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Metering Assemblies — Lease Automatic Custody Transfer (LACT) Systems

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Foreword

Uganda National Bureau of Standards (UNBS) is a parastatal under the Ministry of Trade, Industry and Cooperatives established under Cap 327, of the Laws of Uganda, as amended. UNBS is mandated to co-ordinate the elaboration of standards and is

(a) a member of International Organisation for Standardisation (ISO) and

(b) a contact point for the WHO/FAO Codex Alimentarius Commission on Food Standards, and

(c) the National Enquiry Point on TBT Agreement of the World Trade Organisation (WTO).

The work of preparing Uganda Standards is carried out through Technical Committees. A Technical Committee is established to deliberate on standards in a given field or area and consists of key stakeholders including government, academia, consumer groups, private sector and other interested parties.

Draft Uganda Standards adopted by the Technical Committee are widely circulated to stakeholders and the general public for comments. The committee reviews the comments before recommending the draft standards for approval and declaration as Uganda Standards by the National Standards Council.

The committee responsible for this document is Technical Committee UNBS/TC 16, *[Petroleum]*, Subcommittee SC 2, *Drilling, Development and Production Equipment and materials]*.

Introduction

LACT equipment includes a meter (displacement, turbine, ultrasonic and Coriolis), a proving system (either fixed or portable), devices for determining temperature and pressure and for sampling the liquid, and a means of determining non merchantable oil

A LACT system is an arrangement of equipment designed for the unattended custody transfer of liquid hydrocarbons from producing leases to the transporting carrier. The system must determine net volume and quality, provide for fail-safe and tamperproof operation, and meet requirements of accuracy and dependability as agreed to by mutually concerned parties.

Metering Assemblies — Lease Automatic Custody Transfer (LACT) Systems

1 Scope

This Draft Uganda Standard has been prepared as a guide for the design, installation, calibration, and operation of a lease automatic custody transfer (LACT) system.

2 Normative references

The following referenced documents referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

FDUS ISO 2714:2017 – Liquid hydrocarbons -- Volumetric measurement by displacement meter systems other than dispensing pumps

FDUS ISO 2715:2017 - Liquid hydrocarbons -- Volumetric measurement by turbine meter system

US 1733:2017 Practice for Automatic Sampling of Petroleum and Petroleum Products

US 1732:2017 Practice for Manual Sampling of Petroleum and Petroleum Products

FDUS ISO 8222: 2002 Petroleum measurement systems -- Calibration -- Temperature corrections for use when calibrating volumetric proving tanks

DUS ISO 12242:2012 Measurement of fluid flow in closed conduits -- Ultrasonic transit-time meters for liquid

DUS ISO 10790:2015 Measurement of fluid flow in closed conduits — Guidance to the selection, installation and use of Coriolis flowmeters (mass flow, density and volume flow measurements)

3 Terms and definitions

For the purposes of this document, the following terms and definition apply.

3.1
ALACT system
an arrangement of equipment designed for the unattended custody transfer of liquid hydrocarbons from producing leases to the transporting carrier.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

4 COMPLIANCE

The compulsory verb form “shall," while not necessarily binding for all conditions, has been used when a deviation from the standard is likely to adversely affect the satisfactory operation of a system that is designed for optimum operation under typical producing conditions.

5 Field of Application

The field of application of this Draft Uganda Standard is the unattended and automatic measurement by meter of hydrocarbon liquids produced in the field and transferred to a pipeline in either a scheduled or a non scheduled operation.

6 Requirements for All LACT Systems

The requirements for all LACT systems are as follows:

When hydrocarbon liquids are measured and transferred, the fluid should be stable to permit subsequent storage during transportation without abnormal evaporation losses.

During custody transfer, provisions shall be made for determining net standard volume.

Temperature measurements, recordings, or corrections applicable to volumetric measurement shall be made in accordance with FDUS 8222.

Temperature and pressure measurements (either recorded or indicated) shall be taken, and corrections applicable to volumetric measurements shall be made. The method of performing temperature compensation is a matter of negotiation but should be accomplished by use of volume-weighted temperature averaging devices or temperature compensators for optimum accuracy.

A representative sample of transferred oil for determining density (API gravity), sediment and water content, and any other physical properties required shall be obtained.

The merchantability of hydrocarbon liquids should be established when they are transferred; that is, when the liquids are within a specified density (API gravity) range, do not contain more than a specified sediment and water percentage, are at an acceptable temperature, and are of an acceptable Reid vapor pressure. A means shall be provided to stop the flow of oil to the carriers system and to the sampling system if the oil becomes un merchantable.

