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TN-B1 Pre-Submittal Meeting

Docket No. 71-9372

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FUEL BUSINESS GROUP

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Agenda

- Background
- Project Goals and Schedule
- Update to TN-B1 SAR for Reload Quantities of ATRIUM-11

Background

Background- LTA Shipments

- **In March 2014 AREVA Submitted a request for a Letter Authorization for the shipment of ATRIUM 11 Lead Test Assemblies (LTAs).**
- **This request placed significant restrictions on shipments.**
  1. **There will be a single ATRIUM 11 fuel assembly per container.**
  2. **The other side of the container will contain either a fuel channel, cage assembly with tie plates, or ballast having the same peripheral envelope. This side of the container will contain no fissionable material.**
  3. **The single fuel assembly will be unchanneled.**
  4. **The fuel assemblies will contain U02 and Gd20 3 only.**
  5. **There will be a maximum of eight TN-B1 containers on a single truck.**
  6. **A maximum of eight fuel assemblies will be included in any shipment**

Background- LTA Shipments

- On 9 July 2014 the Letter Authorization was received for the ATRIUM 11 LTA shipments.
- LTA's have been delivered and are in operation
  - Browns Ferry Unit 2 Cycle 19
  - Brunswick Unit 2 Cycle 22

Project Goals and Schedule

Background – Project Goals

- **To gain approval of an updated SAR which will allow for the routine shipment of ATRIUM 11 fuel assemblies without the restrictions used for the LTA shipments.**
- **To obtain approval of an updated SAR by the end of 2019.**

General Approach

- **Intent is to make the minimal number of changes to the SAR needed for incorporation of reload quantities of ATRIUM 11.**
  - **There will also be some minor changes for other items noted during the preparation of the SAR. These changes will be clearly identified and shown to not affect any analysis or conclusion.**
- **Submittal will build upon the documents submitted for the Letter Authorization request whenever possible.**

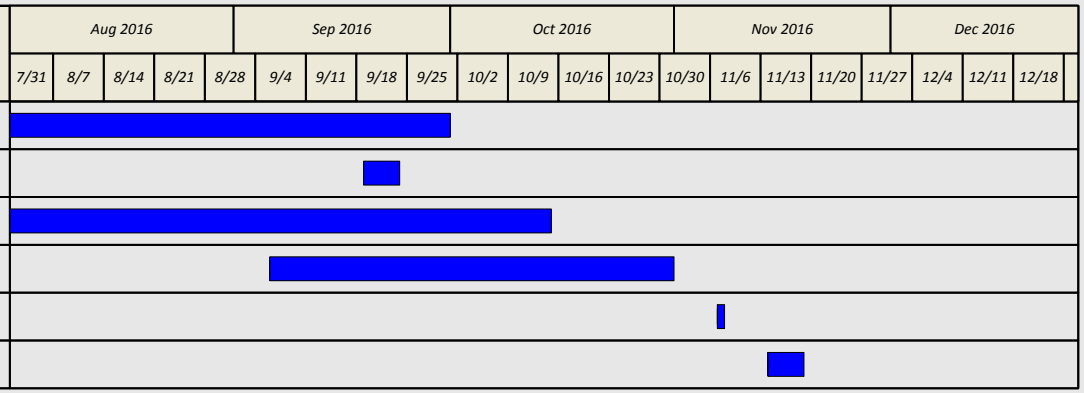
Goal: To make the SAR preparation, submittal and review processes as least time consuming as possible while still ensuring safety and regulatory goals are fully achieved.

