



REPUBLIC OF GHANA

**PETROLEUM (EXPLORATION AND
PRODUCTION) (MEASUREMENT)
REGULATIONS, 2016**

(L.I. 2246)

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(MEASUREMENT) REGULATIONS, 2016**

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In exercise of the power conferred on the Minister by section 32 (2) (a) of the Petroleum (Exploration and Production) Act, 1983 (P.N.D.C.L. 84), these Regulations are made this 26th day of July, 2016.

Preliminary Provisions

Application

1. These Regulations apply to the

- (a) planning, design, testing, calibration, operation and maintenance of a metering system, equipment and methods for
 - (i) measuring the quantities of petroleum produced, transported or sold,
 - (ii) determining allocated quantities of petroleum produced, transported or sold, and
 - (iii) measuring of petroleum used for fuel or flare gas in petroleum activities;
- (b) planning, design and operation of an allocation system for the allocation of petroleum between contractors, licensees or the Corporation; and
- (c) documentation, reporting and applications related to the measurement, allocation, metering system, equipment or method of measurement.

Purpose

2. The purpose of these Regulations is to ensure that an accurate measurement and allocation of petroleum forms the basis for the determination of revenue that accrues to the Republic, a contractor, licensee or the Corporation.

Compliance

3. A contractor, licensee or the Corporation shall

- (a) comply with these Regulations, directives and instructions issued by the Commission pursuant to these Regulations;
- (b) ensure that an employee, an agent or a subcontractor of the contractor, licensee or the Corporation complies with these Regulations, directives and instructions issued by the Commission pursuant to these Regulations; and

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- (c) ensure that a person acting directly or indirectly for the contractor, licensee or the Corporation complies with these Regulations, directives and instructions issued by the Commission pursuant to these Regulations.

Supervision and inspection

4. (1) The Commission may
- (a) conduct the supervision and inspection of a metering system and an allocation system from the design stage to the operation stage; and
 - (b) in consultation with the Standards Authority, appoint an independent person to conduct supervision and inspection on a metering system or an allocation system from the design stage to the operation stage.
- (2) A contractor, licensee or the Corporation whose metering system and allocation system are the subject of supervision or inspection, shall assist the Commission or the person appointed by the Commission to carry out the supervision or inspection.
- (3) The Commission may require a contractor, licensee or the Corporation to bear the expenses of the supervision or inspection.

Placement of seals on critical valves

5. An authorised agency may place a seal on the export valve downstream of a metering station to prevent offloading of petroleum without authorisation.

Use of standards

6. (1) The Commission may approve of the use of a technology or method other than that specified in these Regulations and in standards recommended by the Commission where
- (a) the contractor, licensee or the Corporation demonstrates that the standard, technology or method employed achieves a similar or better level of fidelity, uncertainty and reliability than that specified in these Regulations; or
 - (b) the criterion for the development, testing and operation of the technology or method is established.

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(2) The Commission may approve simplifications in metering if supported by a risk-cost-benefit analysis as set out in the Third Schedule.

Requirements Relating to Management System

Quality management system

7. (1) A contractor, licensee or the Corporation shall develop, implement and maintain a quality management system for petroleum measurement and allocation in accordance with internationally recognised standards.

(2) The quality management system shall form part of the overall management system of a contractor, licensee or the Corporation.

(3) The contractor, licensee or the Corporation shall inform the Commission of a revision of the quality management system.

Responsibility and qualifications

8. A contractor, licensee or the Corporation shall

- (a) nominate a person with the requisite technical competence to be responsible for the metering systems and the allocation systems;
- (b) inform the Commission of the person nominated under paragraph (a);
- (c) specify the responsibility for the on-site day-to-day operation of the metering system; and
- (d) ensure that a person engaged in fiscal metering activities possesses the requisite qualifications and competence to perform the activities.

General Requirements Relating to Allocation, Measuring and Metering System

Uncertainty requirements

9. (1) The maximum allowable measurement uncertainty limits at ninety-five percent confidence level are as set out in the First Schedule.

(2) A contractor, licensee or the Corporation shall carry out an uncertainty analysis for a metering system in accordance with internationally recognised standards with the resulting uncertainty presented at ninety-five percent confidence level.

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(3) The contractor, licensee or the Corporation shall ensure that the uncertainty analysis includes sensitivities of all significant uncertainty contributors to the overall uncertainty and covariances between the uncertainty contributors where applicable.

(4) The maximum uncertainty limits at ninety-five percent confidence level related to a metering system are as set out in the Second Schedule.

(5) The contractor, licensee or the Corporation shall take reasonable steps to avoid systematic measurement errors.

Calibration and traceability

10. (1) A contractor, licensee or the Corporation shall ensure that measurements and calibrations made under these Regulations are traceable to national and international measurement standards.

(2) The contractor, licensee or the Corporation shall ensure that an instrument used for calibration or tracing is adjusted where a calibration result has significant influence on a fiscal figure.

