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BLOWOUT FROM A HYDROGEN STORAGE CAVERN

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Abstract

To prevent catastrophic climate change, Europe and the world must rapidly shift to low carbon and renewable energies. Hydrogen as an energy vector, provides viable solutions to replace polluting and carbon-emitting fossil fuels. Gaseous hydrogen can be stored in underground storage and coupled with the existing natural gas pipe networks.

Storage in salt caverns was recognized to be the best suited technology to meet new energy system challenges. Hydrogen storage caverns are currently operated in the UK and in Texas. A preliminary risk analysis dedicated to underground hydrogen salt cavern highlights the importance of containment losses (leaks) but also of the formation of a gas cloud following a blowout whose ignition may generate dangerous phenomena such as jet fire, Unconfined Vapor Cloud Explosion (UVCE) or flashfire as well. A blowout is one of the major accidental scenarios likely to occur during the operation of a hydrogen underground storage in salt cavern. Blowout is an uncontrolled release of gas from well after pressure control systems have failed. Several examples of blowouts in gas storage caverns have been described in the literature, such as that in an ethane storage at Fort Saskatchewan, Canada (Alberta Energy and Utilities Board, 2002) or in a natural gas storage at Moss Bluff, Texas (Rittenhour and Heath, 2012), see Réveillère et al., 2017.

This paper presents the modeling of the subterraneous and aerial parts of a blowout from a hydrogen storage cavern. In the first part of this article, the method presented in Bérest et al. (2013) is used to predict the duration of the eruption and the evolution of key thermodynamics parameters such as hydrogen temperature, pressure, velocity and density. Then these results are used to compute dispersion in the atmosphere of the hydrogen jet outflowing from the wellhead and to evaluate the effects of potential resulting phenomena on surrounding assets.

Key words: Hydrogen, Blowout, Salt caverns, Computer modeling, Thermodynamics, Flash fire, UVCE, Jet fire.