TRANSNUCLEAR

Enclosure 2

AREVA

Approach for Response to Amendment 10 RAI
September 19, 2007

Transnuclear, Inc.

Meeting Agenda

- Introduction
- Background of Amendment 10
- Categorization of RAIs
- Detailed Discussion of Approach
- Structural RAIs
- Materials RAIs
- Thermal RAIs
- Technical Specifications RAIs
- Schedule for Responses to RAIs
- Questions

Background of Amendment 10

- Changes to Existing 32PT System
- Changes to Existing 24PTH System
- Addition of a New 61BTH System
- Addition of a New 32PTH1 System

Changes to Existing 32PT and 24PTH Systems

- **Changes to 32PT System**
  - Addition of Control Components (CCs) for WE 15X15, WE 14X14, and CE 14X14 Fuel Assembly Classes
- **Changes to 24PTH System**
  - Addition of WE 15X15 Partial Length Shielded Assembly (PLSA)
  - Expand Fuel Qualification Table to Allow Lower Enrichment for Existing Fuel Assemblies

Addition of New NUHOMS® -61BTH and 32PTH1 Systems

- **61BTH System Components**
  - 61BTH DSC
  - OS 197 Transfer Cask
  - Existing HSM/HSM-H Storage Modules
- **32PTH1 System Components**
  - 32PTH1 DSC
  - OS 200 Transfer Cask
  - HSM-H/HSM-HS Storage Modules

Categorization of RAIs

Clarification Type RAIs = 51

Duplicate (Common to 61BTH and 32PTH1) = 9

Editorial/Inconsistencies Type RAIs = 17

Confirmatory or Supplemental Analysis for Justification Type RAIs = 7

RAIs Requiring Revised Analysis = 2

RAIs on HBU Clad Properties = 4

RAIs on Aluminum Properties = 7

Total 97 RAIs

Discussion of RAIs on Aluminum Material Properties at Temperature

- ***RAIs 9-11 to 9-17***
  - ***Aluminum basket components are, in general, captured between stainless steel components, except for the aluminum inserts bolted to the inside of the 32PTH1 Type 2 stainless steel rails.***
  - ***Except for inserts noted above, aluminum components are in compression. Creep rupture is not a concern.***
  - ***All aluminum is non-structural (Type 1100) except for the solid aluminum rails, which is Type 6061. Maximum deadweight compressive stresses are small (on the order of 220 psi).***
  - ***Maximum temperatures with design basis heat loads at time of storage in the loaded rails are on the order of 460ºF.***

Discussion of RAIs on Aluminum Material Properties at Temperature

- ***RAIs 9-11 to 9-17 (Continuation)***
  - ***Allowable stresses based on ASME Section II Part D Appendix 1, Paragraph 1-100 4 (b) ("100% of the average stress to produce a creep rate of 0.01%/1000 hr").***
  - ***Conservatively allowable stress based on 1% strain at 550,000 hrs will be used.***
  - ***Decrease of temperature with time due to decrease in heat decay will be considered. Preliminary analyses show that aluminum rail temperatures drop to about 375ºF after 10 years, 325ºF after 20 years, 250ºF after 40 years and 225ºF after 60 years.***

Discussion of RAIs on Aluminum Material Properties at Temperature

- ***RAIs 9-11 to 9-17 (Continuation)***
  - ***Long-term average ambient temperature (70ºF) will be considered.***
  - ***Use stress-strain rate-temperature relation using Norton law for metals.***
  - ***Use existing creep rate data to fit the Norton Law and integrate over time to determine the allowable stresses.***
  - ***The allowable stress is compared to the calculated stress.***

Discussion of RAIs on Aluminum Material Properties at Temperature

- ***RAIs 9-11 to 9-17 (Continuation)***
  - ***Maximum deadweight stresses in the aluminum inserts in the Type 2 rails are very small (on the order of 10 psi). A uniform gap of 0.02" is considered in the thermal analysis.***

Discussion of RAIs on HBU Cladding Material Properties

- *RAIs 3-4 and 3-6*
- *Mechanical Properties – Effect of Hydrides*
- *Availability of Data is Limited*

