



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

July 12, 2017

MEMORANDUM TO: Anthony Hsia, Deputy Director
Division of Spent Fuel Management
Office of Nuclear Material Safety
and Safeguards

FROM: Norma García Santos, Project Manager */RA J. McKirgan Acting for/*
Spent Fuel Licensing Branch
Division of Spent Fuel Management
Office of Nuclear Material Safety
and Safeguards

SUBJECT: SUMMARY OF JUNE 8, 2017, MEETING WITH AREVA-TN TO
DISCUSS PROPOSED RESPONSES TO REQUESTS FOR
ADDITIONAL INFORMATION FOR THE MODEL NO. TN-B1
TRANSPORTATION PACKAGE (DOCKET NO. 71-9372)

Background.

On June 8, 2017, a phone call meeting was held in Rockville, Maryland, between AREVA-TN (the applicant) and the U.S. Nuclear Regulatory Commission (NRC) staff at the request of the applicant. The meeting was noticed on May 26, 2017, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17146B295) as a partially closed meeting. Enclosure 1 includes the list of participants (in person or by phone) including individuals that serve as the applicant's contractor, Atkins, for the Model No. TN-B1 package. The meeting handout can be found at ADAMS Accession No. ML17159A434.

Discussion.

The purpose of the meeting was to discuss the applicant's proposed responses to the requests for additional information (RAIs) issued on May 15, 2017, (ADAMS Accession No. ML17136A046) for the Model No. TN-B1 transportation package. AREVA-TN discussed questions and proposed responses to the RAIs submitted on May 15, 2017. The following items summarize the discussion.

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RAI Summary of Discussion
Structural Evaluation

- 2-1 The staff asked the applicant to better explain the conservatisms assumed in the end drop analysis and to provide additional details about the assumptions used to model the block and the unyielding surface (e.g., material). The applicant indicated that it provided the material's properties in the report. The applicant also indicated that it performed a finite element analysis with the material properties. The staff asked the applicant to provide a summary of its finite element analysis using the LSDYNA code and explain modeling assumptions as well as results. As the RAI requested, the response should include both qualitative and quantitative descriptions of the end drop analysis, the damage experience of the package (including the fuel), and explanations of how the analysis meets the regulations in 10 CFR Part 71.
- 2-2 The main issue of this RAI is related to the linear and non-linear behavior of the cladding materials, as the applicant expected some plastic deformations. The staff asked where deformations of the cladding materials of the ATRIUM-11 fuel, under the accident conditions, would fall in its deformation versus strength curve. The applicant replied that the cladding material would have a 14% strain corresponding to the ultimate strength and added that the maximum strain of the cladding material after the 30 feet drop was 2.5%. The applicant also explained that it used a margin of safety of 1.4 for the theoretical load for the dynamic analysis of the fuel bundle, imposed a velocity at impact in the model, and determined the deceleration history. The staff asked the applicant to explain what is meant by applying an acceleration time history if an impact velocity is imposed and how they performed the dynamic analysis. The staff also asked the applicant to provide the assumptions used in the dynamic analyses (with rationales) and both the strain curve for Zirc-2 and the applicable references as part of the response.
- 2-3 The draft RAI response did not provide a complete response with respect to the maximum deformation of the end plugs and end plug welds. The applicant explained that the point of impact for the fuel rod was at the tip [fuel rod plug, which may result in 8% tip deformation (compression strength)]. The staff asked the applicant to provide a quantitative analysis related to the maximum deformation of the end plugs and end plug welds as part of the response.
- 2-4 The applicant indicated that the Zirc-2 cladding has a liner, and the ATRIUM-11 fuel will be shipped with the liner. However, the applicant did not take credit for the liner in some analyses. The staff requested to include the use of the Zirc-2 cladding with a liner in the CoC since that reflects the real cladding design for the fuel being shipped. The applicant did not object to this request. In addition, the staff stated that it was staff's understanding from the draft RAI response that 11x11 fuel designs from other fuel fabricators is not to be shipped in the Model No. TN-B1.

