Gas Measurement Auditing

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Gas measurement and accounting system auditing has gradually become somewhat more complex as electronic flow measurement and other computer-based technologies have arrived on the scene.

Before the early 1990s, measurement auditing was often little more than verifying chart integration and struggling through piles of field test slips looking for missed orifice plate changes, incorrect gas quality information, and unnoticed calibration adjustments. Today, however, gas measurement auditing is more complicated than ever before as gas companies rely on high-speed communication and computer networks to gather massive amounts of information required in today's fast-paced energy industry. Flow rates, total energy, pressures, temperatures, gas quality, flow factors, meter performance data and a lot more is included in this enormous information mix.

Much of the information collected through these systems is used for purposes other than calculating gas flow. Gas measurement data are also frequently used to monitor, track, and record operating conditions relating to safety, pipeline integrity, gas management, and environmentally relevant issues.

Gas measurement and engineering groups sometimes support measurement audits as part of their normal responsibilities. In other cases, audit teams do the work alone–with, or without, specialized training in the subject. Still, only occasionally do measurement audits reach much beyond the office walls.

When auditors do venture into the field, it is usually to briefly visit a few sites, possibly witness the calibration procedures, maybe inspect an orifice plate, look at a gas chromatograph or sampling system, and possibly measure the lengths of a couple of meter tubes. Seldom does the field portion of a measurement audit delve into much detail, except perhaps during the review of field-generated paper or electronic printouts or other records.

The advent of ultrasonic meters, Coriolis meters, and other meter types now used for custody transfer gas measurement has helped elevate gas measurement auditing to new and more interesting levels. Industry measurement standards and reports sometime help smooth the way, but not always.

It is important to remember that the measurement audit process should never be limited exclusively to administrative issues, and that targeting only operational issues can be equally misleading. A complete measurement audit must include both.

It is easy to understand how auditors sometimes find it difficult to figure out which pieces of the puzzle are important to the bottom line and which ones are not.

Effective Measurement Audit

Performed primarily as an oversight function, an effective gas measurement audit should develop reliable information concerning past and present activities while also looking prospectively.

The noun "audit" is defined in several ways, including an examination of records or accounts to check their accuracy, an adjustment or correction of accounts, and an examined and verified account. These three definitions would seem to suggest auditors must possess accounting, bookkeeping, or other "administrative" talents. Although knowledge in such disciplines is obviously helpful, other areas of understanding are equally valuable.

It is interesting to note the word audit is derived from the Latin *auditus*, which means a hearing, reportedly taken from the past participle of *audire*, meaning, to hear. From this, we might conclude that an audit is actually a sort of trial or test. Might it also be fair to presume that this suggests an auditor should strive to be a good listener? The answer is most assuredly yes.

A measurement audit should seek immediate as well as long-term results by satisfying the present audit scope while also improving the entire gas measurement and accounting process for all involved parties.

Said another way, it is a good idea for gas companies to look inside their own gas measurement organizations while auditing others.

In today's energy industry, measurement auditors emerge from many backgrounds, some coming from within the natural gas industry and others from outside. Auditors having gas accounting backgrounds sometimes view the measurement processes quite differently than those with experience in gas measurement, operations, volume processing, and other technical areas.

Knowing something about the backgrounds of those involved in an audit can help minimize confusion, especially where multiple disciplines are involved. Identifying the various participants before the onset of an audit expedites the entire process and helps smooth the wrinkles that inevitably occur.

Planning an Audit

Directed outwardly or inwardly, measurement audits normally fall into one of two categories: external or internal. Whether internally or externally directed, audits can be broken down into the two general types: administrative audits and operational audits.

Administrative audits usually concentrate primarily on measurement documentation, industry and company standards, calculation methods, measurement procedures, historical records, and accounting methods (based on measurement data). This type of audit is sometimes referred to simply as an office audit.

By contrast, operational audits commonly dwell on field equipment, including meters, secondary (monitoring or recording) equipment, measurement station design, operating conditions, gas sampling, online gas chromatographs, and secondary equipment calibration methods. For obvious reasons, this type of audit is often called a field audit.

It is important to define the intent and scope of an audit before commencing. Contracts, tariffs, and other legal agreements define how natural gas is produced, purchased, exchanged, processed, transported, measured, and otherwise accounted for. These documents commonly include at least general audit language, and occasionally address measurement auditing specifically.

