Operational and start-up transients in an accelerator driven systems

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Keywords: ADS, reactor kinetics, thermal hydraulics, average channel.

Accelerator Driven Systems (ADS) are sub-critical nuclear reactor cores driven by an external spallation neutron source. These promising devices must be used not only as dedicated burners of transuranic elements but also as energy producers. The spallation neutrons are provided by the bombardment of a heavy metal, when impinged by proton beam, from a high energy proton accelerator. Usually, most simulations of these systems are based on a steady state condition given by the power operation.

Because fast neutrons have more long mean path length, than thermal ones, neutron fluxes, they are more decoupled in such reactors. Thus, an accelerator driven system, that is ultimately a fast one, usually needs many energy groups in core calculations to capture resonance cross sections. That is, because of resonance cross sections have a strong influence on the effective multiplication factor.

Resonance cross sections vary with temperature, not only in the fuel region, but also in the coolant one. In this way, two transients are analyzed: beam interruption and startup transients. These transients are useful to analyze the feedback effect on power of the Accelerator Driven Systems, since they cover a wide range of temperature variations, being a beam interruption in power or a startup one, when the ADS are powered up from zero power to power operation.

Beam interruption and start-up transients, taking into account the LBE correlations purposed in COOL Project, from INPRO-IAEA and results were compared with those calculated with correlations from a Benchmark of NEA [1]. For that, it was used the SIRER-ADS code: a program based on a Point Kinetic Model [2]. In the code, the fuel temperature, cladding and channel are solved numerically, after space and time discretization.

The results have shown good concordance between NEA and COOL correlations, as in the Figure 1 and the Figure 2.

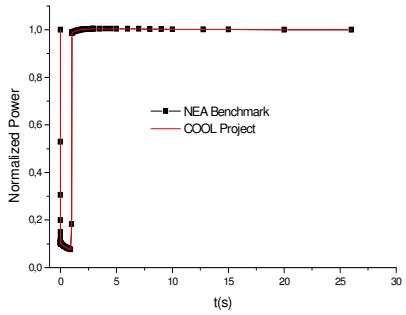

Figure 1. Normalized power during a beam interruption

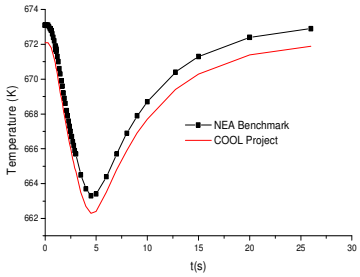

Figure 2. Channel exit temperature for beam interruption

References

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[2] R. S., Santos and J. R., Maiorino, On the Application of SIRER_ADS in the Simulation of Transients in Accelerator Driven System (ADS), 2007 International Nuclear Atlantic Conference - INAC 2007, Santos, Brazil, 2007.

Acknowledgments

The author thanks CNPq and FAPERJ for financial support by National Institute for Science and Technology of Advanced Nuclear Reactors.