In terms of item No. RAI 2-4(b), the staff pointed out that there is no design information in the application (i.e., safety analysis report) about the ATRIUM-11 containment boundary, design of welds, or acceptance criteria of the containment boundary welds nor are there any detailed drawings identifying the welds of the containment boundary. The applicant explained that it had

RAI**Summary of Discussion**

defined the containment boundary in the application as the fuel cladding, and asserted that (1) it had not been asked to provide this type of information before, (2) the fuel rods are leak tested, and (3) the application is for fresh fuel, not spent fuel. The applicant also mentioned that it does not want to come back for a revision to the CoC every time that tolerances are changed for the fabrication of fuel assemblies. The staff indicated the following:

- The Model No. TN-B1 is approved as a Type B package, and the questions asked by the staff are commonly asked for other Type B packages.
- Package applications usually include weld details and acceptance criteria (e.g., non-destructive examination and applicable codes and standards) for containment boundary welds and welds that are not part of the containment boundary.
- Fabrication drawings may be different (more detailed) than licensing drawings that often have larger tolerances.
- Given that the applicant defines the containment boundary as the cladding of the fuel, adding a fuel content constitutes a change in the containment boundary.

Therefore, the staff asked the applicant to provide a drawing of the ATRIUM-11 containment boundary along with additional information in the application about weld design and the acceptance criteria for the welds associated with the containment boundary of the ATRIUM-11 fuel. The staff mentioned 10 CFR 71.119 as one of the bases for requesting this information. The applicant did not agree to provide a drawing of the containment, but agreed to consider adding weld design and acceptance criteria for the containment boundary welds for the ATRIUM-11 fuel.

Thermal Evaluation

3-1 The applicant indicated that the same cladding stress was applied to develop Table 3-5 of the application. The staff asked the applicant what the difference in internal pressure in a fuel rod would be if it assumed that there is a liner inside of the ATRIUM-11 fuel cladding compared to the case with no liner. The applicant responded that the internal pressure varies 10% and that the criteria that they would use for transporting the fuel would be as follows:

“Maximum product of allowed pressure multiplied by Inside Radius/Thickness, excluding the liner thickness (if applicable), may not exceed 10.18653 MPa.”

The staff pointed out that the analyses provided in the application should be clear in terms of using or not using a liner as part of its assumptions. The applicant should also delineate the difference between the assumptions in calculations for the different areas of review and the parameters associated with the licensing action request. For example, the applicant should explain the applicable and non-applicable criteria from the previous analysis and should explain how these criteria constitute bounding conditions for this licensing action request. The applicant should also provide revised

RAI**Summary of Discussion**

documents (and application changes) resulting from these RAIs with the RAI responses. Likewise, when asked, the applicant stated that the certified test unit did not have a liner but was unable to confirm whether the LS-DYNA ATRIUM 11x11 model included a liner. The staff expects the applicant to address this question in the RAI response. In addition, the applicant indicated that the sentence in the draft RAI 3-1 response, "The 11x11 fuel design is currently only offered with non-liner cladding," would be corrected.

The staff requested that the applicant expand on the proposed RAI response by addressing the connection between the cladding stress and radius/thickness criteria (based on oven tests of initial fuel rod designs) and the need for this fuel rod cladding to maintain its integrity after undergoing the hypothetical accident condition tests (e.g., drop, impact, 30 minute fire). For example, it was surmised that a fuel rod could potentially satisfy the stress and radius/thickness criteria but not necessarily survive a 30 ft. drop. The draft RAI response did not make this connection and, in addition, did not explain the extent to which the original oven test data could be extrapolated (i.e., constantly reducing thickness). The applicant was not able to provide a response in this regard at the meeting.

3-2

The applicant pointed out that this response is similar to an RAI response for the Model No. RAJ-II, which is the same packaging as the Model No. TN-B1. The staff indicated the following:

- The discussion provided in the RAI response needs to be put into quantitative terms (e.g., maximum strains expected during accident conditions, mechanical properties during cold work, actual deformation, etc.).
- The applicant should provide references that form the basis for its response including appropriate ADAMS Accession numbers.
- Justify the sentence in the RAI response that mentions that the fuel rod associated with NUREG/CR-5892 "... incurred plastic deformation in excess of the RAJ-II 9m crop CTU-2 assembly," by quantifying the amount of plastic deformation in both units.

