NAFEMS UK Regional Conference 2018 - Abstract Submission

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Please identify the event for which your submitting?	NAFEMS UK Conference 2018
Will you be the presenting author?	Yes
Presentation Title	Effect of Mitigation on Partial Failure of Storage Tank Using Computational Fluid Dynamics
Relevant Themes / Keywords	Computational Fluid Dynamics, bund wall, storage tank, partial failure, dynamic pressures, overtopping fractions

Abstract (plain text)	This study presents Computational Fluid Dynamics (CFD) simulations for the partial failure of a bulk storage vessel in the process industries. Such failure mode occurs in case of a loss of integrity of a small section of the tank shell, which represents a crack propagating much faster in the vertical direction than the circumferential direction. This gives rise to a gap from which the fluid flows. This mode of failure is considered the most frequent one as compared to the total failure that represents the catastrophic failure of a storage tank, which takes place in the wake of catastrophes and natural disasters. In this research, OpenFOAM software was used to analyse the flow characteristics in the vicinity of the secondary containment called also bund wall. The bund wall is a structure made of concrete that surrounds the tank to contain any spillage as a measure of safety. The physics of this problem is governed by the multiphase flow where two fluids come into play. OpenFOAM employs the Volume of Fluid method in which a specie transport equation is solved to determine the volume fraction of the two fluids in each cell. CFD analysis allowed to compute the dynamic pressures exerted on the bund wall and the overtopping fractions which are the ratio of the quantity of fluid that surpasses the bund wall to the quantity of fluid initially located inside the tank. The incorporation of a mitigation measure has been investigated through the inclusion of a baffle inside the storage tank labelled Mitigation of Tank Instantaneous Failure (MOTIF). The partial failure is achieved by creating an aperture in the tank shell. Three different sizes of the aperture have been tested and results were compared to the mitigated cases. CFD simulations showed that MOTIF reduces significantly both of the dynamic pressures and overtopping fractions and changes the fluid flow direction from being directional to speared across the bunded area.
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