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# C1Po3B-06: CFD simulation of cryogenic LH2 external releases: a multicomponent-multiphase approach

*Monday 19 May 2025 14:00 (2 hours)*

The present work presents the computational fluid dynamics (CFD) modeling of the complex phenomena occurring during a cryogenic liquid hydrogen release into quiescent air at standard ambient conditions. The RANS simulated case is a 2D axisymmetric domain presenting the pressurised LH2 reservoir and a large ambient domain. The thermodynamic properties are calculated using the NIST database for the required range of temperatures, pressures and compositions found during this release scenario. Air is modelled as a three-component mixture of nitrogen, oxygen, and argon at their standard compositions. Therefore, it allows the capture of their individual condensation as a result of their mixing with the cold hydrogen jet. Then, these are tabulated and implemented through user-defined functions within the ANSYS Fluent software. As the thermodynamic properties of both hydrogen, air, and their mixtures are pre-calculated, they are thus accessed in real-time, accurately predicting the phase changes associated to this scenario. As well, the NIST database modelling allows for the accurate prediction of all components at LH2 cryogenic temperatures, as low as 20K, for which traditionally used equations of state are known to be insufficient. To the best of the authors' knowledge, this work is the first implementation of such a multicomponent-multiphase approach for cryogenic hydrogen releases. This methodology can then allow an improved foundation of safety analysis for both abnormal or nominal venting scenarios in hydrogen infrastructure applications.

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