Abstract Submitted
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Comparison of the key mechanisms leading to rollovers in Liquefied Natural Gas using Computational Fluid Dynamics ANTOINE HUBERT, Kingston University, MAKSIM DADONAU, University of Cambridge, SIAKA DEMBELE, Kingston University, PETR DENISSENKO, JENNIFER WEN, University of Warwick — Growing demand for the LNG fosters growth of the number of production sites with varying composition and density. Combining different sources of LNG may result in a stably stratified system, in which heat and mass transfer between the layers is limited. Heating of the LNG due to wall thermal conductivity leads to formation of convection cells confined within the layers. While the upper layer can release the extra energy via preferential methane boil-off, the bottom layer cannot and hence becomes superheated. Gradual density equilibration reduces stratification and may eventually lead to a sudden mixing event called "rollover", accompanied by violent evaporation of the superheated LNG. Three phenomena are potentially responsible for density equilibration. The first is the growing difference in thermal expansion of the layers due to the reduced ability of the bottom layer to reject heat. The second is the penetration of the heated near-wall boundary layer into the upper layer. The third is the "entrainment mixing" occurring at the contact surface between the two layers. The present study uses CFD to compare these mechanisms. Boussinesq approximation and an extended version of the k-ε model is used. The code is validated by comparison with a large-scale LNG rollover experiment.

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