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analyst view

Perceptions of Hydrogen Fuelling Safety

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A fuel cell bus refuels at the Emeryville hydrogen station (Source: AC Transit)

On 4th May 2012 a pressure release valve in a hydrogen storage tank mechanically failed at AC Transit's Linde-operated fuel cell bus refuelling station in Emeryville, California. Hydrogen leaking from the valve combusted with an audible bang and created a small fire that quickly burnt itself out. The incident harmed no-one but led to the precautionary evacuation of several surrounding businesses and a nearby secondary school by local authorities.

As is human nature, the evacuation resulted in some exaggerated tales of enormous fireballs rising into the sky; in reality early examinations of the currently closed station show no property damage but discoloured paint indicates there was a small explosion, as was explained to the audience at June's World Hydrogen Energy Conference by Linde hydrogen fuelling engineer Nitin Natesan. Extensive testing of the station's equipment is underway to determine the exact cause of the mechanical failure and the station will not reopen until such time as this is complete later in the year.

Unfortunately this incident does nothing to put the minds of anxious regulators to rest and a hydrogen station that has been in planning for the last three years at San Francisco SFO International Airport is now at risk of abandonment after airport officials, fuelled by fears of hydrogen explosions at the destroyed Fukushima nuclear plant and concerned by the Emeryville incident, demanded that planned operator Linde provide full indemnity for the station.

There are, of course, inherent risks in handling any flammable gas or liquid, but it is important to note that in the Emeryville incident the station's automatic safety procedures initiated as soon as the leak occurred, including the shut-off of hydrogen lines, ensuring the short duration and minimal

impact of the event. All current hydrogen stations are built to the exacting requirements of the International Standard ISO/TS 20100:2008 *Gaseous hydrogen – Fuelling* stations and/or the 2010 Society of Automotive Engineers (SAE International) standard SAE J2601 *Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles*. Between them they specify the characteristics of outdoor fuelling stations, safety distances, dispenser performance and many other detailed requirements.

Hydrogen is lighter than air and although explosive, quickly escapes upwards when released, meaning that fires typically begin with an explosion but quickly run out of fuel. This is unlike petrol or diesel, which are flammable liquids that result in longer-lasting and typically more dangerous fires when leaked. The US Department of Energy (DoE), via the Pacific Northwest National Laboratory, has long maintained a user-populated database of hydrogen incidents, H2Incidents.org. The database contains a total of twenty fuelling station problems recorded between 2007 and 2010, of which only eight are classified as incidents; of these eight incidents, three were the result of human errors, two involved no hydrogen release, only one resulted in ignition, and none resulted in major injuries or fatalities. By the end of 2010 there were 212 hydrogen refuelling stations in the world, according to the TÜV SÜD-operated database H2Stations.org, approximately 80 of which were in the USA, including a station at Los Angeles LAX International Airport that has been safely operating since 2004.

Across 80 stations only one ignition was recorded. Although this assessment cannot be fully comprehensive, to put it into some context the US NFPA (National Fire Protection Association) reports that between 2004 and 2008, on average, one in every thirteen conventional service stations experienced a fire. These fires caused an annual average of two civilian deaths, 48 civilian injuries and $20 million in property damage. 61% of these fires were vehicle fires, most commonly started by gasoline ignition. A 2001 study undertaken by Dr Michael Swain of the University of Miami used two test vehicles to simulate two car fires, one created by a 1/16th inch puncture in a gasoline fuel line, the other by a leaking hydrogen connector. Images taken from his video recording of the experiment at 0 seconds, 3 seconds and 1 minute demonstrate the quick and contained upwards ignition release of hydrogen and the ignition of the gasoline tank engulfing the entire vehicle in flames.

There are many who still consider hydrogen to be unsafe, validated in this belief by escalated fears of isolated incidents. However, when taking a step back it is clear to see that hydrogen transportation can present a safe alternative to the incumbent infrastructure. Dispensing hydrogen through filling stations for vehicular use may be a relatively new field, but it is important to remember that the fuel has been produced, transported and stored safely in industrial applications for decades. When consumers can themselves see and experience the technology and its safe operation, negative perceptions will fade as, ultimately, a consumer cares far more for the benefits of a product than what powers it.

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