Using Space and Time to Help Optimize LNG Refueling

by Chris Herman

REGO ACME CRYOGENICS

Balancing Efficiency and Reliability in LNG Transport and Dispensing

As the use and popularity of liquefied natural gas, or LNG, as a motor fuel continues to expand in the United States and globally, the key to optimizing its safe, efficient and reliable transport and dispensing at the fueling island is oftentimes a matter of finding the proper balance between space and time.

Specifically, space as it applies to the amount of physical interaction the fuel-site operator has with the equipment used to perform the fueling process, and time as it relates to the actual amount of service time the dispenser and its components are able to deliver before it requires planned maintenance, repair of replacement.

Ensuring that this space-time balance is met requires the identification and implementation of LNG-refueling components that have the capability to optimize the space and time parameters that are vital in a successful LNG-refueling operation. This white paper will identify the challenges in creating an optimized LNG-refueling system and the possible equipment solutions that can ease and overcome those challenges.

"Energy is the golden thread that ties together economic growth, increased social equity, and an environment that allows the world to thrive."-Barak Obama

The Challenge

There has always been a niche market for LNG use as a motor fuel, but it started to inch closer to the mainstream around 15 years ago. It was at that time that there began to be a more concentrated effort to, if possible, lessen dependence on traditional motor fuels like gasoline and diesel. This effort was driven by increased focus – from an altruistic viewpoint – on the environmental harm that gasoline and diesel exhaust may be doing to the atmosphere, while – from a more pragmatic point of view – high crude oil and motor-fuel prices were prompting an increased emphasis on identifying and developing possible alternative-fuel solutions that were more cost-effective to produce.

The majority of LNG consumption at that time in the U.S. was concentrated on the West Coast. Globally, some European countries and China have traditionally been bigger users of LNG as a motor fuel than the U.S., but India is now home to the world's fastest-growing LNG market.

LNG's physical characteristics and its need for a specialized transportation and distribution infrastructure have been two of the main reasons that its growth has been relatively incremental. By definition, LNG is a natural gas that has been cooled to -260ºF (-162ºC), at which point it assumes a liquid state. This is an attractive process, because in its liquid state the volume of LNG is 600 times smaller than its volume when it is in a gaseous state. Therefore, turning natural gas into LNG makes it possible to transport it to places that aren't served by pipeline, which helps increase its useability as a transportation fuel.

As a petroleum-based fuel, natural gas is inherently hazardous and must be handled with the utmost care. Because it must be cooled to such a low temperature in order to reach its liquefied state, LNG is also classified as a cryogenic liquid, which brings with it a whole new series of transport and handling challenges.

Chief among them is ensuring that all safety measures are observed during LNG's dispensing. In order to do this, there must be as little human interaction with the refueling process as possible – this is the "space" component in the LNG refueling process. Basically, since LNG is a cryogenic liquid, unlike gasoline or diesel, most people don't know how to properly interact with it at the fueling island. This requires the development and use of refueling systems and equipment that can feasibly remove most human interaction from the process.

This leads to the "time" element as it relates to the LNG-fueling process. Since people were unfamiliar with the fueling technology, the equipment was always in danger of being misused or abused, which could lead to breakdowns and unplanned service disruptions that would compromise the reliability and profitability of the LNG-fueling business. This required the creation of fueling components that would be able to greatly limit the instances of unplanned downtime. This would also make it easier to schedule planned maintenance intervals and remediate any unplanned breakdowns via quicker maintenance routines.

