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Multiphase Flow Analysis: The key to sustainable energy production

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Development of an efficient sustainable energy system requires optimization of several energy processes including energy generation, conversion and transportation. In order to achieve high efficiency at low cost of these processes, accurate prediction of system performance at the best operating conditions is needed. The conventional analyses based on overall system performance and using average thermo-fluid properties, are not adequate to achieve such efficient performance. This is because energy generation is associated with two-phase flow heat transfer and change of phase (e.g. boiling and condensation). Therefore, accurate prediction of two-phase flow parameters is essential to obtain efficient sustainable energy systems. However, several challenges are encountered with the analysis of two-phase flows. This is due to the interaction between phases, the behavior of the deformable phase and the different flow patterns exist and their changes throughout the piping system and components. Additional complexity arise when the two-phase passes through multiple piping components located close to each other. Failures in many energy and oil and gas transportation systems occur in the developing two-phase flow regions in such geometries due to variety of degradation mechanisms such as flow accelerated corrosion, cavitation erosion, erosion corrosion, and liquid impact erosion. This severely affects both safety and reliability of these systems and sometime leads to fatalities and huge economic loss. In this presentation, an overview of typical two-phase flow challenges and solution approaches will be discussed through practical examples of previous and ongoing research work.