The applicant pointed out that they thought they had provided the cumulative effects of HACs as asked in the RAI.

The staff indicated that even though the current RAJ-II packaging is the same as the TN-B1,¹ the RAI responses need to be within the context of TN-B1, which is the package evaluated for this licensing action (i.e., the applicant needs to explain the applicability of the previous analysis of the RAJ-II package to the TN-B1 package in the context of the ongoing licensing action).

Containment Evaluation

4-1

The staff explained that the applicant needs to

¹ The CoC, Revision 0, (issued in 2014) of the Model No. TN-B1 is based on the safety analysis report (version prior to 2014) for the packaging of the Model No. RAJ-II.

RAI**Summary of Discussion**

- explain the changes made to section 4 of the application in order to answer the question as part of the RAI response;
- identify the limiting case for the leak test (normal conditions of transport versus accident conditions); and
- revise Section 4 to ensure that units are consistent and clear (e.g., volume versus rate per week).

The staff also asked the applicant to remove the parentheses in some text for clarity. In Section 4.1.1, the staff asked the applicant to revise the following:

- The “definition” of Model No. TN-B1’s containment boundary, which reads as follows:

“The primary containment boundary for the TN-B1 package is the fuel cladding.”

Note that the applicant indicated that the containment boundary includes the end plugs and welds. The staff stated that the applicant of the RAJ-II package agreed to clarify the definition of the containment boundary for its package as well. The staff also mentioned that the word “primary” should be removed from this containment boundary definition since the applicant only considers one containment boundary (i.e., there is no secondary containment boundary) in the application.

- The last sentence to clarify that the fuel is leak tested after fabrication to demonstrate that it meets the leak-tight criterion (1×10^{-7} cubic centimeters-atmosphere per second ($\text{cm}^3\text{-atm/s}$)), since the ATRIUM-11 fuel would not meet the leak-tight criteria under HAC based on the information in the application.

- 4-2 The applicant indicated that it would provide its proposed text for Table 4 of the CoC, which includes the minimum cladding thickness. The staff pointed out that the applicant needs to verify that the minimum cladding thickness is consistent throughout the application and clearly distinguish between assumptions versus the actual package parameters related to this licensing action request. The staff also indicated that the applicant should include the proposed values for Table 4 of the CoC in Section 4 of the application, since the CoC is based on the information submitted in the application.

Criticality Safety

- 6-1 The staff found the proposed response acceptable. The staff recommended deleting the second paragraph of the proposed RAI response.
- 6-2 The staff asked the applicant to add the following information to the proposed RAI response allowing cross referencing of:

RAI**Summary of Discussion**

- a discussion of the relationship between the input file and the calculation for the material density of the poisoned fuel in the application,
- the input files related to this analysis, and
- an explanation of the calculation of the materials' densities of the fuel rods.

6-3 The applicant explained that it used the same lattice model as the one previously used and that NRC had previously determined that it was conservative. The staff pointed out that the applicant needs to provide a discussion about the conservatisms related to this licensing action and justification for such conservatisms. For example, it could provide a discussion about the possibility of modeling a water region outside of the cladding to better simulate the melt foam and possible fuel configuration for the package under hypothetical accident conditions.

6-4 The staff indicated that the applicant needs to select scenarios such as maximum k_{eff} , various enrichments in the vanished zone (i.e., the part of the fuel assembly that contains no fuel length) and demonstrate that these are bounding conditions for this licensing action. The applicant replied that it used the maximum enrichment values. In response, the staff pointed out the following:

- The staff needs to understand whether the ATRIUM-11 fuel would have axial and horizontal variation of enrichment (the application does not provide this information). NUREG\CR-7224 includes discussions about BWR fuel and may provide some information about the vanished zones.
- Assuming the highest enrichment may not yield the maximum k_{eff} due to the axial and horizontal variations of enrichment related to BWR fuel.
- Adding gadolinium yields a lower, not a maximum, k_{eff} .
- The applicant needs to explain the analysis that it performed, including assumptions and corresponding justification as well as the analysis with the partial length zone.

