

RAI 3-1

Clarify that the bounding cladding stress calculation in Table 3 of Calculation Package FS1-0024572-3.0 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 FS1-0024572-3.0 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.

AREVA Response

The liner and non-liner cladding are analyzed using the same methodology, as detailed in the Calculation Package FS1-0024572. The inputs, however, differ between the two cladding types for the maximum clad thickness and the initial fuel rod fill pressure. The maximum clad thickness used in the calculation for the liner clad does not include the thickness of the liner. The cladding liner material has a strength that is less than that of the parent zirconium alloy material of the cladding. Therefore for the cladding stress calculation, the liner is conservatively assumed to not contribute to the structural strength, and its thickness is not considered in the calculation for determining the cladding stress.

Given the reduced calculated thickness of the liner clad, a lower initial fill pressure in comparison to the non-liner clad is necessary to result in a cladding stress that meets the allowable limit. An example calculation demonstrating the derivation of the results for the bounding 11x11 fuel design with non-liner and liner clad was added to the latest revision of the calculation, FS1-0024572-4.0, to clarify the method used.