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## **AUDITING LIQUID MEASUREMENT**

Class Number 7050

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### **INTRODUCTION**

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An effective audit of liquid hydrocarbon measurement is dependent upon a solid understanding of the measurement process combined with the application of sound internal auditing principles. The quality of liquid measurement activities is contingent upon (1) the reliability of the measurement equipment and instrumentation used; (2) the specific procedures and practices followed in performing the measurement activities; (3) the adequacy of training and proper performance of the measurement technician; and (4) the proper documentation of transactions based on a measured value. All four components must be taken into consideration when auditing liquid measurement. In addition, to ensure the efficiency of the audit process, auditors must identify those areas which present the greatest risk to the organization to achieving its goals, and concentrate audit effort on those areas.

### **"CORPORATE AUDIT" OR FIELD MEASUREMENT SURVEY?**

The audits performed by "corporate" auditors typically focus on auditing business processes and operational activities for compliance with corporate policies and procedures, industry and government standards, and sound management principles. Additionally, accounting and financial transactions are reviewed for accuracy, completeness and timeliness. Other objectives are to assure management that company assets are safeguarded, and that resources are being utilized economically and efficiently. The internal auditing organization should report to an individual within the organization who has sufficient authority to promote independence, to ensure broad audit coverage, and to make certain that appropriate action is taken on audit recommendations. The value of having internal auditing organizations perform audits may be best explained by reviewing the definition of Internal Auditing as established by the Institute of Internal Auditing (1):

"Internal auditing is an independent, objective assurance and consulting activity designed to add value and improve an organization's operations. It helps an organization accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of risk management, control, and governance processes."

In addition to the internal auditing function, companies may also develop a program for conducting liquid measurement field surveys. These surveys typically provide a more thorough in-depth review of measurement equipment and activities, and are commonly performed by trained measurement specialists. In contrast to "corporate audits", liquid measurement field surveys typically include evaluations of the appropriateness of equipment used, review for proper installation of equipment, and tests to determine whether equipment installation and operation is in compliance with API standards. Because the field survey team possesses an extensive level of measurement expertise, their review may involve more in-depth testing and evaluation in comparison to what the "corporate audit" may entail. See ISHM Paper 2220 "Liquid Measurement Field Surveys" for a discussion of topics to include in a liquid measurement field survey.

The extent of in-depth knowledge corporate auditors have in the area of liquid measurement will be dependent upon the resources used to staff the internal auditing organization, and the level of training provided regarding measurement techniques. Measurement specialists, on the other hand, are typically trained experts in this field. A strong working relationship between the two groups can benefit the company directly through coordination of work effort, information sharing and support. A clear understanding of what each group's objectives are and what their program consists of may lead to a more effective company-wide assurance program regarding measurement practices. Additionally, it is possible that synergies may be realized and audit effort reduced by reliance upon work performed in a measurement field survey program.

## DETERMINING WHAT TO AUDIT

In determining the specific topics to be covered in an audit (also known as the "audit scope"), it is necessary to identify those activities that are critical to achieving organizational objectives efficiently and economically. An effective audit will focus on those critical objectives and an evaluation of the adequacy of controls to ensure those objectives are achieved. This process involves determining the answer to the following questions:

1. What are the relevant business objectives?
2. What are the risks which may prevent the organization from achieving these objectives?
3. What internal controls are in place to mitigate these risks?

As an illustration of this analysis, let's assume the identified business objective is to ensure that month-end product inventory is accurately measured and reported according to the corporate policy. The associated risks and various internal controls which may mitigate those risks are then identified. For an example of some of the risks and internal controls that may be identified using this process, see Exhibit1 at the end of this paper. Once completed, the auditor can use this framework to help structure the audit program and ensure that the critical business activities are included in the review.

Since audit time and resources are limited, the auditor must determine which specific areas present the greatest risk to achieving business objectives, and focus his audit efforts on those areas. For companies in the oil industry, perhaps one of the most significant operational activities is the accurate measurement of hydrocarbons - the very lifeblood of these organizations. Some examples of financial data directly impacted by measurement practices include:

- Oil inventories, a significant balance sheet item;
- Oil loss / gain expense;
- Sales and purchases of crude oil and products;
- Transportation revenue (both gathering and trunk) for pipeline companies; and
- Terminalling fees which are based upon volumes handled.

In addition to affecting the company's financial statements which are available to shareholders and potential investors, liquid measurement data may be used internally by management as a basis for making business decisions. Thus, the accuracy of liquid measurement activities impacts a company both internally and externally.