A means should be provided to control flow rates, periods of flow, and net quantities of oil delivered into the carriers system.

A means shall be provided to stop the flow of oil into the carriers system at or before completion of delivery of the leases assigned allowable capacity.

The control and recording system shall include fail-safe components to prevent mismeasurement or hazardous operating conditions in the event of a power or system functional failure of any of the system's components required for the LACT.

All components of the system that require periodic calibration and/or inspection shall be accessible for inspection by all parties involved in the custody transfer transaction. Adjustment, repair, or replacement will be performed by those responsible for the operation of the system. The design of the system shall provide a means for readily detecting leakage throughout the system, for example, double-block and bleed-type valves, sight drains, or pressure instruments.

The piping system shall not have connections or bypasses that would permit liquids to be transferred without measurement and shall be designed or equipped so that a reverse flow of liquid through the measuring device cannot occur.

A means shall be provided to lock or seal components that affect control or indicate measurement of quantity or quality. Unless this requirement has been specifically waived, such components shall be unlocked or unsealed only after prior notice to and consent of the parties concerned.

System malfunctions shall be anticipated, and deliveries that could occur during such periods shall be estimated. This requirement may be met by independent gross fluid delivery-recording systems, that is, by using a dual-head meter and temperature recorder, by using a meter in series, or by recording temperature or pressure or other instruments that indicate periods of flow. In installations where such apparatus is not used, prior agreement shall be established for calculating or estimating procedures that will be followed in instances of measurement system malfunction.

Sediment and water content and density (API gravity) measurements shall be made from composite samples obtained by automatic samplers of acceptable design. Samplers shall be installed in accordance with US 1733:2017

7 SPECIFIC REQUIREMENTS

LACT systems that use meters shall maintain fluid pressure throughout the measurement system in excess of the product bubble-point pressure by an amount sufficient to prevent the formation of vapour. If vapour is introduced into the measurement system, the measurement will be inaccurate.

When vapour removers are specified, they shall be sized for releasing vapour to the atmosphere or to a suitable vapour recovery system at rates equal to or greater than the normal flow rates of the liquid. Vapour outlet lines from removers shall comply with safety standards. When the design of storage facilities ensures fluid-packed line conditions leading to the meter, vapour removers may not be required.

When the installation of the dielectric or capacitance instrument (water monitor) is required, this shall be located upstream from the meter and shall be in operation at all times during delivery. The carrier shall specify the maximum water setting of the instrument.

The water monitor shall automatically stop or divert flow before liquid is delivered to the meter when the carrier's specifications are not met

Meters shall be operated within the manufacturer's recommended flow rates and at a rate as near as possible to the rate at the time of the meter proving when the meter factor was obtained. A back-pressure control valve is necessary to maintain a constant flow rate and pressure independent of downstream conditions.

Meters shall not be subjected to pressure pulsations, flow rate surges and shall not be subjected to shock pressures caused by quick-closing valves.

When temperature compensators with density selectors are used, they shall be adjusted for the density (API gravity) of the metered liquids. When temperature variations result in mismeasurement, temperature stabilization and monitoring may be required. The carrier may require that a pressure surge and/or suction tank be installed upstream from the LACT system to ensure that fluid-packed line conditions lead to the meter and to protect the meter from flow rate surges.

"Weathering" the crude oil, expansion chambers, and other such requirements may be required by the carrier to prevent unstable metering conditions.

When system pressure requires the use of the oil compressibility factor and pressure may not remain constant, flow weighted pressure-averaging devices or pressure recorders may be required.

When required by operating conditions that change sufficiently to alter the meter factor beyond acceptable limits, such as temperature variations and the associated viscosity changes, the oil temperature shall be maintained reasonably constant and shall be approximately the same as the proving temperature.

8 Installation

LACT systems that use meters shall be installed in accordance with applicable industry codes or standards.

Figure 1 is a schematic flow diagram showing the principal components of a meter-equipped LACT unit. All items shown may be used in an installation, but if certain components are not required for the integrity of quantity and quality control, they may be omitted.

