Calculation of the Effective Thermal Conductivity for PWR Spent Fuel Assembly

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Abstract

The spent fuel transport casks and spent fuel storage casks must be evaluated to dissipate the decay heat from spent fuel assemblies to the fuel basket and from the fuel basket to the outer cask surface. No active systems are required for removal and dissipation of the decay heat from spent fuel assemblies that is loaded within the casks. The fuel assemblies are very difficult to be modeled explicitly, i.e., fuel pellet, fuel cladding are not modeled separately on their own, but instead, they are available to be modeled as solids with homogeneous effective properties making no distinction between the different properties and heat transfer characteristics of cladding, pellet, spaces between rods, and gaps between pellet and cladding. This effective thermal property method will reduce analysis time and cost for thermal analysis of the cask. In this paper the effective thermal conductivity through a cross section of the fuel region of the fuel basket is calculated from a detailed two dimensional slice model of the traverse section of W.H 17x17 fuel assembly using FLUENT code based on the finite volume method. The effective thermal conductivity is found to model sufficiently the heat transfer by radiation and conduction between the fuel rods and between the fuel rods and the fuel basket in which the fuel assemblies reside, therefore this method could be applied to the thermal analyses of the transport casks and the storage casks.