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Predictive modelling of small scale hydrogen explosion overpressures related to hydrogen releases from nuclear containment systems: A Collaborative Study with Sellafield Ltd

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I. Introduction
Nuclear waste generates hydrogen at a slow rate via various mechanisms and this hydrogen must be released in a safe manner. In some instances, the hydrogen is released in discrete "burps" rather than as a continuous release. Ignition from these releases has the potential to injure people nearby. The goal of this work is to improve the understanding of overpressure development when small releases of hydrogen ignite [1]. Developing and validating accurate predictive models is essential for ensuring safety in such scenarios.
II. Research Summary
To support the development and validation of these models, a series of small-scale explosion experiments will be conducted using the MK-II test rig. This experimental setup features a high-pressure spherical chamber equipped with four impellers, which enables control over both laminar and turbulent flow conditions. Hydrogen will be introduced into the chamber through a controlled source and ignited using an integrated ignition system. The vessel is designed to withstand internal pressures of up to 40 bar. A photo and Schematic of the MK-II test rig is shown in Fig. 1 below [2,4].

High-speed cameras will be used to visually capture the ignition and flame propagation processes. At the same time, pressure sensors located at various positions inside the chamber will record the pressure dynamics throughout each test. These measurements will provide detailed insight into the behaviour of hydrogen under different flow and ignition conditions [2-4].
The experimental data collected from the MK-II rig will play a critical role in validating computational models of hydrogen explosions. These models aim to accurately simulate flame propagation and pressure development within confined geometries. The findings will not only contribute to more reliable simulations but also offer deeper insight into hydrogen combustion phenomena relevant to nuclear safety.

Technical Track

Safety and Severe Accidents

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