

A New Approach for LNG Custody Transfer Measurement

By Allen Avery

Keywords

Ultrasonic Flowmeter, Liquefied Natural Gas, LNG, Custody Transfer, Tank Gauging, Standards

Summary

Custody transfer of LNG poses significant challenges. Traditional measurement methods work, but often with concerns about overall accuracy. Ultrasonic flowmeters can help clear up any doubts and maintain the integrity of revenue streams.

Emerson's Daniel Measurement and Control, a global provider of fiscal flow and measurement products, systems, and services to the oil & gas industry, recently briefed ARC Advisory Group on the company's latest solution for custody transfer measurement of liquefied natural gas (LNG). This technology helps solve many of the challenges associated with custody transfer measurement of LNG.

Key findings from this briefing include:

- LNG is a large and growing market, as it is becoming increasingly important as a fuel source, especially in some Asian countries.
- Measurement accuracy is tied directly to financial exposure and risk in LNG custody transfer transactions.
- Daniel's Model 3818 LNG Ultrasonic Flow Meter incorporates several unique features to enable highly accurate, dynamic flow measurement under cryogenic conditions. According to the company, this helps overcome many of the challenges of LNG custody transfer by supplementing traditional static measurement techniques.

LNG Market Outlook

Industry experts predict that the global LNG industry will experience significant growth in the coming years. Increasing demand in Asia is driving export markets in Australasia and the Middle East, and, as ARC Advisory



Group discussed in a [recent report](#) for clients (“Unexpected Reversal in the LNG Supply Chain Offers Opportunities for Automation Suppliers”), based on the boom in shale gas production, North America is positioned to become a net exporter of LNG. This is something that would have been unimaginable just several years ago. As a result, ARC expects capital expenditures in LNG to also see a significant increase, following a decline from 2009 to 2011.

Background to LNG Trade

LNG is natural gas that has been cooled to the point that it condenses to a liquid so it can be easily stored or transported by ship where pipelines are neither economical nor feasible. LNG occupies only a fraction (1/600) of its gaseous volume for storage and ease of transportation. Natural gas is liquefied at an export terminal to be transported to import terminals where it is re-gasified for supply to the national distribution network. Stored in cryogenic double-walled tanks at pressures slightly above atmospheric pressure, LNG is kept very close to its boiling point.

LNG has traditionally been a business of long-term, 20-year contracts. More recently, the LNG trade has seen an increasing amount of short-term (spot) contracts as LNG supply has increased.

Within the context of long-term sales agreements, the industry has mainly used and accepted measurement of tank volume as an established procedure for custody transfer that is understood, inspected and agreed upon by both parties. With this static measurement approach, measurements of liquid volume are made in the ship’s tanks, rather than measuring the mass or volumetric flow rate in the transfer lines. The approach relies on correction tables for list, trim, and tank contraction, as well a variety of calculations for density, volume, and gross calorific value to determine the LNG energy transferred. With this approach, overall measurement uncertainty is ± 0.5 percent, a far cry from the ± 0.15 percent uncertainty that is standard for transferring oil or natural gas products.

However, with the increasing amounts of LNG traded in short-term (spot) contracts, there is a general consensus that measurement of delivered flow will be required, as is currently the case for custody transfer of oil shipments. In addition, the increasingly common practice of co-mingled inventory, in which different operators share LNG storage capacity, will

require higher accuracy measurements to more accurately determine allocation of product ownership.

LNG Custody Transfer Measurement is Challenging

Fiscal transactions in the LNG market are huge; it is not unusual for a typical LNG loading/unloading system to move \$4 million of product per hour. While the generally accepted tank gauging measurement approach is based on industry and national standards, users still have concerns over its ultimate accuracy for product custody transfer from either LNG liquefaction facilities to LNG carriers, or from carriers to LNG receiving terminals.