## DESCRIPTION OF THE AUDIT PROCESS

The audit process consists of the following basic steps as defined in the Standards for the Professional Practice of Internal Auditing (2):

1. Plan the audit. The auditor must determine the audit objectives, which define the intended audit accomplishments. These objectives should address the risks associated with the activity being audited. Once the audit objectives are determined, specific audit procedures for collecting, analyzing, interpreting, and documenting information during the audit should be identified. These documented steps provide a plan for achieving the audit objectives.
2. Examine and evaluate information. Information must be collected, analyzed and interpreted in order to provide the basis for audit findings. Auditors must also document this work as support for audit conclusions. The extent of testing performed during this stage of the audit process will be determined by several factors including the reliability of data obtained and the level of risk associated with the process being audited. However, audit tests must provide sufficient data in order for the auditor to make sound audit conclusions.
3. Draw an audit conclusion and report results. Based upon the testing performed, the auditor draws a conclusion and reports those results. If significant control weaknesses are detected, the auditor will recommend corrective action to be taken to address these issues. Audit reports should communicate

effectively the audit results, and must be appropriately distributed to management. Reports should be objective (clear from bias and distortion), clear, concise, constructive and timely.

4. Follow up on reported audit findings. Once the audit report is issued, internal auditors should follow up on outstanding audit findings to ensure that appropriate action is taken in a timely manner. While management is responsible for deciding what action to take in response to an audit finding, it is the internal auditing organization's responsibility to assess the adequacy and timeliness of that action.

## AUDIT EVIDENCE

Audit evidence forms the basis of audit conclusions, opinions, findings and recommendations. It should be substantial and persuasive enough that another knowledgeable person would come to the same logical conclusion. In her 2000 ISHM paper "Auditing Liquid Measurement" (3), Grace Barrett-Smith describes audit evidence as including documentary, physical, testimonial and analytical evidence.

1. Documentary evidence is the recorded information relevant to the audited process. It may include such items as tank gauge or meter tickets, meter proving reports, and measurement equipment calibration records.
2. Physical evidence is data obtained by the auditor through personal observation and inspection. Examples may include observing such activities as the physical gauging and sampling of a tank, meter proving, or verification of automatic tank gauging and temperature devices.
3. Testimonial evidence is information gathered by interview or written statements from individuals knowledgeable of the process under review. For example, an auditor may interview a measurement technician about how meters are calibrated or tanks are gauged in an effort to determine whether the individual's understanding of the process is consistent with company and industry standards.
4. Analytical evidence is information developed through analysis of the relationship of data and trends noted. Examples of analytical data are meter factor control charts and daily stock inventory balancing reports.

The type of audit evidence selected should be consistent with the audit objective, and must provide a reliable basis for audit conclusions. The auditor must also recognize the inherent limitations of each type of evidence used, and should select that method which provides the best level of assurance for the process being audited. For example, testimonial evidence may be used to determine a measurement technician's understanding of meter proving frequency requirements. However, a review of meter proving reports will determine what actual historical practice has been, and whether that practice conforms to company or industry standards. Physical evidence may be the most persuasive; however, its validity may be impacted as personal behavior may be modified given the individual's awareness that he is being observed or "audited". Finally, analytical evidence may indicate when further audit testing is warranted, but in itself is not sufficient for drawing an audit conclusion.

## CONCLUSION

A combination of sound internal auditing principles and a solid understanding of the liquid measurement process are essential elements of an effective audit of liquid measurement. The auditor must identify business objectives, the associated risks, and internal controls which help to mitigate these risks. Using the resulting analysis, the auditor is able to develop an audit program which will include testing of the company's critical internal controls. The auditor must also determine the extent of testing and type of audit evidence necessary to provide an accurate assessment of the internal control environment. This evidence is used to support audit findings, opinions, and recommendations to management for corrective action.

## REFERENCES

- (1) June 1999 International Conference of the Institute of Internal Auditors
- (2) Standards for the Professional Practice of Internal Auditing, "Performance of Audit Work"
- (3) 2000 ISHM paper "Auditing Liquid Measurement" by Grace Barrett-Smith

Objectives	Risk Factors	Internal Controls
<p>Ensure that month-end product inventory is accurately measured and reported according to the corporate policy.</p>	<p>Measurement equipment such as gauge tapes and bobs may not be reliable.</p> <p>The procedure used to take the temperature measurement may not result in an accurate reading.</p> <p>Measurement technicians may not be properly trained.</p> <p>Tank gauge and temperature readings may not be properly recorded.</p>	<p>Establish procedures to require verification of gauge tapes and bobs against an NIST traceable standard, and document verification of equipment.</p> <p>At least annually, review the verification documentation for completeness. Visually inspect gauge tapes and bobs to ensure they have been verified and that they are in good condition.</p> <p>Establish procedures including specific steps to be followed when using either a cup-case thermometer or PET. Instructions to be included are: (1) the number of readings which must be taken, (2) the location and depth for each reading, (3) the length of immersion time, and (4) when ambient temperature must also be considered.</p> <p>Communicate measurement policies and procedures to all measurement personnel.</p> <p>Provide measurement training classes and refresher courses to all measurement personnel.</p> <p>Establish a resource for providing information and on-going support regarding measurement issues.</p> <p>Establish precision requirements for recording tank gauge and temperature readings.</p> <p>Perform a monthly inventory analysis and determine total monthly variations. Determine a tolerance level for monthly stock variations, and establish procedures for investigating excessive variations.</p>