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USE OF CATHARE2 REACTOR CALCULATIONS TO ANTICIPATE RESEARCH NEEDS

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ABSTRACT

To analyze the consequences of the introduction, in Nuclear Power Plants, of advanced fuels at high burn-up, decided by most of the utilities in western countries in order to reduce the fuel cycle costs, IRSN has initiated a research program focused on the study of such PWR fuel behavior in LOCA conditions.

A first step of this program, comprising analytical and experimental parts, has been to identify the main physical phenomena, linked with thermomechanical behavior of irradiated rods in bundle geometry, to be taken into account in reactor safety analysis : cladding deformation and flow section restriction in bundle geometry, mechanical interaction between neighbor rods or structures, axial extension of balloons ; cladding oxidation and secondary hydriding ; fuel fragmentation and relocation, balloons filling rate and FP release ; fuel rods thermal behavior in bundle geometry during reflooding conditions, rewetting of the claddings around ballooned regions with fuel relocation ; mechanical resistance of irradiated claddings in post-quench conditions.

This paper summarizes an analysis of sensitivity calculations performed with CATHARE2 "Best-Estimate" code, used in France in the frame of realistic methodology to evaluate safety margins.

The objective of these calculations is to point out, among parameters affecting last-mentioned phenomena, those for which taking into account basic uncertainties lead to important uncertainty on global code response (Peak Cladding Temperature, oxidation rate …). That is the case of fuel relocation phenomena, whose impact is highly dependent on parameters such as, in the example of LB LOCA transient, cladding radial and axial deformations in bundle geometry, burst criteria, balloon filling rate, thermalhydraulics around balloons. A lack of knowledge on theses parameters for irradiated UO2 and particularly MOX fuel may lead to reduce safety margins.

This study may provide some elements to identify future research needs to complement present experimental data base, reduce uncertainties and develop more realistic calculation models, which may better fit the thermomechanical behavior of advanced irradiated fuels.

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