(3) A third party laboratory used to calibrate equipment covered by these Regulations shall

(a) be accredited in accordance with internationally recognised standards; and

(b) have a documented uncertainty equal or better than those set out in the Second Schedule.

(4) The contractor, licensee or the Corporation shall ensure that a laboratory analysis of the composition or quality of petroleum for custody transfer and allocation purposes is carried out by a competent or an accredited laboratory.

Units of measurement

11. (1) The readings of

(a) a metering system shall be in SI units;

(b) pressure may be in bar; and

(c) temperature may be in degree Celsius.

(2) The critical parameters of a metering system shall be measured in SI units.

(3) A contractor, licensee or the Corporation shall

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- (a) report petroleum measurements to the Commission in SI units; and
- (b) convert and report to the Commission, the net volume of oil in barrels.

Reference conditions

12. (1) The reference conditions for temperature and pressure to determine standard volume is 15 °C and 101.325 kPa.

(2) A reference pressure other than 101.325 kPa may be used for condensate and liquefied petroleum gas.

Bypass of metering system

13. A person shall not bypass a metering system.

Allocation systems

14. (1) A contractor, licensee or the Corporation shall develop an allocation system for the allocation of petroleum quantities commingled from fields consisting of different ownership and royalty interests.

(2) The contractor, licensee or the Corporation shall maintain a field balance or a plant balance of fluids produced, exported, injected, transferred, flared, disposed of or used for fuel, gas lift or other utilities.

(3) In the case of a pipeline system, a contractor, licensee or the Corporation shall maintain a mass balance.

Design of a Metering System

General design considerations

15. (1) A contractor, licensee or the Corporation shall ensure that the design of a metering system, including installation and equipment, are in accordance with these Regulations and internationally recognised standards.

- (2) The contractor, licensee or the Corporation shall ensure that
 - (a) the metering system is suitable for
 - (i) the relevant type of measuring,
 - (ii) the fluid properties, and
 - (iii) the petroleum quantities to be measured;
 - (b) the metering system can measure the full range of planned

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- petroleum flow without any component operating outside the specified working range;
- (c) measurement errors that may be caused by similar drifting in duplicated instruments due to process conditions are minimised;
 - (d) each part of the metering system is easily accessible for maintenance, inspection and calibration;
 - (e) external conditions do not affect the operation and maintenance of the metering system;
 - (f) it is possible to safely remove an individual element from a metering system for custody transfer measurements without a shut-down of the production system;
 - (g) parameters related to the fiscal calculations are readily accessible in the computer part of the metering system or through a service computer; and
 - (h) provision is made for condition monitoring.

Design of mechanical part of metering systems

16. (1) A contractor, licensee or the Corporation shall design the mechanical part of the metering system so that representative measurements are achieved as input signals for a fiscal calculation.

- (2) A single-phase metering system shall be designed
 - (a) to meet the uncertainty requirements set out in the First Schedule; and
 - (b) shall include
 - (i) provisions to maintain all fluids in a single-phase;
 - (ii) sufficient redundancy to measure maximum flow within required measurement uncertainty where a meter or a meter run is out of service;
 - (iii) measures to provide a sufficiently developed flow profile at the position of the measurement;
 - (iv) a temperature measurement point and a pressure measurement point located in a manner that ensures that measurements are representative of conditions at a meter and a proving device;

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- (v) provisions for the verification of temperature measurements;
- (vi) measures to prevent ambient temperature and other external factors affecting a measurement; and
- (vii) adequate valve arrangements for operations and maintenance.

(3) A metering system for sales and custody transfer of petroleum shall be in accordance with nationally and internationally recognised standards for custody transfer measurements.

(4) A metering system for sales and custody transfer of liquid petroleum

(a) shall be designed to meet the requirements set out in subregulation (2); and

(b) shall include

- (i) a displacement prover for the calibration of duty meters; or
- (ii) a master meter in a by-pass loop with provisions for flushing;
- (iii) a provision for the calibration of the proving device at the place of operation; and
- (iv) a provision for the injection of inhibitors where the metering system is exposed to deposits.

(5) A metering system for sales and custody transfer of gas shall be designed to meet the requirements in subregulation (2).

(6) A fuel gas metering system shall be designed to meet the requirements in subregulation (2), where the requirement in subparagraph (ii) of paragraph (b) of subregulation (2) may be fulfilled by

- (a) a single meter run and a by-pass run with sufficient measures to prevent accidental flow through the by-pass run; or
- (b) a single meter run with two meters in series.

(7) A flare gas metering system shall be designed

- (a) in accordance with paragraph (a) of subregulation (2) and subparagraphs (iii), (iv), (v) and (vi) of paragraph (b) of subregulation (2); and

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- (b) to ensure that the sensors of the flare gas metering system are accessible for maintenance during operation.
- (8) A single-phase metering system and a multi-phase metering system forming a part of an allocation system shall be designed to provide a sound basis as input to the allocation system.
- (9) A valve that has an impact on a measurement shall
 - (a) have double barriers;
 - (b) have a monitoring function;
 - (c) be accessible for inspection; and
 - (d) not generate noise that interferes with the signal of an instrument.

