

Crude Oil Sales Verification

Validating Crude Oil Deliveries in the Upstream Sector

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Introduction

As rapidly increasing crude oil production in the U.S. (see Figure 1) continues to challenge the petroleum industry's infrastructure, the most important question every energy company should be asking is "How are we tracking it?"

Crude oil is commonly transferred by truck from storage tanks located at or near the wellhead, for hauling to a terminal and subsequent downstream delivery to a processing facility. In many cases, the truck driver completes a paper delivery ticket to document the oil transfer and leaves a hardcopy receipt in a Mason jar or similar container in the field. While this system has existed for many years, the recent extraordinary increase in domestic hydrocarbon production has created a demand for more sophisticated means of accurately measuring crude oil transfers as they occur. Documenting high-value oil sales with handwritten tickets, which can result in extended reconciliation times and the very real potential for transcription errors, is unacceptable in today's high-tech world. There are simply too many "Mason jars" and paper tickets to keep track of anymore.

The purpose of this whitepaper is to provide updates on advanced technologies that can impart greater accountability and verification of crude oil custody transfer (i.e., sales), on a near-real time basis, through the application of leading-edge measurement, communications and processing technologies. This paper will also detail the components and operation of LACT units as well as the capabilities of new microprocessor-based controllers and liquid measurement soft-

ware. Finally, a set of recommended crude oil custody transfer verification steps and measurement troubleshooting guidelines offered here will provide useful tips on how to more effectively verify crude oil sales with your existing systems and processes.

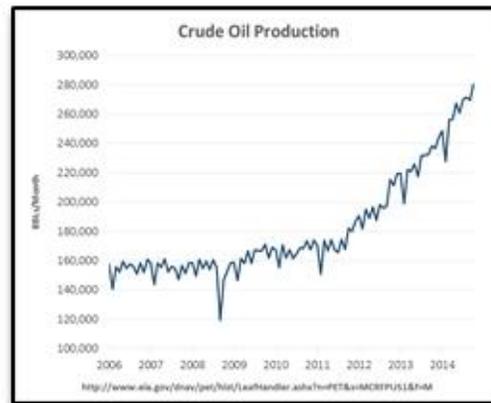


Figure 1: Crude Oil Production

Lease Automatic Custody Transfer (LACT)

One of the most prevalent methods for controlling and measuring the custody transfer of crude oil is through use of a LACT (Lease Automatic Custody Transfer) unit. The LACT unit (see Figure 2) is fundamental to custody transfer of crude oil, but must be properly operated and thoroughly monitored to obtain maximum accuracy. The major elements of a LACT unit include pumping, metering, eliminating air/gas, straining, monitoring of S&W (sediment and water), and sampling. While the functional compo-

nents of LACT units are relatively simple, proper operation and maintenance are paramount for ensuring that design accuracy is fully achieved. The equipment and instrumentation associated with each of these functions should be inspected and verified on a routine basis.



Figure 2: Typical LACT Unit

The meter which measures the custody transfer volumes is, of course, at the very heart of LACT operations. It must be regularly examined and proved to confirm that it's still properly sized and accurate. Other measurement components, such as temperature sensors, pressure transmitters, and S&W monitors, should also be verified for accuracy and reproducibility. With proper operation, regular maintenance and inspections, and periodic component upgrades, LACT units will reliably and accurately provide custody transfer for many years.

Advanced Technologies

The hardware components which comprise modern LACT units, such as their flow meters, are likely to be of the latest designs, materials of construction, and functionality. LACT controllers and supporting infrastructure, unfortunately, have simply not kept pace with technical innovation...until recently.

Real-time communications, timely information collection and dissemination, as well as prompt reconciliation of custody transfer activities, are now available for LACT operations. For existing units, this may require a retrofit of the PLC (Pro-

grammable Logic Controller) with an advanced microprocessor-based controller including onboard communications and options for remote firmware updates. Such highly customizable controllers not only provide utmost accuracy and maximum operational flexibility, but permit secure intercommunication with software systems for comprehensive data collection, processing, and presentation.