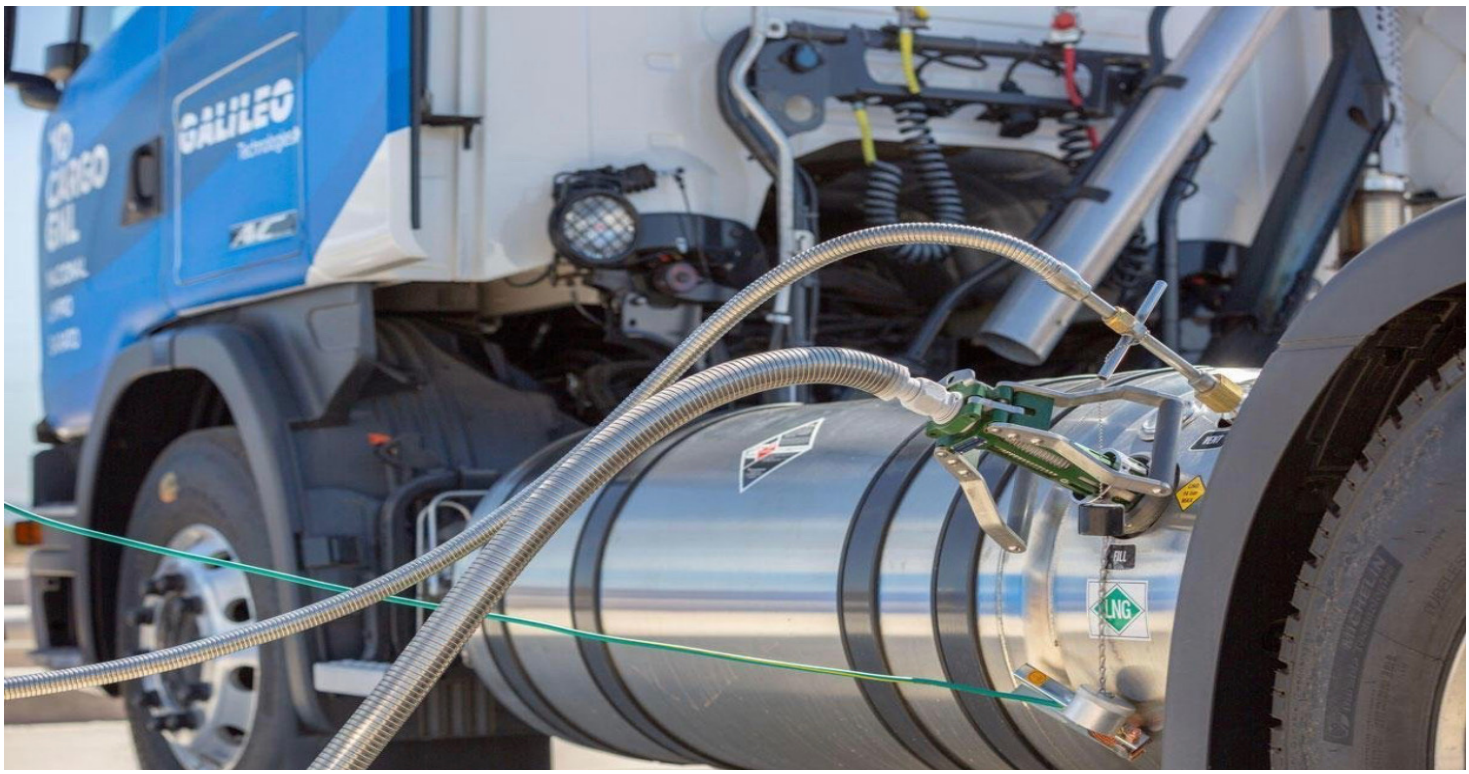
The Solution

The roster of LNG-dedicated OPW CES and RegO Products systems and equipment includes:

CryoMac® Series LNG Refueling Nozzles: The fourth generation of this nozzle, the CryoMac® 4, has recently been released and its enhancements make it the safest fully automatic LNG-fueling nozzle on the market. The CryoMac nozzles isolate the flow path from the operator during the fueling process while a “safety stop” button on the handle prevents the operator from removing the nozzle from the vehicle before any remaining LNG in the nozzle is vented off. This eliminates the “flash and pop” blowback of residual LNG that can occur when the nozzle is disconnected, making it a major fail-safe advantage for the operator. Additionally, since OPW CES is dedicated to continuous improvement in all aspects of its product portfolio, look forward to increased functionality and safety when the CryoMac 5 is released later this year.

Other features and benefits of the CryoMac nozzles include:

- A ball-cage interface with a receptacle adapter ring that guides and locks the nozzle in place for optimum engagement and increased environmental seal life
- A ball-bearing design that helps properly align and engage the nozzle onto the receptacle, thereby reducing the probability of leakage
    - A design featuring non-metallic bearings, air gaps and insulation that prevent freezing onto the receptacle
    - Easy access to the receptacle end seal, poppet assembly and seat for easy maintenance
    - Maximum working pressure of 500 psig (34.5 barg)
    - Burst pressure greater than 1,500 psig (103.5 barg)
    - Flow rate of 50 gpm (189 L/min) at 250 psig (17.2 barg)
    - Operating temperature range from -320ºF to 140ºF (-195ºC-60ºC)
    - ATEX and CE certification, along with compatibility with the ISO 12617-2016 standard



Additionally, OPW CES has entered the final development stage of a new LNG-fueling nozzle. The capabilities of the RegOMac® will continue to build on those of the CryoMac Series with the goal to offer the industry a next-generation completely automatic solution for LNG fueling.