When specific measurement auditing language is missing, agreements often contain other information that can be useful in preparing for a measurement audit, including:

- Measurement definitions (volume, energy, etc.);
- Measurement methods (general);
- Meter types (general or specific);
- Measurement standards (industry, internal, exceptions, combinations, etc.);
- Gas heating value (definitions and determination);
- Minimum gas heating value (definitions and determination);
- Hydrocarbon dew point requirements;
- Maximum allowable water vapor content;
- Maximum allowable concentrations of carbon dioxide, nitrogen, hydrogen sulfide, oxygen and non-hydrocarbon fluids;
- Contract pressure base;
- Average atmospheric pressure used, if applicable (or means of determining atmospheric pressure);
- Contract temperature base;
- Averaging methods (pressure, temperature, flow, etc.);
- Equipment calibration methods and frequency; and
- Witnessing and auditing.

In fact, anything relevant to determining gas quantity or volume (Acf, Mcf, or mass flow), gas composition, and total energy flow (MMBtu) is of interest. The thorough review of agreements and other relevant documents is fundamental to the audit planning process.

A gas measurement audit requires a thorough understanding of three fundamental items, which should be included in the planning process: the audit scope and objective, the overall gas measurement and volume processing process, and the gas accounting process relative to adjustments and corrections.

This list may seem obvious, but measurement and accounting audits often begin without considering any of them–especially the second item, the overall gas measurement and volume processing process.

Auditing Standards

Gas companies and independent measurement auditors develop auditing standards. One document sometimes used by internal auditors was produced by the Committee of Sponsoring Organizations (COSO) of the Treadway Commission. The COSO methodology enables the development of what are termed "soft controls," while attempting to avoid fault-driven auditing techniques accomplished by addressing systemic root causes and avoiding placing blame.

Measurement standards written by gas industry committees sometimes address measurement auditing issues, but to varying degrees of detail. One standard that specifically addresses measurement auditing is the American Petroleum Institute's Manual of Petroleum Measurement Standards (API MPMS), Chapter 21: Flow Measurement using Electronic Metering Systems, Section 1, Electronic Gas Measurement (API MPMS Ch. 21.1).

It includes a section dedicated to auditing titled "Audit and Reporting Requirements." The audit subjects covered in API MPMS Ch. 21.1, along with their individual sections, include:

- Quantity transaction record (1.6.2);
- Daily quantity transaction record for differential type meters (1.6.2.1);
- Hourly quantity transaction record for differential type meters (1.6.2.2);
- Daily quantity transaction record for linear type meters (1.6.2.3);
- Hourly quantity transaction record for linear type meters (1.6.2.4);
- Algorithm identification (1.6.3);
- Configuration log (1.6.4);
- Event log (1.6.5);
- Corrected quantity transaction record (1.6.6);
- Test record (1.6.7); and
- Data retention (1.6.8).

API MPMS Ch. 21.1 is now undergoing revision, having been originally written before the Sarbanes-Oxley Act became law.

Primary Purpose

Another standard addressing auditing is API MPMS Chapter 20: Allocation Measurement, Section 1, Allocation Measurement. Under 1.15.4 (auditing), it states, "The primary purpose of the audit trail is to allow an auditor to know how values were determined and exactly how and why any alterations to original data or calculations were performed. All allocations should be designed with clear audit paths. Current factors should be calculated and compared to historical data. Doing this is a great help in identifying measurement or laboratory differences on a timely basis. Each allocating program should be audited either internally or externally on a least a yearly basis. Again, most gas contracts address this issue and should be reviewed by the allocator."

Sometimes we hear the argument that meters and measurement methods used for natural gas allocation are not important because allocation is not really custody transfer. It is interesting to note that the wording from API MPMS Ch. 20.1 seems to suggest otherwise.

In fact, how can any meter, measurement system, or piece of measurement equipment that affects the bottom line not be important? If the gas in question is not important or has no value, why measure it at all? These fundamental questions should be answered long before an audit begins.

Although the two industry standards noted in this article address auditing in general, there is not yet a comprehensive industry summary covering gas measurement and accounting auditing in detail.

A complete and thorough understanding of gas measurement and gas measurement auditing can take many years to develop. However, an awareness of certain fundamental aspects is sufficient to begin the learning process. A well performed gas measurement and accounting audit begins with a sound plan and a clear understanding of the basics. Such an audit also addresses administrative and operational issues with equal interest. Experience teaches that any meter or measurement system that affects the bottom line is deserving of attention.

This article is based on earlier articles by the author including those appearing in the Proceedings of the International School of Hydrocarbon Measurement (various years), and The American Oil & Gas reporter (October 2007).

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