Application 2046

Characterisation of high pressure hydrogen release flammability profiles

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Understanding of the dispersion behavior of high-pressure hydrogen jets, which are released in close proximity to surfaces, is not fully established. However, since there are indications that the extent of the flammable region could be increased, a better understanding of this phenomenon is required to enable safety distances to be specified with greater certainty.

The main aims of the research are:

- To gain a better understanding of the dispersion behavior of an unignited high-pressure hydrogen jet released close to a surface
- To gain a better understanding of the influence of surfaces on ignited high-pressure hydrogen releases
- To generate experimental data with which to validate CFD modelling

Experimental Objectives:

The objective is to perform the following experiments in order to validate current models for determining the flammable extent of high pressure hydrogen releases:

- Unignited experiments of high pressure H2 jet releases close to the ground (TEST 1)
- Ignited experiments of high pressure H2 jet releases close to the ground (TEST 2)
- Unignited experiments of high pressure H2 jet releases close to a ceiling (TEST 3)
- Ignited experiments of high pressure H2 jet releases close to a ceiling (TEST 4)

For each test performed six configurations can be tested with two repeats of each configuration. The HiPress facility shall be used for this work with two 50l tanks providing the reservoir to enable delivery of the required hydrogen mass flow rate.

It is proposed that two different flow conditions are chosen to give similar distances to the LFL but through differing nozzle sizes and pressures. A flow rate of 7 – 8 g/s is anticipated to give a distance to LFL of 4 - 5 m for a free jet. The hydrogen reservoirs will decrease in pressure during the run, which will be about 20 seconds long, the final pressure being approximately 90% of the initial pressure.

For the unignited releases, it is proposed to measure hydrogen concentration at 5 points per run using thermal conductivity sensors with a working range of 0 to 100% v/v hydrogen. It is anticipated that runs will be repeated at the same release condition, with the hydrogen sensors moved between runs, to give up to 15 hydrogen concentration measurements per condition.

For the ignited releases, three radiometers (maximum range 110 kW/m2) will be used to measure radiant heat flux (positions to be determined) and an IR camera to visualise the ignited jet. A single ignition location will be used for each flow condition.

The effort required for this work will be 5 days per TEST (detailed above), 20 days in total in a 3 month period.