Daniel Model 3818 Ultrasonic Flowmeter

Daniel, a business unit of Emerson Process Management, has developed a new, dynamic LNG measurement method using ultrasonic flow technology. The new approach allows volume measurement of LNG at cryogenic temperatures and delivers higher accuracy than static measurement methods. According to the company, an overall reduction of just 0.2 percent of measurement uncertainty by using the Daniel 3818 LNG meter could equate to a \$12,000 per hour reduction in financial risk.

The meter has been designed and tested to address specific LNG flow measurement challenges including:

- Since LNG is stored and transported at cryogenic temperatures close to its boiling point, it can easily become a two-phase liquid if there are hot spots in the pipeline or if there is an excessive pressure drop anywhere in the system.
- When measuring LNG flow, it is not possible to calibrate the meter at conditions similar to actual operating conditions since there are no large-scale cryogenic flow laboratories.
- It is currently not possible to verify the performance of a meter once installed, making it difficult for users to accept the validity of its measurements.
- Several potential sources for lost and unaccounted for (LAUF) gas in LNG terminals exist due to discrepancies between calculation standards for LNG and natural gas

A New Approach to LNG Measurement

According to Daniel, the Model 3818 LNG Ultrasonic Flowmeter incorporates several critical features that enable it to overcome many of the obstacles posed by LNG flow measurement to achieve precise results. These include a redundant four-path design for immunity to flow profile disturbances, termination cables specifically designed for use at cryogenic temperatures, and a unique meter insulation packaging and cable routing design that results in minimal contact points to the meter body to avoid heat sinks and hot spots.

Additionally, the meter employs a correctional model for changes in meter geometry as the flow tube is exposed to cryogenic temperatures.

According to the company, the 3818 LNG offers all the advantages of transit time, inline ultrasonic flow meters. They are full-bore meters with no internal moving parts to wear or drift, providing for low pressure drop and minimizing the risk of LNG flashing. Also available in large sizes, ultrasonic meters are well suited for high-volume LNG transfers, which equates to faster tanker loading and offloading.

To minimize lost and unaccounted for product and help reduce measurement uncertainty, Daniel recommends that operators supplement their current tank gauging approaches by adding flow metering points to LNG transferred into, within, and out of the terminal.

Also available in large sizes, ultrasonic meters are well suited for high-volume LNG transfers, which equates to faster tanker loading and offloading.

Daniel recommends that operators supplement their current tank gauging approaches by adding flow metering points to LNG transferred into, within, and out of the terminal. This would improve operational efficiency and reduce LAUF LNG due to:

improve operational efficiency and reduce LAUF LNG due to:

- Error in tank volumes related to tank manufacturing and strapping tables
- Changes in tank volumes due to continual temperature cycling
- Errors in terminal inventory created by LNG movements during tank measurements
- Errors related to ship loading and offloading dynamics (list, trim and tank corrections)
- Unaccounted for boil-off gas and flared gas

Conclusion

ARC sees Daniel Measurement and Control's Model 3818 LNG as a promising measuring instrument for the rapidly expanding LNG market. While both ultrasonic and Coriolis mass flowmeters (including Emerson's own

MicroMotion Coriolis meter) have been used in the past with some degree of success to provide dynamic custody transfer measurements of LNG, this application-specific Daniel ultrasonic meter appears to incorporate many unique features designed to target previous pain points.

When used in conjunction with tank gauging, ultrasonic flow metering technology can provide additional benefits, including:

- Improved process management by introducing additional measurement points to provide plant control systems with incremental data inputs to help improve plant efficiencies and safety
- Verification of the contractually stipulated static tank measurements for custody transfer by adding a flow meter at the loading arms or jetty

However, as with any new application of technology, Daniel's challenge now is to gain user acceptance and reference cases for this new product in this demanding application. Emerson and Daniel have a long history in the oil & gas industry, and significant clout among standards bodies. ARC believes that working to further develop and drive adoption of LNG custody transfer standards for ultrasonic technology will help hasten broader industry acceptance.

For further information or to provide feedback on this article, please contact your account manager or the author at aavery@arcweb.com. ARC Views are published and copyrighted by ARC Advisory Group. The information is proprietary to ARC and no part of it may be reproduced without prior permission from ARC.