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Hydrogen Fuel Safety:

ReliOn Inc. is a leading manufacturer of Proton Exchange Membrane (PEM) fuel cell systems and is committed to providing our customers the safest, most cost effective, versatile solutions available. Compressed, bottled hydrogen is the most readily available commercial source of Industrial Grade Hydrogen. Compressed hydrogen can be found throughout the world and at over 1500 locations in the U.S. alone. Compressed hydrogen is a versatile fuel having a wide operating temperature range.

ReliOn is currently deploying systems to the field that incorporate a hydrogen storage and delivery system. This system is provisioned for use with compressed hydrogen gas cylinders. When designing systems which store, distribute and utilize hydrogen gas it is imperative to address the characteristics of hydrogen to ensure a safe operating environment.

Hydrogen is the lightest gas known with a flammable range from 4% - 74% by concentration. It is useful to compare this to a known quantity. By way of comparison, propane has a flammable range from 2.4% - 9.6%. Propane's flammability concentration is nearly 2 times lower than that of hydrogen. While hydrogen has a wider flammability range, it can be argued that the more important metric is the lower flammability limit.

The hydrogen storage cabinet utilized in the ReliOn Outdoor Enclosure is a passively ventilated cabinet open to outside air. The electrical equipment installed in this cabinet is rated for use in a hydrogen environment. While a leak is not likely to occur, the system is designed to ensure a safe operation if one were to occur.

Hydrogen is 0.0695 the density of air, or 14 times less than the density of air. The ReliOn enclosure is designed to ensure that in the event of a hydrogen leak, the hydrogen gas is vented to atmosphere and allowed to disperse. Hydrogen's dispersion characteristics will ensure as distance from the leak source increases, the density of hydrogen will quickly drop below the flammable limit. By comparison, Propane is denser than air at 1.5 times the density of air and will tend to "pool" or settle. Propane may not disperse without the use of forced ventilation.

Hydrogen is colorless, odorless, tasteless and non-toxic. Therefore, it is necessary to utilize gas detection equipment when using or handling hydrogen gas. The ReliOn Outdoor Enclosure utilizes a hydrogen safety sensor in each T-1000™ fuel cell or I-1000™ fuel cell (2ea. H2 sensors in T-2000™ fuel cell) installed in the equipment cabinet of the enclosure system. This sensor activates and shuts the systems down at 7500 ppm or less than 1/5th the Lower Flammable Limit of 40,000 ppm. When replacing gas cylinders in the fuel wing, ReliOn recommends the use of a hand-held combustible gas detector to verify that there is no leakage. Hydrogen gas detectors are commercially available and affordable.

Approximately 0.017millijoules of energy is required to ignite a combustible mixture of hydrogen compared to 0.25 millijoules for other hydrocarbon fuels. While this lower ignition energy may pose an increased risk of ignition, the amount of energy present in a typical static charge is adequate to ignite both hydrogen and a hydrocarbon fuel. ReliOn recommends the use of non-sparking components when working with compressed hydrogen cylinders and hydrogen connections. The ReliOn Outdoor Enclosure utilizes stainless steel and/or brass connection fittings. Additionally, ReliOn recommends the use of non-sparking cylinder wrenches for connecting the gas cylinder fittings.

The ReliOn solution is a certified, tested, safe solution. ReliOn fuel cells adhere to applicable testing codes and standards. ReliOn fuel cells are UL approved and the Canadian Standards Association of America has safety certified these units to CSA FC1 – the industry safety standard for fuel cell systems. ReliOn fuel cells have attained CE mark indicating compliance to applicable European safety standards. The ReliOn solution (fuel cell and hydrogen delivery system) has completed the telecommunications industry's Network Equipment Building Standards (NEBS) testing to Level III compliance. The testing included extreme operating environmental conditions ranging from -40 degrees C to + 46 degrees C, gunfire withstand capability, brush fire testing and seismic zone IV earthquake testing.