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

November 16, 2017

Mr. Tim Tate
Environmental, Health, Safety,
and Licensing
AREVA Inc.
2101 Horn Rapids Road
Richland, WA 99354

SUBJECT: SECOND REQUEST FOR ADDITIONAL INFORMATION FOR REVIEW OF THE CERTIFICATE OF COMPLIANCE NO. 9372, FOR THE MODEL NO. TN-B1 PACKAGE.

Dear Mr. Tate:

By letter dated November 18, 2016, as supplemented on February 17, 2017, you submitted an application for amendment of the Model No. TN-B1 transportation package, Certificate of Compliance No. 9372. The letter requested to add, as authorized contents, the ATRIUM 11 fuel assemblies. The staff issued a request for additional information by letter dated May 15, 2017, to which you responded by letter dated August 29, 2017.

The staff has determined that further information is needed to complete its technical review. The information requested is listed in the enclosure to this letter. We request you provide this information by December 27, 2017.

Please reference Docket No. 71-9372 and EPID L-2017-LLA-0073 (previously referred to as CAC No. L25164) in future correspondence related to this licensing action. If you have any questions regarding this matter, please contact me at 301-415-7505.

Sincerely,

/RA/

Pierre Saverot, Project Manager
Spent Fuel Licensing Branch
Division of Spent Fuel Management
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9372
EPID L-2017-LLA-0073 (CAC No. L25164)

Enclosure:
Request for Additional Information

SUBJECT: SECOND REQUEST FOR ADDITIONAL INFORMATION FOR REVIEW OF THE CERTIFICATE OF COMPLIANCE NO. 9372, FOR THE MODEL NO. TN-B1 PACKAGE, DOCUMENT DATE: NOVEMBER 16, 2017

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Request for Additional Information
AREVA Inc.
Docket No. 71-9372
Model No. TN-B1 Package

By letter dated November 18, 2016, as supplemented on February 17, 2017, AREVA Inc. (AREVA) submitted an application for amendment of the Model No. TN-B1 transportation package, Certificate of Compliance No. 9372. AREVA requested approval of changes made to reflect the addition of ATRIUM 11 fuel assemblies. The staff issued a request for additional information by letter dated May 15, 2017, to which responses were received by letter dated August 29, 2017.

This second request for additional information (RAI) identifies information needed by the U.S. Nuclear Regulatory Commission (NRC) staff (the staff) in connection with its review of the application. The staff used NUREG-1617, “Standard Review Plan for Transportation Packages for Spent Nuclear Fuel," in its review of the application.

Each individual RAI describes information needed by the staff to complete its review of the application and to determine whether the applicant has demonstrated compliance with the regulatory requirements of 10 CFR Part 71.

Chapter 2: STRUCTURAL AND MATERIALS REVIEW:

2-1 Provide additional details on how the fuel was modeled and more importantly how the fuel mass was incorporated into the fuel rod model in the finite element (FE) analysis, and provide the FE analysis results.

In the response to the RAI 2.1, the applicant indicated that the cladding was modeled using shell elements in its LS-DYNA FE analysis. However, there is no discussion about how the fuel was modeled and if 100% of the fuel mass was incorporated into the fuel rod model.

This information is needed to determine compliance with 10 CFR 71.41(a), and 71.73(c)(1).

2-2 Provide additional details on the analysis described below.

The applicant provided the response to RAI 2-3 as following:

"The weld and the accompanying heat-affected zone in the FE model are modeled as shell elements as well as the rest of the cladding. The end plugs are modeled as solids."

"The strain at the weld corresponds to nodal strain at the top boundary of the end plug that is reported with the strain contour of the cladding of the heat-affected zone..."

"The maximum inelastic deformation of the weld and the heat-affected zone in the cladding is 2.6% as shown in the figure above."

The staff understands that the weld between the cladding and the end plug creates a moment connection between the cladding and the plug. It is expected that the bending

strain at this location will be high. Each node in a shell element has translational stiffness as well as bending stiffness. The nodes of a solid element have translational stiffness but no bending stiffness. Therefore, when a shell element is connected to a solid element, there is no moment transfer because it is a pin connection. So the 2.6% strain reported is a membrane strain because the bending strain does not exist due to the pin connection.

