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Thermal-hydraulic study using CFD codes of new nuclear fuel alternatives (UN and UC) for the HPLWR

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The High Performance Light Water Reactor is one of the most promising concepts of the Fourth-Generation reactors. Uranium mono nitride (UN) and Uranium mono carbide (UC) as nuclear fuel alternative for the HPLWR, offer the advantage of high thermal conductivity as compared to UO_2. The use of coating can solve the problems of the reactive nature for UN and UC which arise when these fuels are used in light water thermal reactors. In this paper, a thermal-hydraulic study of the HPLWR fuel assembly, for UO_2, UN and UC, using Computational Fluid Dynamics (CFD) codes was carried out. The use of UN coated with ZrC layers and UC coated with TiN layers and the changes of the fuel thermal conductivity with the porosity were also studied. The radial and axial temperature distributions in the fuels were obtained for all the cases. The maximum temperature values obtained using UN and UC, (coated and uncoated), were lower than those obtained with UO_2. The fuel porosity changes have little influence on the fuel maximum temperature using UN and UC, while using UO_2 the maximum temperature increases in 511 K with a 0.2 % porosity increase.

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