RAI 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 keff. 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.

The staff needs this information to determine the TN-B1 package with the ATRIUM BWR assemblies meet the regulatory requirement of 10 CFR 71.55(a), 71.55(b), 71.55(d), 71.55(d), 71.59(a), 71.59(b), and 71.59(c).

AREVA Response

Two approaches for modeling polyethylene were considered: one in which the polyethylene was homogenized with the clad and one in which the polyethylene was homogenized with the water. Both approaches are applied to the limiting 11x11 HAC single package and package array cases. The SAR will be updated to include the results, which are shown below. For the HAC single package configuration, the case in which the polyethylene is homogenized with the clad is more reactive. For the HAC package array, the case in which the polyethylene is homogenized with water is more reactive. All HAC cases remain below the USL of 0.94094.

HAC, single package

	k_{eff}	σ	$k_{eff} + 2\sigma$
Polyethylene homogenized with clad	0.76615	0.00045	0.76705
Polyethylene homogenized with water	0.76504	0.00045	0.76594

HAC, package array

	k_{eff}	σ	$k_{eff} + 2\sigma$
Polyethylene homogenized with clad	0.93855	0.00044	0.93943
Polyethylene homogenized with water	0.93982	0.00043	0.94068

All cases provided above are developed with the full set of limiting parameters, described in detail in the SAR.

The HAC single package contains 5wt% U235 enrichment with 13 UO_2-Gd_2O_3 rods in all axial regions. The UO_2-Gd_2O_3 rods configurations are shown in Figure 6-52 of the SAR.

The HAC package array contains 5wt% U235 enrichment with 13 UO_2-Gd_2O_3 rods in the bottom and middle axial regions and 3.3 wt% U235 enrichment with 3 UO_2-Gd_2O_3 rods in the upper axial region. The UO_2-Gd_2O_3 rods configurations are shown in Figure 6-52 of the SAR.

Both configurations reflect an un-homogenized polyethylene density of 0.949 g/cm^3.