



Nuvera's fast-fueled power option to replace lead-acid batteries features an interlock circuit to stop the flow of hydrogen to the system if excess hydrogen is present. The system is built to use measures of **separation, containment, ventilation** and **process specific equipment** to support safe operation of Nuvera® fuel cell systems.

Nuvera® fuel cell system design is premised upon applicable codes and standards for fuel cell power systems installed in industrial electric trucks. Design considerations include codes and standards from organizations such as the International Electrochemical Commission (IEC), the National Fire Protection Association (NFPA), Underwriters Laboratories (UL), the Canadian Standards Organization (CSA), and the International Organization for Standardization (ISO).

Nuvera Experience

Nuvera participates on technical committees to share its hydrogen expertise in the development of hydrogen-related codes and standards.

[See details of Nuvera® fuel cell system product safety measures, next page.](#)



SEPARATION: Within the Nuvera® fuel cell system, the high-pressure fuel tank compartment for fuel storage is separate from the low-pressure fuel cell compartment in which hydrogen is delivered to the fuel cell stack. This separation keeps high pressure hydrogen in the fuel tank compartment and away from the unclassified electrical equipment (potential ignition sources) in the low-pressure compartment. In the event of a leak of low pressure hydrogen in the fuel cell compartment, the gas is diluted to a concentration below the limits of flammability (see Ventilation and Safety Circuit).

CONTAINMENT: Components in the Nuvera® fuel cell system are designed to contain hydrogen inside piping and vessels and away from air and potential ignition sources. The hydrogen fuel tanks are designed to industry standards, and hydrogen containing components are selected for resistance to hydrogen embrittlement and other potential failure modes pursuant to codes and standards relevant for hydrogen containing parts.

VENTILATION: The Nuvera® fuel cell system enclosure is ventilated to prevent hydrogen accumulation in accordance with the UL standard. Natural ventilation is provided by vents within the enclosure. Forced ventilation is provided by a fan. The fuel cell system is designed to maintain minimum required airflow to dilute a potential hydrogen leak. A differential pressure switch will shut down the system if the airflow decreases below the minimum level required to dilute leaked hydrogen to 25% of its lower flammability limit.

HYDROGEN PROCESS SPECIFIC EQUIPMENT: The Nuvera® fuel cell system is designed using process specific CID2 electrical equipment in the high-pressure fuel supply compartment. Valves, regulators, fittings, and other components used in the hydrogen system are specifically selected for use with hydrogen pursuant to relevant codes and standards.

INTERLOCK CIRCUIT: Hydrogen containment by this circuit is a preventative measure against an accumulating hydrogen leak or over-pressurization. The interlock circuit provides containment of high-pressure hydrogen by automatically closing valves and shutting down the system in the unlikely event of:

- A loss of ventilation
- Over-pressurization of the cell stack
- Manual activation of the emergency stop