Discussion of RAIs on HBU Cladding Material Properties

- ***RAIs 3-4 and 3-6 (Continuation)***
- ***Effect on Mechanical Properties Due to Hydrides***
  - ***Test Data with radial hydrides (Chu, 5/2007)***
  - ***Tests were performed on unirradiated materials with various levels of hydrogen (130 ppm to 600 ppm)***
  - ***High burnup fuels tend to have relatively high concentration of hydrogen (600 ppm at 65 GWd/MTU)***
  - ***Effect of radial hydrides on axial directional properties insignificant***
  - ***Hoop directional properties decrease as radial hydride increases***

Discussion of RAIs on HBU Cladding Material Properties

- ***RAIs 3-4 and 3-6 (Continuation)***
- ***Evaluation of Radial Hydrides***
  - ***For undamaged spent fuel, assess the applied hoop stress in fuel cladding for radial hydrides reorientation. For damaged spent fuel, presence of radial hydrides has no effect since there is no applied hoop stress due to no pressure and thermal loadings.***
  - ***Radial hydrides are not a major concern for this application because hoop stresses are small.***

Discussion of RAIs on HBU Cladding Material Properties

- ***RAIs 3-4 and 3-6 (Continuation)***
- ***HBU Fuel Beyer's Strength Model***
  - ***Fair amount of data at high fluence (>1x10^{26} n/m^{2})***
  - ***At high fluence, majority amount of the predicted strength is less than measured strength***
- ***Will perform additional sensitivity analysis using elastic modulus that bounds test data***

Discussion of RAIs in Other Structural Areas

- ***RAI 3-1 (61BTH Basket Model Axial Load Response)***
  - ***TN agrees with reviewer's observation***
  - ***Axial load contribution to basket component stresses is small. Vertical and transverse load components are dominant. Preliminary results show that the effect on stresses is small (1%-2%)***
  - ***Affected SAR pages will be updated***

Discussion of RAIs in Other Structural Areas

- ***RAI 3-3 (Pressure stresses not included in table on Page T.3.6-16)***
  - ***Maximum canister stresses for seismic load combination, including stresses due to pressure are provided in Table T.3.7-14. The maximum stress ratio is 0.76.***
  - ***The stresses in the table on page T.3.6-16 used seismic accelerations of 2g simultaneously applied in all three directions which is over conservative relative to the seismic loads of 1.2g vertical (including deadweight), 0.37g transverse and 0.41 axial.***

Discussion of RAIs in Other Structural Areas

- ***RAI 3-8 (Cladding Failure Strain of 1.7% to 3%)***
  - ***Submitted SAR evaluation used loading time history from MP 197 Transportation Cask (COC 71-9302) (30 ft drop impact limiter experimental test).***
  - ***Fuel cladding end drop analysis is revised using input time history from accident drop applicable to transfer conditions using LS-DYNA Model of OS200 TC.***
  - ***Preliminary fuel cladding maximum strains are in the range of .61% to .93% which are within the range of the values referenced in RAI 3-8.***

Discussion of RAIs in Other Structural Areas

- ***RAI 3-12 (Revise Application to Address Only Transfer/Storage Conditions)***
  - ***The damaged fuel evaluation in Amendment 10 is not based on transport loads. Evaluations are for deadweight and handling loads during transfer/storage conditions (this approach was approved previously for CoC 1004 and CoC 1030). TN-68 evaluations used ratios from Part 71 loads for Part 72 storage.***
  - ***Large margin on stresses. Stress ratios of 0.01 for axial and 0.045 for bending.***
  - ***Large margin on fracture mechanics stress intensities. Maximum ratios of K_I / K_{IC} are .11 and .09.***
  - ***Damaged fuel evaluation is acceptable due to large margins of safety.***

Discussion of RAIs in Other Structural Areas

- ***RAI 3-15 (Initial Contact in LS DYNA Side Drop Analysis)***
  - ***Not a mechanistic drop.***
  - ***Additional accident drop analysis performed using maximum gap at given drop orientation.***
  - ***Preliminary results show that maximum stresses increase for some basket components and decrease for others.***