Design of instrument parts

17. (1) A contractor, licensee or the Corporation shall ensure that the instrument part of a metering system
- (a) has specifications that are consistent with the requirements as set out in the Second Schedule;
 - (b) consists of a material compatible with the fluid that it is exposed to;
 - (c) is located in a manner that achieves representative measurements as an input signal for fiscal calculation;
 - (d) is mounted according to the instructions of the manufacturer and recommendations made in national or internationally recognised standards recommended by the Commission;
 - (e) includes a signal transmission system which provides fidelity and security of an instrument signal; and
 - (f) facilitates the active interpretation of diagnostic data, where applicable.
- (2) A flow meter shall
- (a) be suitable for the intended application with regard to process parameters including
 - (i) maximum and minimum flow rates,
 - (ii) Reynolds number,
 - (iii) temperature,

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- (iv) pressure,
 - (v) density, and
 - (vi) viscosity;
 - (b) have a dimension that ensures that the flow meter is calibrated over the operating range; and
 - (c) where applicable,
 - (i) have documented performance with respect to fractions of other fluid phases, that is water, gas or liquids, than the one subject to the measurement;
 - (ii) incorporate temperature and pressure compensation routines;
 - (iii) have provisions for software identification; and
 - (iv) have provisions for protection of software and data.
- (3) A displacement prover shall
- (a) be sized for proving of a flow meter over its operating range;
 - (b) be equipped with piping for calibration, ventilation, drainage, and where necessary, pressure relief; and
 - (c) in the case of a sphere displacer be
 - (i) bidirectional; and
 - (ii) equipped with switches for at least four distinct volumes; and
 - (d) in the case of a piston displacer be mounted vertically, where practicable.
- (4) A master meter shall
- (a) meet the requirements as stipulated for a liquid flow meter in the Second Schedule;
 - (b) be sized to prove a line meter such that the operating range of the line meter falls within the proven operating range of the master meter; and
 - (c) be selected to minimize the effect of variances in flow rate and viscosity.
- (5) A temperature measuring instrument, a pressure measuring instrument, a differential pressure measuring instrument and a density measuring instrument shall each

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- (a) transmit a signal to a computer part digitally;
 - (b) have an integrated local indicator displaying the measurement result; and
 - (c) provide for sensor linearization, where applicable.
- (6) A density measuring system of by-pass type shall
- (a) facilitate corrections to the conditions at the point of flow measurement;
 - (b) be equipped with two density measuring instruments; and
 - (c) be configured in a manner that allows the density measuring instruments run in parallel and in series.
- (7) A gas chromatograph shall be capable of analysing all components within the uncertainty limits as set out in the Second Schedule.
- (8) A single-phase gas metering system for custody transfer shall be equipped with two independent gas analysis systems.
- (9) A gas chromatograph system shall be designed to determine a flow-weighted calorific value.

Design of sampling system

18. (1) A single-phase metering system shall include a sampling system for determining the representative mean composition of the bulk quantity of petroleum and quality of the bulk quantity of petroleum.
- (2) A sampling system for a single-phase metering system shall
- (a) be capable of providing a sample that, at the location and time of samplings has the same composition as the average composition of the petroleum over the whole cross-section of the pipeline;
 - (b) be capable of transporting a sample to a storage unit or an analytic unit without
 - (i) loss of liquid, solid or gas; and
 - (ii) contamination of the sample;
 - (c) be configured in a manner that sampling is automatic;
 - (d) be configured in a manner that sampling is flow proportional;

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- (e) be capable of collecting representative sample volumes;
 - (f) be capable of dividing a sample into a number of sub-samples in a manner that ensures that each sub-sample has the same composition as the sample; and
 - (g) include a facility for manual sampling.
- (3) A gas sample may be transferred directly to an analytical unit.
- (4) Where a gas sample is transferred directly to an analytical unit, paragraphs (a), (b) and (c) of subregulation (2) shall apply.

Design of computer part

19. (1) A metering system shall include a dedicated computer part for purposes of

- (a) calculating flow of petroleum;
 - (b) calculating the quantities of petroleum accumulated;
 - (c) reporting; and
 - (d) system control.
- (2) A contractor, licensee or the Corporation shall
- (a) dedicate a flow computer to each meter run; or
 - (b) where a multiple meter run is computed by one machine, provide a hot operating independent standby to allow maintenance or replacement of parts of a computer system to be carried out without interruption to the measurement of petroleum.
- (3) The contractor, licensee or the Corporation shall ensure that the computer part under subregulation (1)
- (a) is capable of performing calculations within the uncertainties as set out in the Second Schedule;
 - (b) is capable of performing a full calculation cycle within one second;
 - (c) is equipped with security functions to ensure that measurement figures cannot be changed as a result of incidents of a technical nature or as a result of a manual fault;
 - (d) is capable of documenting the various fiscal parameters and the fiscal quantities calculated;

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- (e) has uninterruptible power supply such that a power failure shall not cause loss of measured data;
- (f) is capable of detecting equipment faults as an alarm and where applicable activating a back-up system;
- (g) is capable of logging all events with a time stamp; and
- (h) clearly marks manually entered parameters, where substituting live values, on the screen and in reports.

