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Mitigation of Sloshing Effects in High level Liquid Waste (HLW) Storage Tank for Nuclear Spent Fuel Applications

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High level liquid waste (HLLW) is often stored in large capacity horizontal cylindrical tanks especially in fast reactor fuel reprocessing plants. However, these huge tanks when partially filled, pose safety concerns due to seismicity. Violent sloshing during an earthquake-induced Fluid-Structure Interaction (FSI) can lead to catastrophic effects such as structural failures, gas entrainment and roof impact buckling. Therefore, it is important to ensure safe design margins and develop methodologies to overcome a wide range of possible scenarios during design.

In this context, a Computational Fluid Dynamics (CFD) based numerical study is proposed to understand the liquid sloshing dynamics in horizontal cylindrical tank subjected to harmonic excitations. For the purpose of tracking the free surface during the simulation, Volume of Fluid method (VOF) is to be employed. Verification and validation of the proposed numerical model will be presented in detail. An optimum baffle configuration will be recommended to suppress the free surface fluctuations and the associated slosh forces. The sloshing induced free surface height and hydrodynamic pressures will be measured at different locations inside the tank under these conditions. Furthermore, the effectiveness of the baffle geometry is to be tested for a seismic excitation in mitigating the free surface fluctuations and thereby forces on tank walls.

Country/Int. organization

India

Author: Dr V S, Sanapala

Co-authors: Mr T, Ashwin; Mr T, Selvaraj; Mr K, Rajan; KRISHNAMURTHY, Ananthasivan (IGCAR, DAE)

Presenter: KRISHNAMURTHY, Ananthasivan (IGCAR, DAE)

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