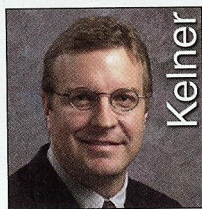


Measurement Matters

Improvements In Multiphase Flow Measurement

By **Eric Kelner, PE**



I was reviewing some recent columns and realized that I've been ranting about knowledge management and training programs for much of this year. Knowledge management and workforce issues are important and should be kept at the forefront of our minds, but let's get back to measurement technology.

It's always a good idea to look at other industries and other segments of our industry. You may discover technologies that apply to what you're doing. There's an effort currently in the production measurement community to improve the state of the art of multiphase flow measurement. For high gas volume fractions, this is known as "wet gas measurement," but I'll lump it all together for this discussion. Let's take a quick look at it. Multiphase meters have been around since the early '90s. Early applications were located topsides and complementary to test separators, but measurements were not generally accepted for fiscal allocation of commingled production. Later designs moved into the deepwater subsea environment. Perhaps the most notable early application of deepwater measurement (wet gas in this case) was the Canyon Express application. The Canyon Express experience showed that subsea metering for fiscal allocation of commingled production could be successful. However, it highlighted issues limiting widespread use of the technology in deepwater applications.

There are various designs of multiphase flow meters, but virtually all tend to use some sort of differential pressure measurement, usually a Venturi meter, to measure total mass flow rate, combined with other technologies, such as gamma radiation or electromagnetic methods, to determine the relative amounts of oil, water and gas.

The multiphase meter is an exciting solution to growing production measurement issues. Production is occurring in deeper and deeper waters, and with increasing tieback distances, calling traditional measurement by well-test into question. Furthermore, new developments commingled with older developments create a variety of royalty payment requirements and further complicate the allocation process. These issues create the need for accurate measurement at the wellhead and help to drive the development of subsea multiphase measurement technology.

But applying this technology to the subsea environment presents some difficult challenges. For example, since subsea multiphase meters require fluid properties as input, variations in the input properties from the stream's actual properties lead to errors in flow measurement. Ideally, one would monitor the properties at the meter and provide real time input. But we're not there yet. In fact, subsea sampling isn't really done except under very specialized circumstances. What about check measurement? How would an operator check to make sure the subsea meter's measurement is realistic? Current applications use redundant instrumenta-

tion, and "by-difference" check measurement, but separate check measurement for verification isn't available. Virtual Flow Meters, the use of live pressure and temperature measurements combined with flow modeling, are another topic for investigation. How accurate are they and how can they facilitate accurate subsea measurement? Another issue involves the effect of precipitates and other sources of deposition on the discharge coefficient of differential meters such as Venturi and Cone-type meters.

The production measurement community has formed a Joint Industry Project, in conjunction with the U.S. Department of Energy and the Research Partnership to Secure Energy for America (RPSEA — www.rpsea.org), to address these issues and others. The project is known as RPSEA Project DW1301, "Improvements to Deepwater Subsea Measurement." Its objective is to improve the recovery from ultra-deepwater (depths greater than 5,000 feet) reservoirs. Achieving success in this project will have a major impact on the future development of deepwater petroleum resources for the United States. Without these solutions, reservoirs will be depleted in ways that leave millions of barrels of oil and MMBTUs of gas in the ground while the risk of revenue misallocation and lost royalties will remain high.

So how does this project impact the pipeline business? Discussions of the impact of hydrocarbon-saturated and water-saturated gas on pipeline operations have been going on for years. The RPSEA sampling research could lead to improved methods for sampling these saturated gases and other streams traditionally considered too difficult to accurately sample. Another example of the potential positive impact of this research on the pipeline community is the investigation into the use of Virtual Flow Meters.

Improvements in Virtual Flow Metering could lead to improvements in pipeline control and leak detection. The effect of fouling on the discharge coefficient of a production differential pressure meter may provide insight into deposition and fouling mechanisms that can be applied to traditional pipeline measurement technologies, like ultrasonic and orifice meters.

It's a big industry with a lot going on right now. It's hard to keep track of everything. Sometimes we tend to stay focused on our own industry segment. But there's a lot to gain by exchanging ideas with others. Take advantage of networking opportunities. Venture out to conferences outside your industry segment. By tracking developments throughout the industry you may discover a new technology that, with a little creativity, might solve some technical issues you're dealing with. Special thanks to my business partners, Chip Letton and Jim Hall for their input.

Until next time. **PE&GJ**

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