Testing and Calibration Prior to Start-up of Metering System

General requirements on testing and calibration

20. (1) A contractor, licensee or the Corporation shall, prior to start-up of a metering system, test the metering system and document or record in detail the result of the test and indicate whether the metering system meets the requirements set out under these Regulations.

(2) The contractor, licensee or the Corporation shall ensure that critical elements of a metering system are

- (a) fully operational, with the requisite functionality; and
- (b) capable of operating within required tolerances.

(3) The contractor, licensee or the Corporation shall develop

- (a) project specific test procedures for a Factory Acceptance Test and a Site Acceptance Test that are in compliance with
 - (i) the requirements under these Regulations,
 - (ii) relevant standards, and
 - (iii) instructions of the manufacturer, and
- (b) an acceptance criterion for the Factory Acceptance Test and the Site Acceptance Test.

(4) The contractor, licensee or the Corporation shall submit to the Commission a plan and procedure for the tests referred to in subregulation (3), at least one month before carrying out the tests.

(5) The Commission may authorise a person to witness a calibration or a test of a metering system.

(6) The contractor, licensee or the Corporation shall, within one month of completion of a test referred to in this regulation and regulations 21 to 24, submit to the Commission a report summarising

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the results of the test, identifying any problems encountered and action points to address.

Calibration of instrument parts

21. (1) A contractor, licensee or the Corporation shall ensure that an instrument

- (a) is calibrated before initial installation, and
- (b) transmits signals, to a computer part,

in accordance with subregulation (3) of regulation 20.

(2) The contractor, licensee or the Corporation shall document geometrical parameters critical to the measurement uncertainties as set out in the First and Second Schedules.

(3) The contractor, licensee or the Corporation shall, in accordance with subregulation (3) of regulation 20, carry out a test including a flow calibration test, on a flow meter along with representative upstream and downstream pipework to

- (a) verify the meter performance across ranges of flow, flow profiles, pressure, temperature, density and viscosity of the fluid that the flow meter may be exposed to during its life span or as close to these conditions as is practically possible with respect to a flow meter,
- (b) demonstrate compliance with the linearity and repeatability requirements of a flow meter,
- (c) establish and implement a calibration curve or calibration factor of a flow meter,
- (d) verify an implemented calibration curve or calibration factor of a flow meter, and
- (e) collect relevant data as reference for condition monitoring of a flow meter.

(4) A flare gas flow meter and a flow meter based on standardised geometric measurement

- (a) shall be tested in accordance with subregulation (3) of regulation 20; and
- (b) may be tested without undergoing the flow calibration test referred to in subregulation (3).

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(5) The contractor, licensee or the Corporation shall ensure that an accredited laboratory or service company determines a base volume of a displacement prover within the uncertainty limits set out in the Second Schedule

- (a) before the prover leaves the place of manufacture; and
- (b) before start up at the place of operation.

(6) The contractor, licensee or the Corporation shall, in accordance with subregulation (3) of regulation 20, carry out a test on a gas chromatograph including verification of the

- (a) ability to separate components,
- (b) stability,
- (c) linearity over the measuring range for each component,
- (d) repeatability,
- (e) calibration function,
- (f) calculations of individual components, gross calorific value, and density at standard conditions,
- (g) alarm and event generation,
- (h) restart after power loss, and
- (i) generation of analysis report,

of the gas chromatograph.

Verification of sampling system

22. (1) A contractor, licensee or the Corporation shall, in accordance with subregulation (3) of regulation 20, carry out tests on an automatic system for indirect sampling including verification of the

- (a) instrumentation,
- (b) pumps,
- (c) grab sampler,
- (d) pipings,
- (e) receiver system, and
- (f) sampling receiver filling monitoring,

of the automatic system for indirect sampling.

(2) The contractor, licensee or the Corporation shall, in accordance with subregulation (3) of regulation 20, carry out tests on an automatic system for direct gas sampling including verification of the

- (a) transport time,

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- (b) dew point temperature control,
- (c) pipings,
- (d) valve functions for different sample streams, and
- (e) venting of waste samples,

of the automatic system for direct gas sampling.

Verification of computer part

23. (1) A contractor, licensee or the Corporation shall, in accordance with subregulation (3) of regulation 20, carry out tests on a computer part including verification of the

- (a) calculations of flow,
- (b) accumulation of quantities,
- (c) system control functions,
- (d) alarm functions, and
- (e) reporting functions,

of the computer part.