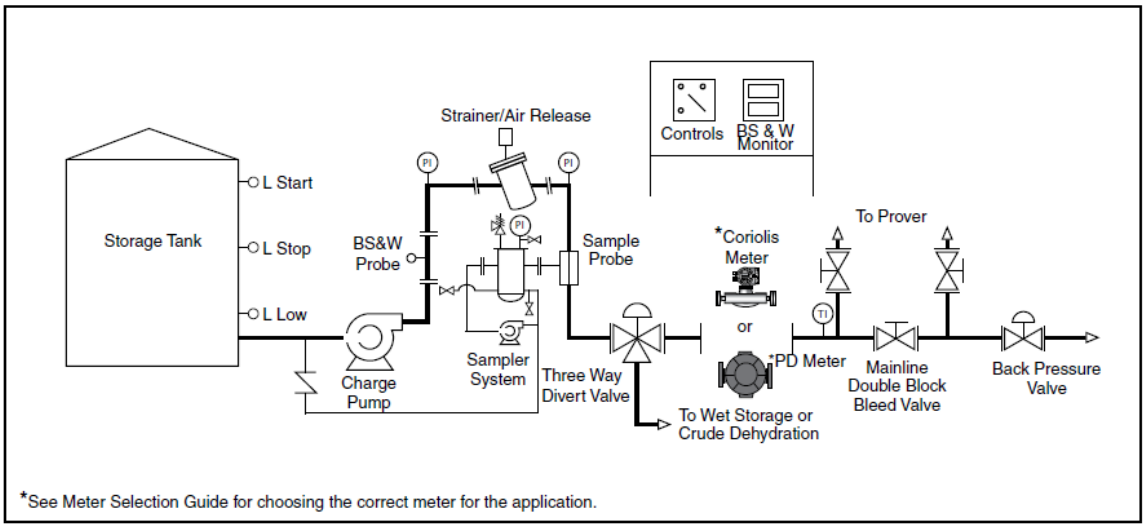

Figure 1 field LACT typical components

9 Procedures for proving meters

Proving procedures for each LACT location shall be agreed to by the parties concerned. Copies of the agreement should be furnished to both the operating personnel and proving personnel. Such procedures should include:

a. A step-by-step method to be followed at the location.

b. A procedure for checking valves for leakage before and during the proving operation.

c. A preliminary inspection or operation of the proving equipment.

d. The locations and specifications of seals to be inspected at time of proving.

e. The notification and witnessing required when seals, are broken for maintenance purposes.

f. The location, type, scale division, and methods for reading the thermometers used in the proving process.

g. The location, type, scale division, and methods of reading pressure instruments used in proving.

h. The specifications of a proving run, such as:

1) The number of times the prover tank should be filled.

2) Specifying the number of runs for a pipe prover.

3) Defining a minimum time and/or volume if the master-meter method is used.

i. The repeatability criteria for runs to be used and the number of runs to be averaged to obtain a new meter factor.

j. The normal period between required meter provings. The period between provings may be established either on a through put or on an elapsed-time basis. This period may be amended based on individual location meter performance records.

k. The normal date and time of provings or the notice to be given to witnessing parties when a proving schedule is established.

l. L. The witnessing required for provings.

m. The standard of consistency desired between meter factors obtained from consecutive provings.

n. The procedure to be followed when the desired consistency is not obtained, either in the results of consecutive runs during an attempted proving or in meter factors obtained from consecutive provings.

o. The frequency of inspection or the frequency and method of recalibration or calibration verification of the basic proving device.

p. The content for the forms to be used to record meter-proving data, complete with sample calculations and references to tables used for correction factors and conversions.

q. The proving record for each meter shall be kept on file for at least the same period as the meter tickets to which it applies or for a period mutually agreed to by the parties concerned, at least one copy of each official proving record should be supplied to each party concerned.

10 Meter system operation

The operation of a meter system will vary depending on the characteristics of the liquid, the design of the installation, the type of pipeline facility connection, and the operating schedule of the pipeline.

For meter system using ea displacement meter, with equipment arranged to meet the requirements defined in this standard shall meet specifications in FDUS ISO 2714

For meter system using a turbine meter, with equipment arranged to meet the requirements defined in this standard shall meet specifications in FDUS ISO 2715

For meter system using a Coriolis meter, with equipment arranged to meet the requirements defined in this standard shall meet specifications in DUS ISO 10790

For meter system using an Ultrasonic meter, with equipment arranged to meet the requirements defined in this standard shall meet specifications in DUS ISO 12242

11 Maintaining allowables

When regulatory agencies apply production allowables, runs from the LACT system shall conform to but shall not exceed these allowances. Automatic means shall be used to accomplish this requirement.

