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GAS INTERNATIONAL
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NEWS

Ofgem proposes to slash investor returns on UK energy networks

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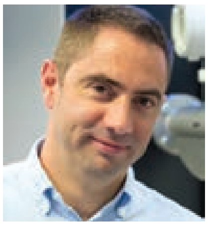
WHAT LIES BENEATH

Knowledge management isn't always smooth sailing

IGEM
Institution of Gas Engineers & Managers

ENHANCING CUSTODY TRANSFER MEASUREMENTS THROUGH DIGITAL TECHNOLOGY



Digital Lead at ABB Dr David Lincoln takes a look at some of the digital technologies available to enable operators to better utilise measurement device data and, more importantly, reduce the risk and cost of mismeasurements

Many processes in the gas industry rely heavily on measurement devices. For example, critical measurements that incur higher capital and operational expense are used in custody transfer applications.

Custody transfer metering systems typically measure physical properties such as flow rate, density, pressure, and temperature, and can also include compositional data.

The measurement data is used to calculate the monetary value of transferred material using a flow computer. These systems are found in storage locations at ports and wherever a liquid or gas is transferred from one legal entity to another.

Custody transfer metering systems are designed and manufactured to

FIGURE 1 Typical problems that can occur, which cause mismeasurement (Han van-Dal, 2018)

Ambient temperature influence **Leaks**
Ice formation **Plugged impulse lines**
Disturbed flow profile
Transmitter drift and shift **Blockage** **Debris**
Wear **Corrosion** Damage **Pulsating flow**
Solids Proving problems **Out of range**
Calibration errors
Two phases (gas in liquid, liquid in gas) TYPOS
Non-compliance with measurement standards and vendor recommendations (installation, geometry, fluid properties, calculation boundaries)
Wrong configuration settings

FIGURE 4 Cloud and PC verification software provides verification of flow measurement devices

national/international standards to ensure measurement traceability.

The level of integration of device data into the flow computer and higher level systems, such as remote terminal units (RTU) and SCADA systems, is primarily focused on process variables and alarm functions.

However, these devices contain a rich source of diagnostic information which is largely unused by operators and maintenance teams.

Small errors in custody measurement data translate into incorrect billing that will negatively impact the revenues of the seller or buyer.

Companies therefore invest significant sums of money testing their measurement devices to minimise measurement errors.

Flow meters are typically proved in the field and/or recalibrated in a test laboratory, while other measurement devices are compared with a traceable reference device or fluid and, if necessary, recalibrated.

The testing frequency depends on a number of factors, including the relationship between the buyer and seller, and some operators have been known to test liquid flow meters before each transfer.

SO WHY IS THERE A NEED TO TEST THE SYSTEM ACCURACY SO OFTEN?

Measurement devices are expected to operate at the highest levels of accuracy. In practice, however, the systems can be operating outdoors in harsh environments with non-ideal process conditions, and definitely far from laboratory conditions.

FIGURE 2 Meter diagnostics display of SpiritIT SmartCen

Due to the high performance expectations of these critical measuring systems, manufacturers have developed sophisticated methods of checking their health and accuracy, including mismeasurement management (MMM) software, utilising virtual flow computing technology and measurement device verification.

WHAT IS VIRTUAL FLOW COMPUTING AND HOW IS IT INVOLVED IN CALCULATING MISMEASUREMENT?

Virtual flow computing involves mathematically modelling the system and using live data to predict and match actual measurement data.

When a fault condition occurs – such as three-hour loss of pressure measurements the MMM software uses – the mathematical model, logs, historical data trending, alarms and other information sources calculate the mismeasurement and a report is generated incorporating the recalculated figures.

The approach described is a highly sophisticated method of dealing with everyday occurrences that can improve a company's top and bottom line performance.

An example of an available MMM

software is Spirit SmartCen, jointly developed by ABB Spirit and Petronas (Figure 2).

WHY USE MEASUREMENT DEVICE VERIFICATION WHEN CALIBRATION IS FAR MORE ACCURATE?

Measurement device verification is an in-situ tool for checking product accuracy and health. It is not calibrated and typically doesn't conform to international or OGC standards. Proprietary verification software developed by the measurement device manufacturers utilises on-board diagnostic information to establish the device condition.