(2) The contractor, licensee or the Corporation shall assess each independent programme routine to verify that the total uncertainty is within the total uncertainty limit for calculations as set out in the Second Schedule.

(3) The contractor, licensee or the Corporation shall verify the computations and reporting related to the allocation system referred to in subregulation (1) of regulation 14.

Testing of assembled metering system

24. (1) A contractor, licensee or the Corporation shall ensure that an assembled metering system including instruments and computer parts is tested at the place of manufacture for full functionality.

(2) The contractor, licensee or the Corporation shall, in accordance with subregulation (3) of regulation 20, carry out tests on the assembled metering system including

- (a) visual inspection of equipment to verify design and compliance with drawings,
- (b) test of the instrumentation interface,
- (c) review of the computer display,

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- (d) verification of calculation function,
- (e) automatic valve operation and flow balancing,
- (f) where applicable, verification of functional aspects related to flow calibration of duty meters, and
- (g) review of reporting function,

of the assembled metering system.

(3) The contractor, licensee or the Corporation shall perform the test in subregulations (1) and (2) on liquid metering system with flow.

Operation and Maintenance of Metering System

General operation and maintenance requirements

25. (1) A contractor, licensee or the Corporation shall operate a metering system

- (a) in accordance with the requirements of these Regulations; and
- (b) in a manner that ensures that the measurement uncertainty is within the measurement uncertainty limits as set out in the First Schedule.

(2) The contractor, licensee or the Corporation shall

- (a) monitor the performance of a metering system;
- (b) monitor the performance of an allocation system;
- (c) establish relevant alarm limits for an instrument;
- (d) utilize diagnostic tools of instruments; and
- (e) compare parallel or supplementary data, where practicable.

(3) The contractor, licensee or the Corporation shall maintain a metering system to the standard to which the metering system is designed.

(4) The contractor, licensee or the Corporation shall ensure that a frequency of verification and calibration of an instrument

- (a) is such that the uncertainty of the measured figure does not exceed the uncertainty requirements as set out in the Second Schedule; and
- (b) takes into account factors such as
 - (i) the specification of the manufacturer for the instrument as regards uncertainty and stability;

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- (ii) process conditions;
 - (iii) results of previous verifications and calibrations;
 - (iv) method of calibration;
 - (v) estimated uncertainty in the period between a verification or a calibration;
 - (vi) probability of error; and
 - (vii) consequences of an error;
- (c) is evaluated after
- (i) a verification or calibration; and
 - (ii) after a failure; and
- (d) is supported by documentation.

(5) A contractor, licensee or the Corporation shall ensure that an instrument is calibrated and verified in accordance with the default and maximum periods for verification and calibration as set out in the Fourth Schedule.

Operation and maintenance of valves

26. A contractor, licensee or the Corporation shall ensure that a valve of a metering system

- (a) is operated in accordance with the design; and
- (b) that the integrity of valves are maintained.

Operation and maintenance requirements for flow meters

27. A contractor, licensee or the Corporation shall

- (a) operate a flow meter within the specification provided by a vendor for
 - (i) flow range,
 - (ii) operating conditions, and
 - (iii) fluid properties,
- (b) continuously monitor a flow meter;
- (c) inspect a flow meter after each incident that affects the measuring quality;
- (d) recalibrate or reprove a meter where a damage or fault that affects the traceability and uncertainty of the measurement is detected; and
- (e) re-calibrate or verify a flow meter in accordance with subregulations (4) and (5) of regulation 25.

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Operation and maintenance of proving device

28. (1) A contractor, licensee or the Corporation shall determine a meter factor or k-factor of a flow meter

- (a) at stable operating conditions with respect to factors including
 - (i) flow rate;
 - (ii) density;
 - (iii) viscosity;
 - (iv) temperature; and
 - (v) pressure;
- (b) within the repeatability limit as set out in the Second Schedule; and
- (c) in accordance with subregulations (4) and (5) of regulation 25.

(2) The contractor, licensee or the Corporation shall, in the case of a prover based metering system,

- (a) determine the sensitivity of a meter factor or k-factor to variations in process conditions;
- (b) set relevant re-prove alarm limits;
- (c) set limits for acceptance of new meter factors or k-factor as compared to previous meter factors or k-factors; and
- (d) provide a log of meter factors and k-factors.

(3) A liquid meter proving device shall be re-calibrated by a certified company or at an accredited flow laboratory

- (a) in accordance with subregulations (4) and (5) of regulation 25; and
- (b) after each repair, equipment failure or any other occurrence that affects the validity of the measurements traceability and uncertainty.

(4) A liquid meter proving device used in a metering system for custody transfer measurement shall be calibrated in situ at the place of operation.