The system shall be fail-safe, tamperproof, and sealed so that neither the producer nor the carrier can change the arrangement without the consent and/or knowledge of the other party.

System devices shall be capable of being pre-set and verified for a predetermined volume that will approach but not exceed the lease allowable. When the predetermined volume has been reached, the arrangement used must prevent any further movement of oil from the lease until it is manually reset. The arrangement shall be adjustable so that changes in production allowables are accommodated.

Registers and counters shall be readily visible so that oil deliveries can be checked at any time.

12 Monitoring quality

Means shall be provided to prevent water-contaminated oil or slugs of water from entering a carrier's system. The parties shall agree on the maximum permissible sediment and water content of the crude oil. One such satisfactory automatic device which detects water is an instrument that measures capacitance (dielectric constant of the liquid stream).

This BS&W should be installed in a vertical riser in the piping before the meter and should be used to actuate controls so that water-contaminated oil is not delivered to the pipeline. A time-delay element should be incorporated into the monitor system.

13 Sampling

The relevant sampling procedure given in US 1733:2017 or in US 1732:2017 shall be used to provide samples for testing.

When, accounting for a crude oil run is to be determined on the basis of net standard volume, which includes corrections for meter factor, temperature, pressure, and sediment and water content, the composite sample accumulated in a run period and any portion used for the determination of density (API gravity) and sediment and water content must represent all crude oil delivered during that run period.

When density (API gravity) and sediment and water content are based on a sample from the composite sample of the run, the procedures used shall ensure that this secondary sample is representative of the composite sample. The sampling should be proportioned to the flow rate through the meter.

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Annex A
(informative)

DISPLACEMENT AND TURBINE METER SYSTEM OPERATION

A.1 Operation Sequence

Before an installation is completed, operating sequences shall be checked to ensure that the requirements of all interested parties have been met. The following cases are typical, and the items to be checked are suggested as guides for system studies

A.1.1 Case A-Normal Delivery to a Gravity Flow Pipeline in Nonscheduled Operation

a) When the liquid level in the delivery tank reaches the normal high working level, the charge pump starts and the control valve opens to the pipeline, admitting flow through the meter.

b) When the valve reaches its open-to-pipeline position, the automatic sampler begins sampling as soon as the meter starts turning.

c) Under normal conditions, delivery to the pipeline continues until the liquid level reaches the normal low-level position.

d) The back-pressure valve then closes the pipeline outlet; the charge pump stops, and the automatic sampler stops sampling when the meter stops turning.

A.1.2 Case B-Normal Delivery to a Pressurized Pipeline in Nonscheduled Operation

a) When the liquid level in the delivery tank reaches the normal high working level, the charge pump starts and the control valve opens to the pipeline, admitting flow through the meter.

b) When the valve reaches its open-to-pipeline position, the pipeline shipping pump starts and the automatic sampler begins sampling as soon as the meter starts turning.

c) Under normal conditions, delivery to the pipeline continues until the liquid level reaches the normal low-level position.

d) The charge pump stops, the back-pressure valve closes the pipeline outlet, and the pipeline shipping pump is shut down.

A.1.2 Case C-Normal Delivery to a Pipeline in Scheduled Operation

Some pipeline systems are operated on a schedule whereby it is desirable to admit oil only during a certain interval. For this arrangement, the operation sequence shall be the same as for non-scheduled delivery (6.1.6.4.1 and 6.1.6.4.2) except that a time-interval controller shall be added to the circuit that overrides the normal high working level control.

A.2 Non merchantable oil interruption

In each of the three cases, the following procedures shall be followed:

a) After delivery to the pipeline has begun, if non merchantable oil flows continuously past the water monitor for a predetermined time interval, the charge pump is automatically stopped unless the pump is required to circulate oil for treatment

b) The valve closes, stopping flow to the pipeline.

c) The automatic sampler remains energized in case of inadvertent flow through the meter

d) The controls lock out the transfer of oil to the pipeline until the non merchantable oil has been treated to meet specifications.

The LACT unit can be designed to restart automatically after a period of recirculation.

Bibliography

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[3] API 11N : 1994 Specification for Lease Automatic Custody Transfer (LACT) equipment

[4] API MPMS Chapter 7 Temperature Determination

[5] API MPMS 12.2 Manual of Petroleum Measurement Standards Chapter 12—Calculation of Petroleum Quantities

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