EFFECTS OF SQUARE ROOT ERROR ON GAS LIFT MEASUREMENT

As a well is produced, reservoir pressure decreases and, at some point in the life of the well, secondary recovery is required to extend the production. One of the more popular means of secondary recovery is gas lift—which is performed by compressing natural gas and injecting it down hole to assist in lifting the oil to the surface. Sometimes there is an apparent loss in formation gas volumes (produced gas volume - lift gas volume) in this process. This is often a result of pulsation created by the compressor used in the process to increase gas pressure for lift.

The opening and closing of the valves in a natural gas reciprocating compressor create waves of high pressure pulsing down the line. When this pulse reaches the measurement device, it causes an increase in the upstream pressure. This often causes measurement error, (overstating the volume) and is most often associated with differential pressure (DP) devices, like an orifice plate, but can also affect other meter types as well. Since the flow for DP devices is proportional to the square root of the DP, pulsation error is often referred to square root error (SRE).

When the produced gas returns to the surface without pulsation, the effect is not evident since the reservoir absorbs the pulsing waves. The error for the produced gas volume is minimal, but for the injected gas (lift gas volume) it is significant and this difference results in lost and unaccounted-for gas (L&U).

Assume the sales gas volume is 100 Mcf per day:

Example *without* SRE:
Formation Gas Volume = Produced Gas Volume - Lift Gas Volume
102 Mcf = 312 Mcf - 210 Mcf
Measurement imbalance is 2%, (102-100)/100

Example *with* SRE:
Formation Gas Volume = Produced Gas Volume - Lift Gas Volume
80 Mcf = 312 Mcf - 232 Mcf
Measurement imbalance is 20%, (100-80)/100. SRE caused the lift gas volume to be overstated.

This has often been misdiagnosed as a leak in the formation, allowing some of the gas to migrate to another formation. Although this can happen, SRE should be the first and most logical consideration. SRE is always positive regardless of meter type. It is necessary to reduce the Pulsation effect after compression to achieve accurate measurement. Although SRE is not equivalent to measurement error, Industry standards suggest SRE greater than 2% will cause measurement error.

If you are experiencing similar L&U issues, SPL has the technical expertise and resources to diagnose and assist in the resolution of this problem. Contact our technical experts today at 877-775-5227.

THE SCIENCE OF SURE