

Knowledge gaps in the risk assessment of hydrogen and carbon dioxide pipelines

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There are several UK Net Zero projects at the planning stage that involve the construction or repurposing of transmission pipelines for the transport of hydrogen and/or carbon dioxide (CO₂). These include two hydrogen and Carbon Capture and Storage (CCS) cluster projects, HyNet North West and the East Coast Cluster, which aim to be operational by the mid to late 2020s.

The Health and Safety Executive (HSE) is the statutory authority in Great Britain responsible for providing public safety advice to planning authorities on the risks associated with proposed new developments (e.g., housing, schools, hospitals) near major hazards sites and major accident hazard pipelines. For natural gas pipelines, HSE and UK pipeline operators make use of well-established methods for assessing risks that are based on validated models and statistical data on failure rates stretching back several decades. Hydrogen and CO₂ transmission pipeline networks do not yet exist in the UK or Europe, and so there is a lack of this operational data from which failure rates can be derived. There are also significant differences in properties between natural gas, hydrogen and CO₂ that affect the risk calculations. For hydrogen pipelines, specific issues include:

How fracture mechanics models need to be adapted to take account of the effects of hydrogen on different grades of steel

- Assessment of the fire and explosion consequences
- Selection of suitable ignition probabilities for each part of the event tree

For CO₂ pipelines, issues include:

- Response of the pipeline material to external interference and its effect on failure rates
- Modelling release rates from dense-phase CO₂ pipelines
- Effect of terrain on the dispersion of CO₂ from pipeline releases

This paper discusses the progress made to date in addressing these issues together with areas that could benefit from knowledge sharing and/or collaboration across organisations.