Based on the staff's discussion above, the staff needs the following information to complete the review, and determine the acceptability of the applicant's computational modeling and its analysis results:

(a) Provide analysis that calculates the maximum bending strain in the cladding weld in the heat-affected zone.
(b) Is reduced integration used in the cladding shell elements or are the shell elements fully integrated? How many integration points are used through the shell thickness? Is reduced integration used in the plug solid elements or are the solid elements fully integrated?
(c) The nodes connecting the shell and solid elements are at the weld location. Is the 2.6% strain in the weld the average strain in the nodes at the weld from the 4 elements (2 shells and 2 solids) connected to a given weld node? What is the maximum strain in each of the 4 elements connected to a weld node?
(d) Provide a plot of the shell and solid finite element mesh in the heat-affected zone.

This information is needed to determine compliance with 10 CFR 71.41(a), and 71.73(c)(1).

2-3 Revise Chapter 8 of the application to incorporate the fuel rod acceptance and qualification tests for the ATRIUM-11 fuel rods and end caps.

In response to RAI 2-4, the applicant revised the description of the containment boundary in Section 4.1.1 of the application by describing qualification and acceptance tests for the ATRIUM 11 fuel rod and end caps. The applicant is asked to incorporate these tests into Chapter 8 of the application, which the staff can incorporate as a Certificate of Compliance condition.

This information is required to ensure compliance with 10 CFR 71.33(a).

Chapter 3: THERMAL REVIEW

3-1 Clarify that the bounding cladding stress calculation in Table 3 of Calculation Package FS1-0024572 has adequate margin when a liner is present.

The response to RAI 3-1 stated that "all fuel designs must be verified to meet the allowed cladding stress limit, including the requirement to exclude the thickness of the liner from the minimum cladding thickness." The results of the pressure (P), inside radius (r), and cladding thickness (t) ratio (Pr/t) calculation in FS1-0024572 Table 3 indicate margins of approximately 0.01. There was no information concerning the effect of including the liner on the pressure and resulting stress/strain. This information is required to ensure compliance with 10 CFR 71.51(a)(2) and 71.73.

3-2 Provide additional information that justifies the statement included in Section 7 of calculation package FS1-0024572, which states: “testing resulted in no failure of the cladding as verified by leak tests.” Likewise, justify the conclusion in Sections 7 and 8 of calculation package FS1-0024572 that the GNF-J CTU 2J certification unit resulted in no failure of the simulated fuel assembly cladding after hypothetical accident condition tests.

The information presented in the SAR does not appear to be consistent with the statements in FS1-0024572. For example, SAR Section 2.12.1.3 stated that the CTU 1 and CTU 2 certification units were helium leak tested after the drop tests and that results from the CTU 2 tests indicated a helium leakage rate of 5.5E-6 atm-cc/s. In addition, there was no mention of helium leakage rate testing in SAR Section 2.12.2 for the corresponding GNF-J certification tests.

This information is required to ensure compliance with 10 CFR 71.51(a)(2) and 71.73.

Chapter 6: CRITICALITY REVIEW

6-1 Revise all of the criticality safety analyses with assumption that the unburned polyethylene foam in the package is mixed with water for package under hypothetical accident conditions (HAC) or demonstrate that the case analyzed is bounding for the ATRIUM 11 fuel package. In the initial safety analyses for the ATRIUM 11 fuel package under HAC, the applicant assumed that the unburned polyethylene foam in the package were mixed with cladding material in its models and states that it made this assumption because of the limitation of the SCALE computer code it used. By letter dated, May 15, 2017(ADAMS Accession No. ML17136A046), the NRC staff requested (via RAI 6-3) that the applicant clarify what was the limitation(s) of the SCALE computer code that made the applicant assume that the unburned polyethylene foam had to be modeled as a mixture with the cladding material for a package under HAC.

In its response to the RAI, the applicant performed a case study in which the applicant revised the model to assume that the unburned polyethylene foam is mixed with water outside the cladding (in fact, the revised model is physically more representative because the unburned polyethylene foam is more likely to soak with water than being burned into the cladding). The applicant’s result shows that the model with the new assumption is slightly more reactive. The staff finds that this is consistent with the staff’s confirmatory analysis. Since this study shows that the previous modeling assumption is not conservative for criticality safety analysis of package under HAC, the applicant needs to revise all of the criticality safety analyses for package under HAC or demonstrate that the case analyzed is the most reactive case, i.e., with the maximum k_{eff}. The applicant also needs to provide information on what fuel assembly configuration, fuel parameters (including U-235 enrichment, gadolinium loading), and polyethylene density are used in the revised model of the damaged fuel package to justify that the values used are bounding for all requested ATRIUM 11 fuel configurations.

This information is required to ensure compliance with 10 CFR 71.55(a), 71.55(b), 71.55(d), 71.55(e), 71.59(a), 71.59(b), and 71.59(c).