Major Activities

- **Structural Analysis**
  - **Builds upon the analysis done for the LTA shipments, but is a separate, stand alone, analysis.**
  - **Demonstrates that the both the inner and outer containers are not damaged in such a way that their performance in protecting the fuel assemblies during the thermal event is not compromised and the fuel itself is not damaged.**
  - **Provides needed inputs for criticality analysis.**
- **Criticality Evaluation**
- **Updates to Safety Analysis Report**

Schedule

ID	Task Name	Start	Finish
1	Structural Analysis Revision	8/1/2016	9/30/2016
2	Pre Submittal Meeting	9/19/2016	9/23/2016
3	Criticality Analysis	8/1/2016	10/14/2016
4	SAR Revision Preperation	9/6/2016	10/31/2016
5	Submit SAR Revision	11/7/2016	11/7/2016
6	Post Submittal Meeting	11/14/2016	11/18/2016



Notes on Schedule

- **Structural Analysis Revision**
  - The structural analysis was completed earlier in the year and fully supports the conclusions needed for the structural analysis portion of the SAR revision.
  - During a review of the structural analysis conducted for the criticality evaluation it was determined that improvements in the analysis were needed to adequately justify some of the assumptions used in the criticality analysis.
- **Criticality Evaluation**
  - Preliminary analysis has been completed which shows that the shipment of ATRIUM 11 fuel assemblies will fully meet applicable IAEA and 10 CFR 71 requirements for a Type B fissile material shipping container.
  - Once the revisions to the Structural Analysis are formally complete, the needed criticality analyses will be reviewed and rerun, if necessary, to ensure the evaluation remains satisfactory and fully meets all requirements.

Review of Update to TN-B1 SAR for Reload Quantities of ATRIUM-11

Section 1
“General Information”

Section 1
"General Information"

- **Administrative updates to include the information needed to incorporate the ATRIUM 11 fuel assembly.**
  - **Section 1.2.3 "Contents"**
  - **Table 1-2 "Quantity Of Radioactive Materials (Type A And Type B)"**
  - **Table 1-5 "Typical Dimensions Of The Main Components Of Fuel Assembly And Fuel Rod"**
- **Update to Table 1-6 "Example Of Fuel Structural Materials"**
  - **For the Spacer component part, remove Ni-Cr-Fe alloy (Inconel X-750) from the table as this material is no longer used.**
  - **For the Nut component part, add Zirconium alloy to reflect a current design option. Stainless steel will be retained as a design option as well. No impact on structural integrity of the fuel assembly either during NCT or HAC.**

Section 2
“Structural Information”

Section 2
"Structural Information"

- **Containment Structure**
  - **The fuel cladding continues to provide the primary containment structure for the nuclear fuel.**
  - **There are no changes to the non-containment vessel structures of the TN-B1 shipping container. These structures continue to prevent large deformations and buckling.**
- **A structural analysis has been performed to confirm that the ATRIUM-11 Fuel Assemblies shipped within a TN-B1 Shipping Container during transportation can structurally withstand the free drops under both Normal Condition of Transportation (NCT) and Hypothetical Accident Condition (HAC) without breaching the containment boundary caused by structural failure or plastic instability.**
  - **The minimum factor of safety for the ATRIUM-11 Fuel Assembly is 1.4.**

Section 2
"Structural Information"

- The analyses were performed using the LSDYNA finite element dynamic analysis program.
- The finite element model and the material properties were validated using the instrumented 30-ft (9-meter) drop test performed on the RAJ-II Certification Test Unit (CTU) at room temperature.
- The validated finite element model were then used to predict the peak accelerations of the container dropped under NCT and HAC at -40^{O}F and 150^{O}F.
- The results of the analytical model were compared to container drop tests were performed at National Transportation Research Center (NTRC) in Oak Ridge, Tennessee.