Examples of the types of information available within a device include:

- Sensor transducer internal measurements (resistance, capacitance, inductance, frequency etc)
- Meter output accuracy (analog pulses or 4-20mA, digital outputs)
- Cable insulation resistance

To identify any change in the condition, the results are compared with a fingerprint test that is used as a benchmark.

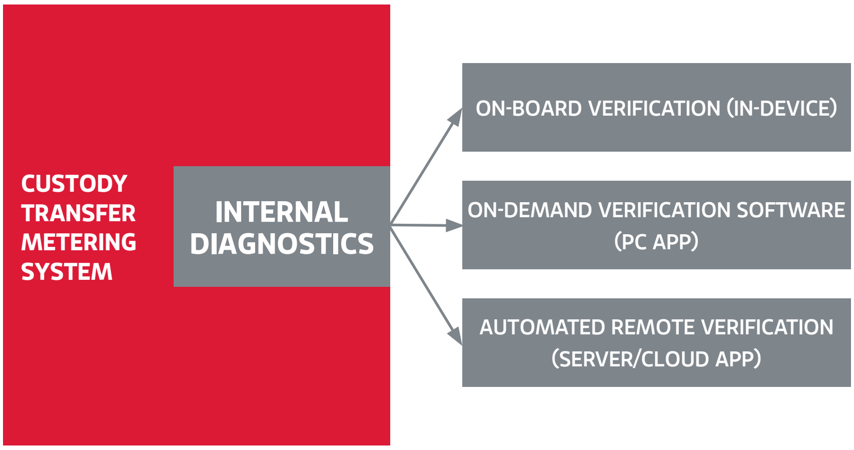
Any deviations from this benchmark are indicative of a potential problem, which can be pinpointed and rectified before it escalates.

Typically, the fingerprint is generated when the measurement device is first manufactured and is performed under laboratory conditions. An operator may also prefer to create a fingerprint test after the measurement device is commissioned within the custody transfer metering system, operating in 'real-life' conditions.

Verification tests, however, do not offer the confidence in measurement accuracy that flow testing, proving or calibration provide. If periodic flow testing does not result in a change in the calibration factor and sequential verification tests additionally show no change in test results, an operator might instead reasonably consider extending the period between flow tests, and thus save money. Verification technology can be implemented in a number of ways (see Figure 3).

On-board verification provides continuous self-checking of the device with the result outputted to higher level systems. Measurement devices tend to be resource constrained, and the data from each test is not typically stored or available for post-processing. However, access to the result provides an operator with meaningful information to act upon (pass, marginal pass, marginal fail, fail).

FIGURE 3 Available verification techniques for measurement devices



Verification software installed on a computer communicates independently with the device, collecting diagnostic data and performing a verification test. This method allows a comparison with previous test results/trending parameters to identify long-term degradation and certificate generation as a proof of test. These software applications typically rely on the operator to manually perform the test. The build-up of historical data for trending and predictive failure detection may take time to be statistically meaningful.

Automated remote verification involves hosting a server/cloud-based version of the verification software and, at a pre-defined interval, collecting the diagnostic data and performing the verification test. Automated verification is a form of condition monitoring for which the data is stored in a historian program. Trends can easily be reviewed by operators and maintenance teams and the application can be programmed to provide alerts when a test deviates from the original fingerprint test result. These alerts assist in identifying some of the problems experienced by operators in the gas industry, helping to reduce mismeasurement time.

CONCLUSION

Gas operators can use verification and mismeasurement management software to better utilise system data. These software tools contain embedded expert knowledge to interpret system data and deliver actionable information for the enhancement of operational performance. With an ideal custody transfer system, operators use mismeasurement management software to efficiently deal with identified errors when they arise. Automated/regular verification of measurement devices supports identifying potential issues before mismeasurement errors occur and provides operators with the confidence to extend the period between tests.

FUTURE DIRECTION

The data from the system will continue to be refined, providing additional value. Operators can expect machine learning to be used for detecting an increased number of anomalies before they develop into mismeasurement, with artificial intelligence generating prescriptive maintenance orders with automatic spare parts delivery. Systems will operate at higher levels of accuracy and availability with a reduced cost of maintenance, ultimately ensuring the correct custody transfer revenues, and potentially saving operators millions of dollars each year. ■

REFERENCES

Spirit IT Mismeasurement Management, Han van Dal, 2018. Available at: www.crt-services.com/download/han-van-dal-spirit-mismeasurement-management-pdf