CELLULAR CONVECTION STUDIES IN ROOF TOP OF FAST BREEDER REACTOR

VERTICAL:
POWER & NUCLEAR ENERGY

SERVICE:
CUSTOMIZED CAE SOFTWARE

TECHNOLOGY:
CFD

Our customer is a globally recognized leader in scientific research and advancement of fast breeder reactor technology. In their 500 MWe Prototype Fast Breeder Reactors (PFBR), many components like Intermediate Heat Exchanger (IHX), rotating plugs, etc. penetrate through the roof top slab. These penetrations form vertical annular gaps, where there is a possibility of natural convection of argon gas. This results in non-uniform circumferential temperature distribution and associated uneven expansion in the penetrating component, and hence impacting their safety requirement.

Zeus Numerix replied upon CFD simulations to predict the number & extent of cellular convection cells. The numerical model accounted for buoyancy driven flow, conjugate heat transfer and S2S radiation effects. Script based automated custom meshing was developed on proprietary, GridZ™ and pressure based solver, FlowZ™ was extended to include relevant physics. The results were validated against experiments & methodology was established to undertake parametric analysis.

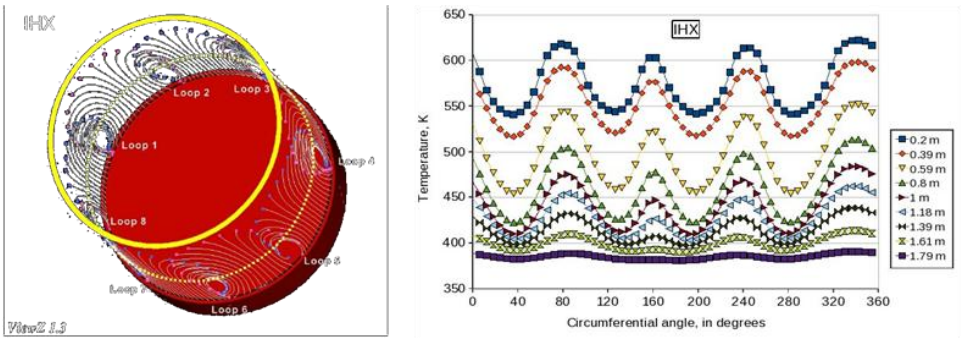

Figure 44: (a) Convection cells in IHX penetration (b) Circumference temperature distribution

The results from the customized package delivered to the customer ensured that circumferential temperature variation is marginal for all penetrations. The simulation also demonstrated that different penetrations can have different number of convective loops, which was undesirable and hence customer modified the design to completely eliminate the need for roof top penetrations in their future FBRs.

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