

MODELLING OF ATF MICRO-CELL UO₂ FUEL BEHAVIOUR UNDER IRRADIATION Impact of thermal conductivity on expected thermal-mechanical behavior under irradiation

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Microcell CERMET (CERamic METal) is an ATF (Accident Tolerant and Advanced Technology Fuels) where granules of UO₂ are enveloped in metallic channel resulting in a nuclear fuel characterized by enhanced thermal conductivity. This reduces the energy stored in the fuel thus increasing the grace period in case of an accident. Few experimental data are today available on this type of fuels. Modelling and simulation can therefore support the understanding of the expected performance under irradiation and help the optimization of this promising ATF. The actual scope of the work presented here is to develop a computational scheme dedicated to simulate the behaviour under irradiation of CERMET fuels, in nominal, incidental and accidental conditions. This paper presents the first step in the process: the effective thermal conductivity of a micro-cell CERMET is modelled by homogenization approach and then verified/validated against available experimental data and full-field calculations. Maxwell model is found to be well adapted in modelling the effective radial thermal conductivity of CERMET fuel, even though anisotropy is neglected. The model is then implemented in the ALCYONE code of the PLEIADES platform where the expected thermal-mechanical behaviour of the CERMET is studied in nominal conditions. The CERMET shows lower centreline temperatures and a lower tendency to crack. Gap closure is delayed. Future work is dedicated to modelling the mechanical behaviour of the metal additive and of the resulting CERMET fuel under irradiation

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