RAI 2-1

Provide technical discussions 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 how the fuel mass was incorporated into the fuel rod model. The applicant must address this, because if 100% of the fuel mass was not included in the fuel rod model, the FE analysis results would be very unconservative.

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

AREVA Response

As noted in ATKINS-NS-DAC-ARV-15-02 (FS1-0025122-1.0) Section 3.3-2 the design weight of the ATRIUM-11 Fuel Assembly is 696 kg for the Type 11x11 fuel. The maximum weight of uranium in the ATRIUM 11 fuel element is 281 kg per fuel assembly. The maximum weight considered in the analysis sensitivity studies is 720 kg.

As noted in NSA-DAC-AREVA-14-01 (FS1-0015328-2.0) section 5.1 the fuel pellets are not modeled separately. The weights of the fuel pellets are added to the cladding tubes in the base finite element model. The fuel cladding is coupled together with the fuel such that the mass of the fuel pellets are uniformly distributed to the cladding surface. The lumping of the fuel mass in the cladding shell simplified the finite element model development and made the cladding heavier causing the fuel tube to buckle during and at the end of impact in the analysis.

To determine fuel pitch changes this overly conservative approach was modified. The model was modified to decouple the fuel pellets from the fuel cladding over the length of the fuel rod and lump the fuel pellet weight to the lower end of the fuel rod as described in Appendix C of Atkins-NS-DAC-AREVA-14-01.