Operational requirements for gas chromatographs

29. (1) Where a gas chromatograph is in use, a contractor, licensee or the Corporation shall

- (a) continuously monitor the composition and calorific value of the process gas;

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- (b) provide a log of retention times determined at calibration;
 - (c) provide a log of response factors determined at calibration; and
 - (d) calibrate the gas chromatograph by analysing a certified calibration gas in accordance with subregulations (4) and (5) of regulation 25.
- (2) A calibration gas shall have a composition and a calorific value
- (a) representative of the composition and the calorific value of the gas analysed by the gas chromatograph in normal operation;
 - (b) such that the gas analysis by the gas chromatograph in normal operation meets the requirements as set out in the Second Schedule; and
 - (c) certified by an accredited flow laboratory.
- (3) Acceptance criteria for the calibration in paragraph (b) of subregulation (1) shall be based on the requirements as set out in the Second Schedule.
- (4) A contractor, licensee or the Corporation shall ensure that
- (a) an adjustment is made and verified by a subsequent calibration if the results of the calibration in subregulation (1) do not meet the acceptance criteria referred to in subregulation (3); and
 - (b) an independent calculation is performed, using a dedicated computer programme to calculate and compare gas physical properties to those presented by the gas chromatograph for the corresponding gas composition parameters after replacement of a calibration gas.
- (5) The contractor, licensee or the Corporation shall perform a linearity test where changes in process conditions have triggered a new calibration gas with composition outside the linearity of the analyser.

Operational requirements for pressure, temperature and density instruments

30. (1) A contractor, licensee or the Corporation shall
- (a) ensure that pressure, temperature and density instruments are operated in accordance with their specifications and within their calibrated range;

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- (b) recalibrate or verify the instruments in accordance with subregulations (4) and (5) of regulation 25; and
- (c) maintain and recalibrate an instrument if the instrument deviates from pre-set limits.

(2) Where two instruments are used and recalibrations are staggered, the most recently calibrated instrument shall be used as the primary instrument.

(3) The contractor, licensee or the Corporation shall ensure that linearization constants are incorporated in a temperature measuring instrument.

(4) The contractor, licensee or the Corporation shall verify a gas density measuring instrument against a calculated density or any other relevant method.

(5) The contractor, licensee or the Corporation shall ensure that a differential pressure measuring instrument is

- (a) calibrated at a high static pressure that is representative of the normal operating pressure for the instrument, and
- (b) verified at atmospheric pressure.

Operating requirements for computer part

31. (1) A contractor, licensee or the Corporation shall

- (a) establish and maintain a back-up system to ensure that computer operations can be re-established where a fault occurs;
- (b) establish a procedure for the handling of an error message and a fault;
- (c) carry out a verification of calculations after a software change and a replacement of a computer part; and
- (d) establish a master list for all constants employed by the computer part.

(2) The contractor, licensee or the Corporation shall ensure that the calculation referred to in paragraph (c) of subregulation (1) is verified with an independent calculation software system.

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Operating requirements for sampling and analysis

32. (1) A contractor, licensee or the Corporation shall operate and maintain a sampling system in a manner that a sample acquired from the sampling system is representative of the bulk quantity measured.

(2) The contractor, licensee or the Corporation shall in the case of a liquid sampling system

- (a) ensure adequate mixing upstream of the sampling system;
- (b) ensure that a spot sample is continually received;
- (c) ensure that the sampling is flow proportional;
- (d) optimize mixing time to ensure representative sub-samples;
- (e) use a container that will not deteriorate or contaminate the sample;
- (f) have operating instructions available in the sampling cabinets; and
- (g) ensure that a manual sampling is available.

(3) The contractor, licensee or the Corporation shall

- (a) in analysing petroleum at a laboratory
 - (i) ensure that the analysis is performed on a sub-sample which is representative of the sample, and
 - (ii) document results of the analysis, and
- (b) maintain the equipment used for analysis.

Operational requirements for test equipment

33. (1) A contractor, licensee or the Corporation shall

- (a) dedicate test equipment to fiscal metering activities; and
- (b) store the test equipment onsite at conditions prescribed by the manufacturer.

(2) The contractor, licensee or the Corporation shall calibrate a test equipment in accordance with subregulations (4) and (5) of regulation 25.

Correction of mismeasured quantity of petroleum

34. (1) A contractor, licensee or the Corporation shall correct a mismeasured quantity of petroleum where

- (a) the error is larger than 0.1 times the maximum allowable measurement uncertainty of the fiscal figure as set out in the First Schedule and the cost of correction is less than the value of the mismeasured quantity; or

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(b) the total value of the mismeasured quantity exceeds the cost of correction even though the error is less than 0.1 times the maximum allowable measurement uncertainty of the fiscal figure as set out in the First Schedule.

(2) Where there is doubt as to the time at which a measurement error arose, the contractor, licensee or the Corporation shall correct the measurement for half of the maximum possible time span within which the error could have occurred.

(3) Where a correction for a mismeasured quantity and loss of measurement is to be performed, the contractor, licensee or the Corporation shall perform the correction in accordance with the quality management system.

(4) The contractor, licensee or the Corporation shall ensure that necessary re-allocation is performed and documented.

