Contribution ID: **416** Type: **POSTER**

Modeling of the coolant region in the ALFRED core in case of thermal expansion

Friday, April 22, 2022 10:30 AM (2 hours)

From a neutronic point of view, the effects of thermal expansion on the reactivity of a reactor core are an important feedback mechanism, both in steady-state and during many postulated accidents sequences. It is therefore necessary to model the expanded configuration in terms of shapes, densities and volumes as accurately as possible. Unfortunately, this is not easy for those regions that expand differently due to a temperature gradient. This is the case of the coolant region along the active height, where the change in temperatures determines a change in the flow area and consequently a change in both the mass and volume of the coolant itself. In this study, three alternative approaches to modelling the coolant region are theoretically discussed. In the first model, masses and volumes of the expanded configuration are calculated for the entire subchannel using a single averaged pitch, and uniform density along the active height as evaluated by the average expansion of the coolant. In the second model, the first approach is enhanced by taking into account the axial change in mass, i.e., a discretization of the subchannel in equivalent regions is introduced so that in each axial region a more precise value of the coolant density can be used. Finally, in the third model, starting from the idea of explicitly preserving the reaction rates by preserving the coolant inventory compared to the real case, the mass is again calculated for each axial region in which the subchannel has been discretized but using an effective density which is derived from the physical density applied to the real-case volume of that region. These three approaches applied to the elementary cell of the ALFRED core are then compared by detailed analysis with MCNP6.1. This is done to assess, on one hand, their discrepancy on the reactivity of the system and, on the other hand, their demanding in terms of model setup and computational costs. An insight on the cost-benefit ratio of each model is in fact necessary to obtain quantitative information for establishing a reference calculation route catching the aimed details while balancing the required efforts.

Speaker's email address

roberto.pergreffi@enea.it

Speaker's title

Mr

Country/Int. organization

Italy

Affiliation/Organization

ENEA

Primary authors: Mr PERGREFFI, Roberto (ENEA); Mr GRASSO, Giacomo (Italian National Agency for New Technology, Energy and Sustainable Economic Development (ENEA)); Mr LODI, Francesco (ENEA)

Presenter: Mr PERGREFFI, Roberto (ENEA)

Session Classification: Poster Session

Track Classification: Track 6. Modelling, Simulations, and Digitilization