- VFL Series Vent/Fill Breakaways: ISO requested that RegO be the subject matter experts for the development of LNG-fueling breakaways, which led to the creation of the VFL Series. As with any traditional gasoline or diesel fueling station, driveaways will occasionally occur at an LNG-fueling site. To mitigate the effects of these potentially catastrophic incidents, use of the VFL breakaways will help protect the LNG dispenser and its components, which will also help eliminate unwanted product releases. The VFL breakaway is able to lessen the hazardous effects of a driveaway incident through the placement of a small vent on the truck side of the breakaway so if the driver were to drive off with the hose still attached to the vehicle the LNG will be vented off and the hose won't rupture.

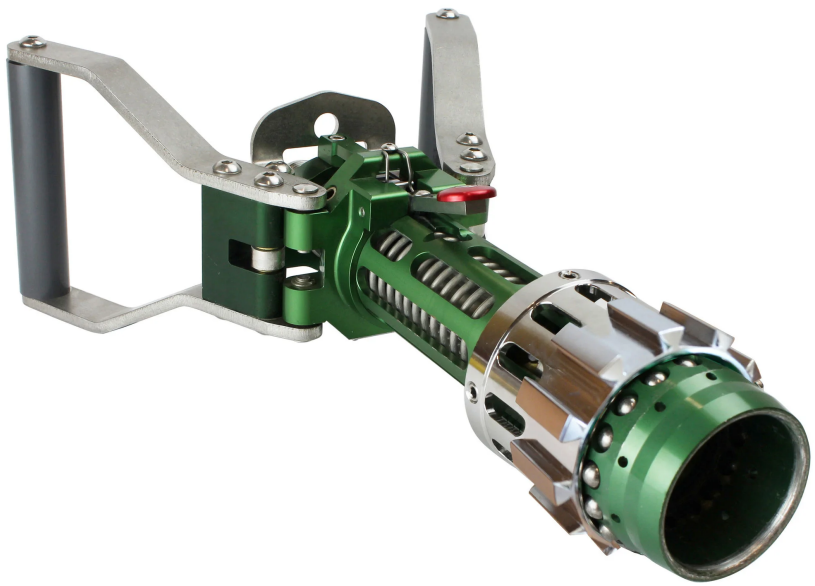
Operational features of the VFL Series breakaways include:

- Maximum internal pressure while fueling of 300 psig (20.7 barg)
- Maximum static system pressure of 550 psig (38 barg)
- Fill breakaway flow capacity of 50 gpm (189 L/min)
- Vent breakaway flow capacity of 10 gpm (39 L/min)
- Operating temperature range from -340ºF to 140ºF (-206ºC-60ºC)

FQD10 Series Female Vent Couplers: The QD10 Series is the world's most popular female vent coupler for use on LNG dispensers with more than 100,000 units in service worldwide.

Operational features of the FQD10 Series vent couplers include:

- Easy connection to a male LNG vent/fill coupler with the ability to handle both LNG vent gas and LNG liquid
- Maximum internal pressure while fueling of 300 psig (20.7 barg)
- Maximum static system pressure of 550 psig (38 barg)
- Operating temperature range from -350ºF to 150ºF (-212ºC-65ºC)



If, as the old saying goes, “space is the final frontier,” then it will only be conquered if the equipment and systems that are needed to facilitate the exploration of space by human beings satisfy all of the application-specific characteristics that help ensure safe, reliable and efficient operation.

When it comes to handling cryogenic liquids, numerous different types of components, all with precise duties to reliably perform, must function together harmoniously in order to not only ensure the success of the mission, but – more importantly – to guarantee that it is completed in the safest manner possible with little threat to humans or the greater environment.

About The Author:
Chris Herman is the Senior Product Planning & Business Development Manager for OPW Clean Energy Solutions and RegO® Products and can be reached at chris.herman@regoproducts.com or (336) 446-7225.

OPW Clean Energy Solutions was formed in December 2021 when OPW acquired both ACME Cryogenics and RegO Products, with the portfolio expanded to five companies in July 2024 with the acquisition of Demaco, Marshall Excelsior Company (MEC) and SPS Cryogenics. ACME is a leading provider of mission-critical cryogenics products and services that facilitate the production, storage and distribution of cryogenics liquids and gases. RegO is a leading provider of highly engineered flow-control solutions for cryogenic and liquified gas end markets. Demaco is a dedicated designer, developer, builder, tester and installer of vacuum-insulated solutions for use in the cryogenics industry. MEC is a leading developer of severe-service flow-control solutions for use in the handling of compressed and liquefied gases. SPS Cryogenics is a developer of pipeline systems and ancillary equipment for use in cryogenic applications. Together, they are taking OPW beyond conventional fueling solutions and helping define what’s next for alternative energy markets.

For more information on OPW Clean Energy Solutions, please visit opwces.com.