

# CHARACTERIZATION OF BLOCKAGES IN NUCLEAR FUEL PIN BUNDLE

VERTICAL:  
**POWER & NUCLEAR  
ENERGY**

SERVICE:  
**CUSTOMIZED CAE  
SOFTWARE**

TECHNOLOGY:  
**CFD**

Our customer is the nodal atomic energy center for design and development of Fast Breeder Reactors. It is a Sodium cooled pool type reactor where heat is generated in the fuel subassemblies, each comprising of 217 tightly packed fuel pins. Solid impurities, if any are present, in the Sodium pool can lead to local blockages in fuel pin bundle which may cause flow disruption, boiling of Sodium or melting of fuel pins. Analysis of such event by experiment is practically infeasible; moreover, typical sub-channel empirical codes are not applicable for pin bundles with blockage

Zeus Numerix simulated subassembly blockage event using full scale CFD approach, in the process, overcoming major hurdles of complex mesh generation, & massively scalable solver. Zeus Numerix used proprietary software GridZ™ to create very unique structured mesh around wire wrapped fuel pin bundle. Blockages were modeled as porous zone. Its proprietary solver completed one simulation of 35 million grids in less than 10 hours on 84 cores computing cluster.

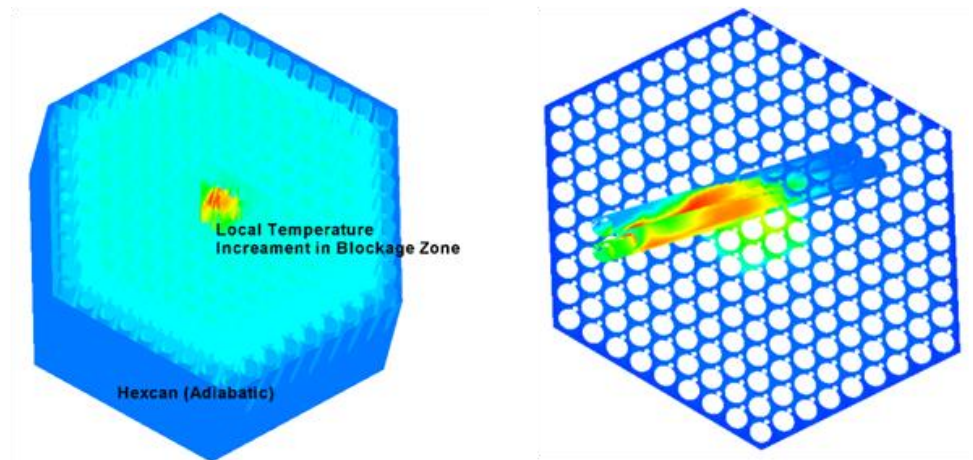


Figure 43: (a) Increase in Sodium temperature in blockage (b) Blockage hot spots on pin clad

The proprietary simulation setup was commissioned at customer's premises. Parametric studies were done for understanding the effect of size, shape & location of blockages. It established the relation between blockage size, reduction in flow & local hot spots meeting a major safety & regulatory requirement. To best of customer's knowledge, full scale fuel subassemblies were simulated with such details, first time globally.