Section 2
"Structural Information"

- **The results of the analysis showed**
  - **Regular fuel shipment (2 fuel assemblies) using the finite element model and calculated inner container acceleration time histories from the HAC drops were performed to reconfirm the structural integrity of the fuel assembly.**
  - **Fuel shipments of reduced weight (one fuel assembly) were performed to reconfirm the structural integrity of the fuel assembly.**
  - **A puncture analysis is performed for hot temperature condition. The puncture pin did not penetrate the outer container. It deformed the lid inward and it contacted the inner container lid and deformed it a small amount. The outer lid total deformation was less than 4.7 inches and the inner container lid deformed less than 0.6 inches.**

Section 2
"Structural Information"

- **Conclusions**
  - **The predicted accelerations of the accident and normal conditions drops at -40^{O}F and 150^{O}F are calculated and confirm that the structural integrity of the ATRIUM-11 fuel is preserved with a factor of safety greater than 1.4.**

Section 3
“Thermal Evaluation”

Update to Section 3 "Thermal Evaluation"

- **The thermal evaluation documented in the current SAR encompasses the TN-B1 container and the fuel assembly. Since the container design is unchanged, the existing thermal evaluation for the container in Section 3 of the SAR remains applicable. Therefore, only the fuel assembly designs were evaluated.**
- **The thermal evaluation for the limiting fuel assembly designs, including the 9x9, 10x10 and 11x11 arrays was completed .**

Update to Section 3 "Thermal Evaluation"

- **Table 3-5 "Maximum Pressure" will have the following changes:**
  - **A column has been added to include 11 x 11 fuel.**
  - **Table values for cladding thickness and diameters for 9 x 9 and 10 x 10 fuel types have been updated to reflect the current limiting fuel designs, specifically the use of liner cladding.**
  - **Initial fill pressure for 9x9 and 10x10 fuel types have been updated to reflect the current design requirements.**
  - **All other values have been recalculated and updated as needed.**

Section 4
“Containment”

Section 4
"Containment"

- **No effect of inclusion of ATRIUM 11 fuel assemblies on the containment.**
- **The primary containment boundary for the TN-B1 package with the ATRIUM 11 will be the fuel cladding. The containment system includes the ceramic sintered pellet, clad in zirconium tubes which are contained in a stainless steel box which is contained in another stainless steel box.**
- **No changes**

Section 5
“Shielding Evaluation”

Section 5
"Shielding Evaluation"

- **No effect of inclusion of ATRIUM 11 fuel assemblies on the shielding.**

Section 6
“Criticality Evaluation”

Section 6
"Criticality Evaluation"

- **A specific criticality evaluation was performed for the ATRIUM 11.**
- **Previous analyses for the TN-B1 used SCALE 4.4. For ATRIUM 11 SCALE 6.1.3 was used.**
- **Benchmarking for SCALE 6.1.3 was performed and USL determined.**

Section 6
"Criticality Evaluation"

Summary of Results

- A criticality safety analysis was performed to demonstrate the safety of the TN-B1 shipping container loaded with ATRIUM-11 fuel. The TN-B1 meets applicable IAEA and 10 CFR71 requirements for a Type B fissile material shipping container, transporting heterogeneous UO_2.
- The criticality analysis for the TN-B1 container was performed at a maximum enrichment of 5.00 wt. percent U-235 for UO_2 contained in zirconium alloy clad cylindrical rods. The ATRIUM-11 fuel assembly contains a square lattice array of 11x11 fuel rods with a larger water channel replacing the center 3x3 fuel rods. Sensitivity analyses were performed by varying fuel parameters (rod pitch, clad ID, clad OD, pellet OD, fuel orientation, polyethylene spacer mass, and moderator density) to obtain the most reactive configuration. Gadolinia-urania rods were added to the assembly to maintain the reactivity of the system below the USL.

Sections 7 “Package Operations” and 8 “Acceptance tests and maintenance programs”

Sections 7 and 8

- **Section 7 "Package Operations"**
  - **No effect of inclusion of ATRIUM 11 fuel assemblies on package operations.**
  - **No changes to this section.**
- **Section 8 "Acceptance tests and maintenance programs"**
  - **No effect of inclusion of ATRIUM 11 fuel assemblies Acceptance tests and maintenance programs.**
  - **No changes to this section.**

Questions?

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