Discussion of RAIs on Thermal Analysis

- ***RAI 4-1 Tech Spec on Helium During Blowdown and Helium Environment***
  - ***TN is proposing to add a new Tech Spec 1.2.19 to require helium during bulk water removal similar to Amendment 11 Tech Spec 3.1.1***
  - ***Chapter T.8, Sections T.8.1.2 Step 15, Section T.8.1.3 Steps 6, 18 and 19 for 61BTH and Chapter U.8, Sections 8.1.2 Step 16, Section U.8.1.3 Steps 6, 16 and 17 have provisions to use a helium source at 1-3 psig for this operation. This will account for any leakage of helium out of the DSC***

- ***RAI 4-2 Keff for Neutron Shield***
  - ***Values for both OS197FC-B & OS200 TCs previously submitted and accepted by NRC staff***
    - ***OS197FC-B: Identical to OS-197 in Appendix M.4.9 of Rev. 5 of Application for Amendment No. 5 to the NUHOMS® CoC No. 1004, (TAC NO. L23343)***
    - ***OS200: Geometrically similar to OS187 TC in NUHOMS® HD CoC No. 1030, (TAC NO. L23738)***
    - ***Values derived using standard equations for convection within enclosures and validated by CFD***
    - ***Values for horizontal orientation conservatively bound (i.e., lower) vertical orientation - based on standard equations for convection within enclosures***

Discussion of RAIs on Thermal Analysis

- ***RAI 4-3 DSC Shell Temperatures Below 225°F***
  - ***The annulus between DSC shell and Transfer Cask is filled with water and the top of the annulus is open to ambient.***
  - ***Chapter T.8, Section T.8.1.3 for 61BTH DSC and Chapter U.8, Section U.8.1.3 for 32PTH1 DSC have a "CAUTION" to monitor the water level and replenish as necessary.***
  - ***These steps assure that the DSC shell temperature will be below 225°F which is slightly higher than the boiling temperature of water. The 225°F is assumed over the entire length of the DSC shell which is conservative.***

- ***RAI 4-4 Transfer Time Limitation***
  - ***Time Limit Calculation Assumes Bounding Ambient Temperature, Insolation, & Orientation***
    - ***Only basket design & heat load affect time limits***
    - ***Approach simplifies operations***
  - ***Transfer Operations Completed Within Tech Spec Time Limits And Actions Are Considered Normal Operations***
    - ***Transfer clock re-set if TC returned to fuel building and annulus re-filled with water***
    - ***No time limit if blower used***

Discussion of RAIs on Thermal Analysis

- ***RAI 4-5 No time limit for other DSCs***
  - ***SAR text will Be Revised To Add Clarification***
    - ***For a given basket design, lower decay heat allows higher DSC shell temperature limit***
    - ***Validation of acceptable shell temperature provided in Sections T.4.6 and U.4.6***
    - ***Revisions to text to provide details and tie-in with DSC analyses***
- ***RAI 4-6 Fire Boundary Condition***
  - ***15 minute, 10 CFR 71 Fire assumed***
    - ***Cask emissivity set to 0.8 with 1,475°F flame with an equivalent emissivity of 0.9 consistent with 10 CFR 71.73***
    - ***Radiation & forced convection during fire period consistent with previous P71 & P72 amendments reviewed and approved by NRC staff***
    - ***Liquid-filled shield assumed during fire, empty after fire***
      - ***K-eff same as normal value for OS197 TC; OS200 TC used value established in NUHOMS® HD CoC No. 1030. Maximizes heat input during fire***
      - ***Approach conservative - pressure relief valves will open at 274 to 290°F water temp. Boiling will make process a nearly constant temperature process***
      - ***Assumption of air-filled shield post-fire minimizes cool-down***

Discussion of RAIs on Thermal Analysis

- ***RAI 4-8 DSC Shell Temperature Limits***
  - ***DSC shell temperatures of 435°F for 61BTH DSC and 420°F/ 450°F for 32PTH1 DSCs correspond to transient temperatures during the loss of fan air-flow accident as shown in Figure T.4-19. The Figure contains transient and steady state results for DSC shell under this accident condition. The steady state DSC shell temperatures are used to show that cladding temperatures are below the cladding temperature limit for accident condition. The real limit for thermal analysis is the fuel cladding material temperature limit and not the DSC shell temperature values reported.***
  - ***The SAR will be clarified.***