(5) The contractor, licensee or the Corporation shall submit revised data where corrections affect data that has been reported to the Commission.

Application, Documentation and Information

Application for consent

35. (1) A contractor, licensee or the Corporation shall apply for and obtain written consent from the Commission for

- (a) the design of a metering system and an allocation system;
- (b) the transportation of the metering system from the place of manufacture; and
- (c) the start-up of the metering system.

(2) The contractor, licensee or the Corporation shall not carry out

- (a) a change to the design of the metering system and allocation system;

- (b) a major re-building of the metering system;
- (c) a change to the method of measurement and allocation; or
- (d) a change to the purpose of use of the metering system

without the written consent of the Commission.

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Documentation related to application for consent

36. (1) An application for consent as stipulated in paragraph (a) of subregulation (1) of regulation 35 shall include

- (a) a technical description of the metering system;
- (b) an overview of the location of the metering system;
- (c) uncertainty analysis to demonstrate compliance as specified by these Regulations;
- (d) a list of documentation for the metering system;
- (e) a drawing and description of equipment included in the metering system;
- (f) a progress plan for the project up to the time of application for consent to the start-up of the metering system; and
- (g) any other document that the Commission considers necessary.

(2) An application for consent as stipulated in paragraph (b) of subregulation (1) of regulation 35 shall include documentation to demonstrate that the fully assembled fluid metering system has been tested and calibrated in accordance with regulations 20 to 24, including test reports with calibration certificate and configuration parameters.

(3) An application for consent as stipulated in paragraph (c) of subregulation (1) of regulation 35 shall include

- (a) procedures for calibrations and verifications to be carried out in order to prepare the metering system for start-up; and
- (b) procedures for operation, maintenance, calibration and verification.

Documentation related to the metering system in operation

37. (1) A contractor, licensee or the Corporation shall maintain an archive, available on-site, that contains documents on the quality and traceability of the measurements and metering system.

(2) The archive shall include

- (a) documentation that provides information for an independent verification of the calculations in the computer, including standards used, the version number, year and relevant section;

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- (b) the physical dimensions and parameters which affect the measurement result;
 - (c) documented uncertainty of actual measurements;
 - (d) records of routine calibrations carried out on the metering system; and
 - (e) measurement correction reports.
- (3) A contractor, licensee or the Corporation shall maintain a log available on-site that contains details of non-routine and routine events.
- (4) A contractor, licensee or the Corporation shall ensure that the serial numbers of equipment removed and installed are recorded together with the reason for the removal or installation.
- (5) A contractor, licensee or the Corporation shall make measurement data under these Regulations accessible to the Commission.
- (6) A contractor, licensee or the Corporation shall document the procedures for calibration and inspection, as well as the results of the calibration and inspection.
- (7) A contractor, licensee or the Corporation shall document the quantification of liquid petroleum used for operation of combustion machinery.

Information to Commission

38. A contractor, licensee or the Corporation shall provide the Commission with information on

- (a) the status of a metering system
 - (i) within two months after start-up; and
 - (ii) each quarter subsequently;
- (b) an abnormal situation or error which requires rectification;
- (c) an incident where a fiscal measurement data has been corrected based on calculations;
- (d) the annual plan for activities relating to fiscal metering maintenance;
- (e) a change in calculation software;
- (f) a change that affects the basis on which the consents are given;

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- (g) agreements regarding allocation;
- (h) agreements regarding transport;
- (i) agreements regarding handling of cargo claims;
- (j) a change in cargo claim procedure applicable for sale of petroleum in liquid phase; and
- (k) a change in procedure for allocation of petroleum.

Miscellaneous Provisions

Offences and penalties

39. A person who

- (a) obstructs the Commission in the performance of a function of the Commission,
 - (b) obstructs an authorised agent of the Commission in the performance of a function of the agent,
 - (c) manipulates the measurement of petroleum for fraudulent purposes,
 - (d) knowingly provides wrong information in relation to a measuring, weighing or calibrating device, or
 - (e) contravenes any other provision of these Regulations
- commits an offence and is liable on summary conviction to
- (f) a fine of not less than six hundred penalty units and not more than one thousand penalty units or to a term of imprisonment of not less than three months and not more than six months or to both the fine and the term of imprisonment, and
 - (g) where the offence continues to a further fine of fifty penalty units for each day during which the offence continues.

Exemptions

40. The Commission may under special circumstances and upon application to it, issue written exemptions from the provisions in these Regulations.

