Alternative Methods of Delivering Renewable Natural Gas to the Natural Gas Vehicle Market

Discussion Paper

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1. Summary

SAFE NORTH AMERICA, is pleased to provide the following document highlighting alternative methods of delivering Renewable Natural Gas (RNG) to the Natural Gas Vehicle (NGV) market by utilizing virtual pipeline in conjunction with CNG Daughter Stations and Mobile Refueling systems. One of the difficulties in bringing RNG to the NGV market, is the connection to the natural gas pipeline whereas the distance from the RNG source is too great or the connection cost is too high in relationship to the volume injected into the system. Through the use of proven technologies and equipment, the need of connecting to the pipeline can be eliminated while still ensuring the RNG is delivered to NGVs in a reliable and financially competitive method. This document does not attempt to evaluate the complete system and all of its related components, but focuses on how to deploy RNG into the transportation sector by utilizing different methods of moving the RNG from the source to the NGV marketplace.

2. Company Background

SAFE NORTH AMERICA is an extension of SAFE SpA (SAFE), an Italian company located near Bologna in the industrial heart of Italy. SAFE has been manufacturing CNG compression and other ancillary equipment, as well as compression packages for the oil and gas industry, for more than 40 years. Founded in 1975, SAFE has become a global market leader and has delivered over 4,000 compressors worldwide.

SAFE is part of the Landi Renzo group of companies. For over 60 years, Landi Renzo has been providing effective solutions to the challenges of environmental sustainability through the development of systems for the automotive sector based on alternative fuels which are more economical and better for the environment.

SAFE has one of the widest compressor model portfolios available from a single manufacturer, including units from 50 horse power (HP) to over 6,000 HP. The CNG compressor model portfolio (proprietary design and production) includes radial, V and W-shaped, horizontal balanced-opposed, hydraulic piston reciprocating compressors and mobile compression systems.

The following systems are of particular interest to the topic and will be discussed in greater detail in a following section.

- Low inlet pressure, high-capacity compressors
- Hydraulic compressors for daughter stations and high peak demand situations
- High-capacity compressors especially suitable for mother stations
- Gas powered, fully mobile fueling systems, including metered dispensers and storage

For the North American market, SAFE has partnered with Broadwind Energy as the exclusive North American packager for SAFE. With decades of experience manufacturing turn-key solutions, Broadwind is recognized for delivering high quality advanced equipment packaging, large structural fabrication and pressure boundary welding. Broadwind is an ISO 9001-2008 and ASME certified manufacturer with a national service network to support in-field service needs.
3. Typical Direct Pipeline Injection System

As depicted in Figure 1. of the Ontario Ministry of Agriculture, Food and Rural Affairs discussion paper, dated May 2017, the typical RNG system is directly connected to the natural gas pipeline, injecting the RNG into the existing natural gas grid. This method is convenient and most economical when the digester is located near a natural gas transmission line and the volume generated by the digester can justify the associated pipeline connection cost. To allow injection into the pipeline, the system requires a compressor capable of raising the pressure above the pipeline pressure. As portrayed in Figure 2., a compressor is necessary to raise the RNG pressure above that of the pipeline pressure. Conversely, when a pipeline is too distant from the digester or the RNG volume is relatively low, it can become cost prohibitive to implement a direct pipeline injection system.

Figure 1. Ontario Ministry of Agriculture, Food and Rural Affairs discussion paper.

Figure 2. Example of typical pipeline injection system depicting necessary compressor.
4. Virtual Pipeline System

In situations where the pipeline is too distant from the digester, a virtual pipeline system can be implemented. As portrayed in Figure 3., RNG from the biogas upgrading system can be compressed into gas transportation modules and transported to the CNG station. The CNG station (sometimes referred to as a daughter station) is composed of a hydraulic booster compressor and metered dispensers for Fast-Fill, or fill posts for Time-Fill, allowing the transfer of the RNG from the transportation module into the vehicles. Since the RNG has been compressed into the transportation module, the compressor size at the CNG station can be relatively small (50 to 100HP) when compared to traditional higher capacity CNG stations (200+HP). As mentioned above, the CNG station can be either Fast-Fill or Time-Fill.

Figure 3. Example of virtual pipeline system.
5. Mobile Fueling System

A viable option for lower capacity digesters systems, where it doesn’t make economic sense to connect to the gas grid or use a virtual pipeline, is a totally self-contained CNG Mobile Refueling Unit (MRU). This CNG system is composed of a storage module, a variable inlet pressure compressor and two metered fueling panels, all mounted on a trailer. This arrangement eliminates the need for a stationary station and can refuel many small fleets in different locations. Because of the onboard storage, the system is Fast-Fill only. Figure 4. demonstrates a typical RNG Mobile Fueling System.

Figure 4. Example of mobile refueling system.
6. Remote Pipeline Injection System

In the event of high capacity digesters where the distance from the pipeline is too great for a direct connection but within a reasonable driving distance, a remote pipeline injection system is possible by merging the virtual pipeline system with a traditional transmission line injection system. Accordingly, the RNG is compressed into gas transportation modules and transported to the injection point. Depending on pipeline pressure, a compressor including a Pressure Reduction System (PRS) might be required to allow the empting of the gas transportation module. If the pipeline pressure is below approximately 300 psig, a compressor is not necessary. Of course once the gas enters into the grid, it can be virtually deployed into any CNG station connected to the same gas grid. Figure 5. demonstrates this type of system.

![Diagram of remote pipeline injection system]

Figure 5. Example of remote pipeline injection system.

7. Conclusion

Since every system is different and there are many variable inputs, this document does not an attempt to evaluate the overall cost and economic feasibility of the discussed systems. The intent is to highlight the different possible systems of bringing RNG to the NGV marketplace, especially in situations where the traditional direct grid injection method is not feasible. These “nontraditional” methods have been used and proven in other parts of the world with success. However, an evaluation of each method is necessary to ensure it will offer the required benefits and reliability.