Discussion of RAIs on Thermal Analysis

- ***RAI 4-9 Discussion of Correlation Based Analysis Method***
  - ***Thermal analysis methodology was validated using thermal tests performed on full scale mockup of HSM-H.***
  - ***Thermal test report was submitted to NRC for CoC 1004 Amendment 8 and for CoC 1030.***
  - ***The methodology and the correlations used were described in details in Appendix P, Section P.4.9 which were reviewed and accepted by the staff for Amendment 8 to CoC 1004 and Chapter 4 for the NUHOMS HD FSAR for CoC 1030.***

- ***RAI 4-10 Effect of Elevation of ISFSI on Thermal Analysis***
  - ***Sensitivity analysis was done to confirm that elevation will not affect the thermal analysis results.***
  - ***Elevation increases the delta T between the inlet air and exit air temperature due to decrease in air density, however, this is more than offset by the decrease in ambient temperature as a function of elevation.***
  - ***No effect on the thermal analysis results.***

Discussion of RAIs on Thermal in Chapter 11

- ***RAI 11-2 133°F Ambient Temperature as an Accident Condition***
  - ***One of the potential clients for dry storage had requested 133°F ambient temperature as an accident condition based on their needs.***
  - ***The client only had PWR fuel therefore it was not added for the 61BTH system.***

- ***RAI 11-3 133°F Ambient Accident is Bounded by Blocked Vent***
  - ***The blocked vent analysis is based on 117F which is off-normal ambient condition.***
  - ***133F is not used as the ambient temperature for blocked vent accident because 133F ambient is considered as an accident condition. Probability of two independent accidents occurring at the same time is very small and therefore not considered.***

Discussion of RAIs on Technical Specifications

- ***RAI 2-4 Add Codes and Standards to Tech Spec***
  - ***TN is proposing to add a Section "Codes and Standards" for DSC, Transfer Cask and HSM identical to the proposed Tech Spec Section 4.2 for Amendment 11.***
  - ***Alternatives to ASME code are already a part of UFSAR.***

- ***RAI 9-4 Requests a New TS for Hydrogen Gas Monitoring or an Alleviating Measure, in Accordance With ISG-15.***
  - ***ISG-15 calls for SAR Chapter 8 operating procedures to contain this guidance. NUREG-1745 standard TS format and content does not have such a TS.***
  - ***Amendment 10 Chapters T.8 and U.8 operating procedures contain hydrogen gas monitoring requirements and are consistent with the ISG.***
  - ***TN believes removal from SAR Chapter T.8 or U.8 per the 72.48 process is not possible.***

Discussion of RAIs on Technical Specifications

- ***RAI 9-7 Definition of Damaged Fuel***
  - ***TN is proposing to stay with the definition of the damaged fuel which is currently in the proposed tech spec.***
  - ***TN's definition of damaged fuel is more restrictive than that proposed by Staff. Damaged fuel assemblies are required to be handled by normal means similar to undamaged fuel assemblies.***
  - ***TN's clients do not need the more broad definition at this time.***

- ***RAI 9-8 Top and Bottom End Caps for Damaged Fuel Compartments and ISG-1***
  - ***TN's definition of Damaged Fuel is more restrictive than ISG-1 definition. See discussion on RAI 9-7 above.***
  - ***For storage per ISG-2, retrievability is required only for normal and off-normal conditions.***
  - ***TN will demonstrate the retrievability after P71 drop conditions in a separate P71 application at a later date.***

Discussion of RAIs on Technical Specifications

- ***RAI 9-18 Tech Spec on Neutron Absorber Testing for Other DSCs***
  - ***The scope of Amendment 10 is limited to the addition of 61BTH and 32PTH1 DSCs. The changes proposed to 24PTH and 32PT DSCs are not related to neutron absorber material.***
  - ***TN proposes to not change the licensing basis for previously approved canister designs.***

RAI Response Schedule

- ***TN plans to meet the schedule given in the RAI for response (November 5th 2007)***
- ***TN plans to have additional discussion with NRC if needed before the formal submittal of RAI responses***

Questions