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C1Po3B-03: Numerical Simulation of the Protective Effectiveness of Bund Walls and the Impact of Key Parameters in Accidental Liquid Hydrogen Releases

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Hydrogen is widely regarded as an ideal clean and renewable energy source. Liquid hydrogen (LH2) is often used for storage due to its high energy density and suitability for various applications. However, in the event of an accidental LH2 release, the liquid rapidly and extensively evaporates into gaseous hydrogen, posing significant safety risks. To address these concerns, a study utilizing open-source computational fluid dynamics code, OpenFOAM, was undertaken. The objective was to analyze the behavior of LH2 during accidental releases and to propose strategies for mitigating associated hazards. The validity of the numerical model employed has been demonstrated in previous publications.

Bund walls are a commonly implemented safety measure around LH2 storage facilities to limit the spread of released hydrogen. This study systematically evaluates the protective performance of bund walls, using a prototype LH2 storage facility as the reference scenario. The analysis focuses on the influence of bund wall dimensions, including height and radius, as well as the impact of varying wind speeds on their effectiveness. The results indicate that at low wind speeds, bund walls significantly reduce the horizontal dispersion of gaseous hydrogen, mitigating potential risks. Increasing the height and radius of the bund wall further enhances safety; however, the improvements are relatively marginal. In contrast, wind speed exerts a dominant influence on the outcomes. When wind speeds exceed 7 m/s, the effectiveness of bund walls diminishes substantially. Additionally, after the cessation of LH2 release, larger bund walls impede the dilution of hydrogen, prolonging the presence of flammable concentrations.

These findings highlight the complex interplay between bund wall geometry and environmental factors, emphasizing the importance of considering site-specific conditions in designing safety measures for LH2 storage facilities.

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