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NUMERICAL MODELLING OF AN AIR-HELIUM BUOYANT JET IN A TWO VENTED ENCLOSURE

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We present a DNS study of an air-helium buoyant jet rising in a two vented cavity. The geometrical configuration mimics the helium release in an experimental set-up [1] built at CEA Saclay in the framework of security assessment of hydrogen-based systems with an indoor usage. The dimension of the enclosure was chosen to ensure a laminar-turbulent transition occurring at about the middle height of the cavity.

This study aims at determining the relevant computational domain and boundary conditions necessary to accurately model the jet development in a vented cavity where the mass flow rates crossing the vents are not prescribed. We observe that applying constant pressure outlet boundary conditions directly at the vent interfaces underestimates the volumetric flow rate of air entering the enclosure and thus overestimates the helium mass inside the cavity. On the contrary, adding a surrounding volume into the computational domain better predicts the air flow-rate across the vents and leads to a better agreement with the experimental Particle Image Velocimetry measurements along the vents but also inside the cavity.

Once the numerical model being set, helium distribution inside the cavity is compared to the Linden theory [2]. Then the dominant terms of the Turbulent Kinetic Energy equation expressed in the Reynolds averaged formulation are investigated and in particular the buoyancy production term.

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