CNG & LNG Safety: Perception & Reality

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One of the strong selling points of natural gas vehicles (NGVs) is safety; of the vehicles and the fuel. Since the advent of the Type 2, aluminum, fiberglass-hoop-wrapped CNG cylinder (1983) NGV advocates have been showing video and still pictures of the CNG Cylinder Corporation 'Severe Abuse Test' demonstrating that gun shots, bonfires, dynamite strapped to the cylinder and cars with CNG cylinders dropped from heights up to 90 feet (~30 meters) can't necessarily cause a fatal CNG failure. Methane doesn't pool on the ground like liquid fuels, has a narrow flammability range (5-15% gas to air ratio) and is as-safe-or-safer than any of the other vehicle fuels currently in the market. As NGV champion Boone Pickens once said, "I'd rather have natural gas pipes in my car than have gasoline pipes running through my house."

That is the reality. But the (mis)perception of natural gas compressed to 3000 psi (200 bar) on a vehicle has been that an NGV has the potential to explode like a bomb or that if a cylinder ruptures or leaks it will result in a catastrophic fire and/or explosion. Cryogenic, odorless liquefied natural gas (LNG) trucks, ships and fuelling operations face different but overlapping safety misperceptions.

The NGV industry faces three separate but related challenges to ensuring safety:
- Dealing responsibly and professionally to improve technology and safety through legitimate standards and regulatory channels that are supported by effective industry and government oversight;
- Trying to ensure that, on a global basis, NGV suppliers and stakeholders are accountable if NGV safety is jeopardized due to inferior materials, poorly made equipment, or lax enforcement of the standards and regulations.
- Develop authoritative scientific studies, risk analyses, and consumer information to dispel consumer and regulators' concerns about NGV safety.

Applying lessons learned

Despite having one of the best safety records in the transportation sector, the steady growth of NGVs has resulted in a constant learning process through accidents, incidents and understanding 'best practices.' Increasingly rigorous testing and certification requirements have resulted. While there are a handful of NGV champions worldwide who track and, to the best extent possible evaluate NGV incidents there is no centrally-based, coordinated, institutionalized mechanism to create a 'safety database' for NGVs, fuel storage systems or fuelling stations.

Standards and regulations: Enforcement is the key!

NGV champions nationally and internationally are fully engaged with private standards organizations and government regulatory institutions to create reasonable requirements that provide models for safe and reliable NGV equipment and best practices. Many governments and industry institutions go to great lengths to certify and inspect equipment in conformance with national and/or international standards and regulations. But what about countries where enforcement is lax or non-existent due to lack of knowledge, staff resources, corruption or other factors? Unfortunately, there are some industry stakeholders in various global markets who prioritize and embrace 'low cost' over safety and reliability. The resulting lower quality of the NGV systems resulting from weak enforcement of good regulations is a potential threat to otherwise solid NGV industry support for safety.

Overcoming the Unsafe Image

Each time the NGV market expands in a new direction the issue of 'safety' comes up. A combination of steady advocacy and education efforts plus good science is required to overcome safety skeptics among regulators, local code officials and even customers.

For example, two 'show-stoppers' in the developing U.S. NGV market in the early 1990s were the prohibition of NGVs in underground parking garages and in tunnels. Gas industry-funded, sophisticated hazard assessments helped remove those restrictions by demonstrating to regulators that, in parking garages

"CNG-fuelled vehicles do not pose any greater hazard than conventional fueled vehicles"[1] and in tunnels that, "CNG fueled vans can be expected to produce smaller flammable regions than gasoline fueled vans given a fuel line rupture incident."[2]
More recently U.S. NGV advocates performed a hazardous operations study (HAZOP) related to LNG and CNG vehicles in maintenance facilities concluding that, in low release scenarios for CNG or LNG boil-off, "There was no significant hazard expected."[3]

Cryogenic (liquefied) natural gas in the form of LNG brings a new dimension to NGV markets and technologies for trucks, marine vessels and railway trains. Regulatory challenges, restrictions and prohibitions to LNG-fuelled trucks, ships and refueling must be dealt with; also to overcome perceptions that LNG is much more dangerous than diesel.

But these studies come at a cost and finding the financial resources remains a challenge.

Understanding perceptions from reality

The Clean Fuels Consulting workshop '*CNG & LNG Safety: Perception & Reality*' will address safety issues for road, marine and rail markets on 8-9 October 2014 in Brussels. This sixth in the series of *Critical Issues Workshops* since 2008 is designed to gather expert speakers to address a knowledgeable audience of NGV stakeholders including equipment manufacturers and suppliers, government policy makers, regulators and others who are interested or involved in safety aspects of compressed natural gas (CNG) and liquefied natural gas (LNG) vehicles and fuelling stations for road, marine and railway transport.

The goal is to leave the workshop with a firm idea of the key safety issues facing the CNG and LNG vehicle industry. This includes understanding the current standards and regulatory state-of-play related to CNG and LNG fuel storage systems, vehicle technologies, and fuelling options. The workshop will identify existing gaps and the immediate pathway to fill the gaps to help facilitate further market development and commercialization of natural gas vehicles as *safe*, clean alternatives to petrol and diesel. For more information please visit: www.CNGandLNGSafety.org

1 *Hazard Assessment of Natural Gas Vehicles in Public Parking Garages*, EBASCO Services Inc., 1991. *D*

2 *Dispersion of CNG Fuel Releases in Naturally Ventilated Tunnels*, Center for Fire Safety Studies, Worcester Polytechnic Institute, November 1994.

3 *Analyses in Support of Risk-Informed Natural Gas Vehicle Maintenance Facility Codes and Standards: Phase I*, SANDIA REPORT, SAND2014-2342, Unlimited Release, March 2014, available through the Clean Vehicle Education Foundation.

http://www.cleanvehicle.org/technology/CVEF SANDIAFinalReportPhase1.pdf