AREVA indicated that they did not believe NUREG\CR-7224 was applicable to fresh fuel shipping containers, but did agree to review it further in light of these discussions. The staff agreed with the applicant about the applicability of NUREG/CR-7224 to the TN-B1 application. The staff pointed out that it was using the complexity of the BWR fuel designs for the applicant to consider in identifying the most reactive fuel assembly design to demonstrate compliance with 10 CFR 71.55(b).

At the end of the meeting, the staff indicated that the applicant should perform the following actions:

- State in the application, when applicable, whether previous analysis are bounding.
- Ensure that changes related to the ATRIUM-11 fuel are made throughout the application and show in the application that the ATRIUM-11 fuel is analyzed and/or bounded by the

NCT and sequential HAC tests, especially regarding structural, thermal, containment, and criticality.

- Ensure referencing of the appropriate documentation throughout the application.
- Submit revised documentation and application changes resulting from the RAI.
- Provide the sections or portions of the references that they are relying upon in an RAI response or licensing basis.

The applicant agreed to provide an estimated timeline for submittal of the RAI responses after discussing the outcome of this meeting with its staff and contractors.

Docket No. 71-9372

CAC No. L25164

Enclosures:

1. Meeting Attendees
2. Meeting Agenda

SUBJECT: SUMMARY OF JUNE 8, 2017, MEETING WITH AREVA-TN TO DISCUSS PROPOSED RESPONSES TO REQUESTS FOR ADDITIONAL INFORMATION FOR THE MODEL NO. TN-B1 TRANSPORTATION PACKAGE (DOCKET NO. 71-9372), DOCUMENT DATE: JULY 12, 2017

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ADAMS Package Accession No.: ML17198A316

OFFICE:	DSFM	E	DSFM	N	DSFM	N
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Meeting to Discuss Request for Additional Information Model No. TN-B1

June 8, 2017
TWFN-6-D44
12:00–4:00 p.m.

Attendee List

Name	Organization
Norma García Santos	NRC
Joseph Borowsky	NRC
Caylee Kenny	NRC
Yong Kim	NRC
Zhian Li	NRC
Ricardo Torres	NRC
Christina Leggett	NRC
Harold Scott	NRC
Larry Tupper	AREVA-TN
Glenn Mathues	AREVA-TN
Jim Davis	AREVA-TN
Kevin Elliot	AREVA-TN
Tim Tate	AREVA-TN
Michelle Guzzardo	AREVA-TN
Scott Edwards	AREVA-TN
David McDaniels	Atkins (Contractor to AREVA-TN)
Tony Chung	Atkins (Contractor to AREVA-TN)

Agenda

June 8, 2017
12:00–4:00 P.M.
Location: TWFN-6-D44

Purpose:

Discuss proposed responses to requests for additional information (RAIs) for the Model No. TN-B1 transportation package (Docket No. 71-9372).

Outcomes:

- Clarify questions from the applicant regarding the RAIs issued on May 15, 2017, as part of the review of the application of the Model No. TN-B1 transportation package.
- Discuss proposed responses to RAIs.

Process:

- | | |
|---------------------------|--------------|
| 1. Opening Remarks | NRC\AREVA-TN |
| 2. Introductions | All |
| 3. Discussion of RAIs: | AREVA-TN |
| • Containment: 2-1 to 2-4 | |
| • Thermal: 3-1 and 3-2 | |
| • Criticality: 6-1 to 6-3 | |
| 4. Action items | All |

Closed Portion of the Meeting

- | | |
|------------------------|--------------------|
| 5. Discussion of RAIs: | AREVA-TN |
| • Containment: 4-2 | |
| • Criticality: 6-4 | |
| 6. Action items | All |
| 7. Closing Remarks | NRC\ NNSA\AFS\LANL |
| 8. Adjourn | NRC |