Through such processes, nearly instantaneous creation and distribution of electronic delivery tickets is possible each time that a transfer is made, with web-based archiving of tickets for future reference and analysis. By capturing flow at the transfer point and making that information immediately available in electronic form, disputes can be readily resolved and transportation losses minimized...adding significant transparency and reconcilability to the custody transfer process. And the fully electronic, hands-off nature of this method eliminates the potential for transcription errors and lost tickets, which can result through manual ticketing, while significantly reducing reconciliation times.

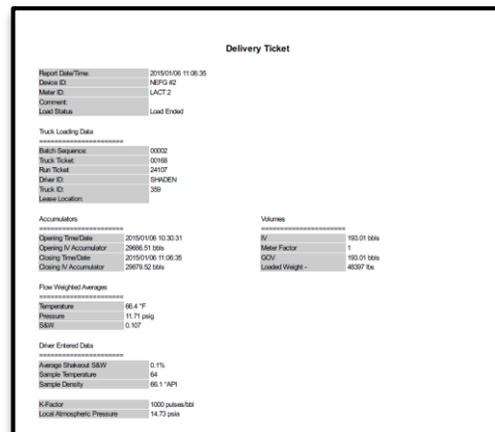


Figure 3: Sample Digital Delivery Ticket

When a measurement department successfully combines the accuracy, flexibility, and secure communications of microprocessor-based LACT controllers with advanced hydrocarbon measurement software, the sales verification process can be significantly improved and streamlined.

Oil Sales Determination & Verification

The latest developments in systems and technologies offer new options for verifying crude oil sales volumes. Hydrocarbon measurement software is available for processing, validating, editing, storing, and balancing crude oil volumes. Delivery ticket data can be imported quickly and easily, even including meter and location characteristics. This saves analysts time that would otherwise be spent on setup.

To complement these more advanced technologies in the crude oil sales verification process, the following additional steps should be adopted:

- Perform a comparison of gauged production to expected production based upon well tests and flow times;
- Reconcile changes in tank inventory to truck or pipeline deliveries;
- Conduct a comparison of current quality values (API gravity and S&W) to historical numbers;
- Perform routine net sales calculations (including meter factor determination — see Figure 4); and
- Reconcile deliveries (tickets) to the payment summary.

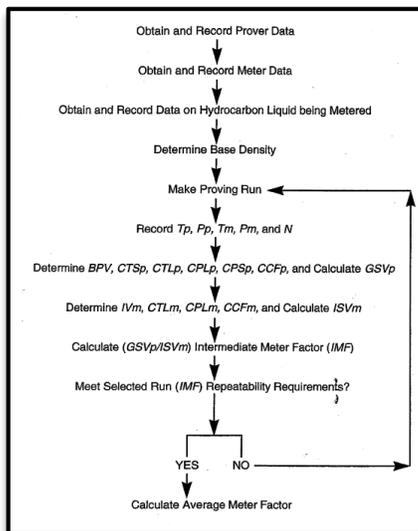


Figure 4: Flow Diagram for Meter Factor Calculation

Once armed with accurate and accountable measurement data, analysts can spend critically important time constructing and examining liquid balances...and, if unacceptable gains or losses exist, begin the process of identifying the source(s) of those problems and taking the actions necessary to correct the problems for the month when they occurred.

Measurement Troubleshooting

Of course, carefully monitoring the gains and losses of a crude production system is not necessarily the end-game. A fundamental objective is to recognize and resolve any problems that exist in the measurement process so that the sales values are correct. The analyst should troubleshoot any apparent problems with the custody transfer quantities and resolve them on a timely basis.

Some helpful troubleshooting questions to consider when working to reconcile custody transfer quantities include:

- Is the sales quantity complete?
- Could there be a problem with the field data used for verification?
- Have the crude oil S&W and API Gravity been correctly determined?
- Have appropriate API standards been applied to all calculations?
- Has the fluid quality been applied correctly to the final volume?
- Have the measurement instruments used been correctly verified or proved (Figure 5)?
- If any discrepancies were found in the instruments upon proving or inspection, have the required corrections been properly made to the measurement?

