity for the package exterior in the HAC cooldown phase is bounding.*
- **NUREG 1609 and Reg. Guide 7.9 apparently do not address the issue of solar absorptivity. The applicant needs to know where the referenced information can be found.**
- **A solar absorptivity of 0.9 after the HAC fire has been used for many years in package applications.**

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