Coupled Computational Fluid Dynamics and MOC Neutronic Simulations of Westinghouse PWR Fuel Assemblies with Grid Spacers

Neutronic coupling with Computational Fluid Dynamics (CFD) has been under development within the US DOE sponsored ?Nuclear Simulation Hub?. The method of characteristics (MOC) neutronics code DeCART (,) under development at the University of Michigan was coupled with the CFD code STAR-CCM+ to achieve more accurate predictions of fuel assembly performance. At Westinghouse, lower order, neutronic codes such as the nodal code ANC have been
coupled to thermal-hydraulics codes such the subchannel code VIPRE to predict the heat flux and fuel nuclear behavior. However, a more detailed neutronics and temperature / fluid field simulation of fuel assembly models which includes explicit representation of spacer grids would considerably improve the design and assessment of new fuel assembly designs. Coupled STAR-CCM+ / DeCART calculations have been performed for various representative three-dimensional models with explicit
representation of spacer grids with mixing vanes. The high fidelity results have been compared to lower order simulations. The coupled CFD/MOC solution has provided a more truthful model which includes a more accurate representation of all the important physics such as fission energy, heat convection, heat conduction, and turbulence. Of particular significance is the ability to assess the effects of the mixing grid on the coolant temperature and density distribution using coupled thermal/fluids and neutronic solutions. A more precise cladding temperature can be derived by this approach which will also enable more accurate prediction of departure from nucleate boiling (DNB), as well as a better understanding of DNB margin and crud build up on the fuel rod.

Author Name:
Jin Yan
Brendan Kochunas
Mathieu Hursin
Thomas Downar
Zeses Karoutas
Emilio Baglietto
Author Company:
Westinghouse Electric Company LLC
University of Michigan
CD-ADAPCO
Industries:
Energy [1]
Products:
STAR-CCM+® [2]

Conference Location:
Toronto, Ontario, Canada
Conference Proceeding PDF:
NURETH14-254.pdf[3]
Link:
Sitemap [4]
Rights:

Pages:
15
Conference Date:
Tuesday, September 25, 2012
Paper Reference:
NURETH14-254
Publisher:
CASL
Conference Name:
The 14th International Topical Meeting on Nuclear Reactor Thermalhydraulics, NURETH-14

Links:
[1] http://www.cd-adapco.com/industries/energy
[2] http://www.cd-adapco.com/products/star-ccm%C2%AE
[3] http://www.cd-adapco.com/sites/default/files/conference_proceeding/pdf/NURETH14-254.pdf
[4] http://www.cd-adapco.com/references/www.casl.gov/docs/NURETH14-254.pdf