LNG Storage Tank Pressure-Cost Considerations for Virtual Pipelines

In the design of small to mid-scale natural gas liquefaction facilities, the decision of storage tank operating pressure can have considerable economic impacts on overall operating costs. Therefore, when deciding on tank design and operating pressure, it is important to look beyond the plant site. For virtual pipelines (where LNG is delivered to a location and gasified for end use) these considerations are different than, for example, situations where alternate engine fuel as LNG is the end use.

Next to natural gas, the second most expensive component of LNG is the energy consumption required to liquefy the natural gas. Among other factors, small changes in liquefaction storage pressure can significantly impact liquefier energy consumption. The higher the storage tank pressure, the lower the power consumption and the higher the product temperature. The opposite is true for lower storage tank pressures.

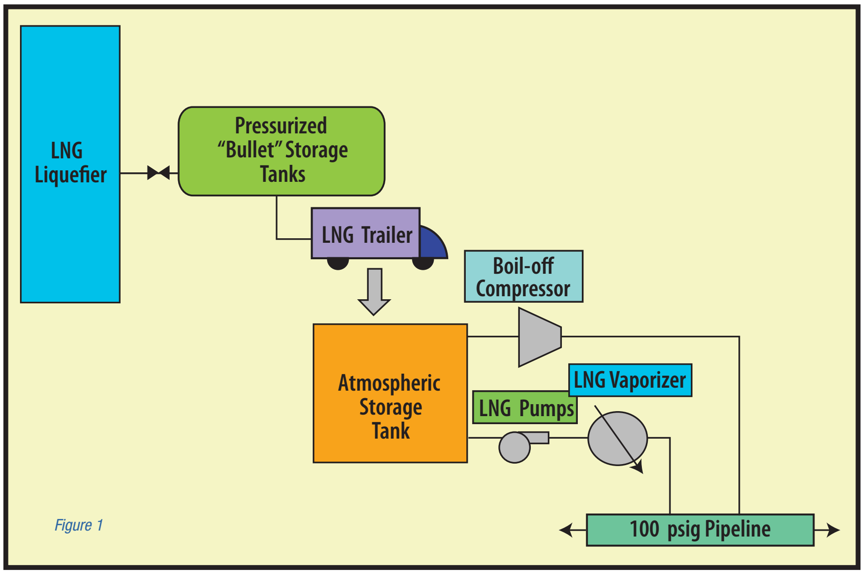

Figure 1

When transporting LNG by trailer, the assumption is typically made that colder, lower pressure LNG product put into the plant storage tank results in the lowest overall operating cost due to the reduction of flash losses. In some cases, this proves to be true. However, for a virtual pipeline, this may not be the case and therefore, an analysis of the entire supply system, from the liquefaction plant to the pipeline should be completed to ensure the system with the lowest operating cost is designed.

Take for example, the following case study. A client has pre-fabricated, high pressure storage available at the LNG production site. The plant fills these tanks with saturated LNG and the LNG is then loaded onto trailers. The trailers transport the LNG over the road to a gasification station hundreds of miles away. It is assumed that the trailer's allowable working pressure up to 20 psig will prevent any boil-off while on the road. At the gasification site, the LNG is unloaded into a large atmospheric storage tank then pumped through a vaporizer into a pipeline at 100 psig. In addition, for flash gas generated during trailer offloading into the tank and tank heat leak, there is a boil-off gas compressor to compress the flash gases into the pipeline. See Figure 1.

For this case study, the client has a choice of storing the LNG at 20 psig (warmer LNG) or at atmospheric pressure (colder LNG) or anywhere in between. The lowest cost solution will involve a comparison of the overall power consumption difference of the liquefaction power and flash gas compression between both cases. See table below for the results of this comparison for a 300,000 GPD LNG system.

In summary, you will note that producing saturated LNG at atmospheric pressure instead of 20 psig results in 774 kW more power consumption even when considering the power required to compress the flash gases at the gasification station. It is important to note that this situation was unique to this client because bullet tanks were installed at the plant site (versus an atmospheric flat bottom tank) which allowed operation at higher than atmospheric pressures. LNG was re-vaporized to a pipeline which made it easy to recover the flash losses into the pipeline (a different evaluation would occur if the LNG were being sent to a filling station to fill LNG engines where flash losses would add a different, more substantial operating cost) and finally, the trailers can operate at higher than atmospheric pressure.

Regardless of the outcome of the analysis, a nitrogen expansion cycle liquefier allows a client to dial in any product temperature and storage pressure required to achieve the goals of the project.

For further information, please visit www.cosmodyne.com.

	CASE 1	CASE 2
LNG Production	300,000 gpd	300,000 gpd
LNG Product Storage pressure	20psig	atm
LNG Product Temperature	121K	109K
Liquefaction Power Consumption	Base	+945 kW
% of Product Flash at Gasification Station	7.5%	0%
Boil of Gas Compressor Power for Flash	171kW	0 kW
Net Power Consumption	Base	+774kW