Interpretation

41. In these Regulations, unless the context otherwise requires, “accreditation” means a third-party attestation related to a conformity assessment body conveying formal demonstration of its competence to carry out specific conformity assessment tasks;

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- “accredited flow laboratory” means a laboratory accredited to perform calibration of flow meters;
- “adjustment” means a set of operations carried out on a measuring system to provide prescribed indications corresponding to given values of a quantity to be measured;
- “allocation” means an apportionment of petroleum between fields of different ownership and royalties;
- “allocation system” means methods, measurements and estimates used for the allocation of petroleum and appurtenant documentation and procedures;
- “authorised agency” means an institution that has been mandated by law to carry out a task under these Regulations;
- “authorised agent” means a person mandated by an authorised agency to carry out an act pursuant to these Regulations;
- “barrel (bbl)” means a unit of quantity for oil equal to 42 U.S. gallons or 9702.0 cubic inches;
- “calibration” means the establishment of relationship between measured value and reference value with known uncertainty;
- “calibration factor (k-factor)” means the relationship between the measured value coming from a meter and the measured value from a reference measurement system and is normally a designated value that signifies pulses per volume unit;
- “calibration gas” means a reference gas used as comparative standard in the calibration of a gas chromatograph;
- “calorific value” means energy per unit mass or unit volume that is released by complete combustion in the air;
- “Commission” means the Petroleum Commission established under the Petroleum Commission Act, 2011 (Act 821);
- “computer part” means the part of the metering system that consists of dedicated computers performing communication with field equipment, calculation of quantities, system monitoring, reporting and control functions;
- “custody transfer” means a change in ownership or a change in responsibility for commodities;

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- “custody transfer measurement” means a measurement of quantity and quality information used for physical and fiscal documentation of a change in ownership and a change in responsibility for commodities;
- “dew point temperature control” means the ability of a metering system to control the temperature of that metering system in order to ensure that the metering system is kept above the temperature at which hydrocarbon liquids begin to form;
- “displacement prover” means a prover where the displacement of a known volume of liquid from a calibrated section of a pipe is achieved by an oversized sphere or a piston travelling through the pipe;
- “factory acceptance test” means a test that is carried out by the vendor on an equipment before delivery of the equipment from the factory to the place of operation;
- “fiscal metering” means a metering carried out in connection with purchase, sale and the calculation of taxes and royalties;
- “flare gas” means a natural gas burnt off or vented to the atmosphere;
- “flow meter” means an instrument for continuous measurement, registration and display of the amount of petroleum which flows through a pipeline;
- “fuel” includes a natural gas, oil, condensate or diesel used for operation of combustion machinery such as turbines;
- “gas chromatograph” means a device for measuring the gas composition;
- “gas chromatograph system” includes elements in the nature of the sample handling system, analytical units, computer units, GC controllers and calibration equipment;
- “grab sample” means the volume of a sample extracted from a pipeline by a single actuation of a sampling device;
- “gas single phase metering system” means a metering system for gas;
- “independent person” means a competent company or person appointed by the Commission to carry out supervision or inspection on behalf of the Commission;

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- “input signals” mean signals provided by an instrument at the digital input of the computer part of the metering system;
- “inspection” means examination of a product design, product, process or installation and determination of its conformity with specific requirements or, on the basis of professional judgment, with general requirements;
- “instrument” means an assembly consisting of a transducer and one or more sensing elements whereby the signal from an instrument represents a physical condition and a technical device used to measure a physical parameter;
- “instrument part” means a part of the metering system from the measuring instrument to the digital input of the computer part;
- “instrumental drift” means continuous or incremental change over time in indication, due to changes in metrological properties of a measuring instrument;
- “international measurement standard” means a measurement standard recognized by signatories to an international agreement and intended to serve worldwide;
- “linearity” means the difference between the value measured by a measuring instrument and a reference value through the operational range of the measuring instrument;
- “liquefied natural gas (LNG)” means natural gas mainly consisting of methane (CH₄) refrigerated to liquefied form at about minus 160 degrees C, with density at atmospheric pressure of around 430 – 460 kg/m³ and standard density is typically in the area 0.67 – 0.74 kg/Sm³;
- “liquid single phase metering system” means a metering system for oil, condensate and liquefied petroleum gas;
- “maintenance” means a process of conducting a calibration, verification, diagnostic, proving, internal inspection or repair to a meter system to ensure it is operating in the correct manner to meet the expected uncertainty requirements;

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- “manual sampling” means the steps taken manually to obtain a sample that is representative of the contents of a pipe, tank or other vessel;
- “maximum permissible error” means an extreme value of measurement error, with respect to a known reference quantity value, permitted by specifications or regulations for a given measurement, measuring instrument, or measuring system;
- “measurand” means quantity intended to be measured;
- “measurement error” means a measured quantity value minus a reference quantity value;
- “measurement traceability” means a property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty;
- “measurement uncertainty” means a non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used;
- “measuring instrument” means a device used for making measurements, alone or in conjunction with one or more supplementary devices;
- “mechanical part” means a mechanical equipment included in a metering system;
- “meter factor of a flow meter” means a dimensionless term that states the relationship between the measured value coming from a meter and the measured value from a reference measurement system;
- “metering station” means an assembly of metering equipment dedicated to the determination of measured quantities;
- “metering system” means the mechanical parts, instrument parts, sampling system and computer parts, as well as appurtenant documentation and procedures;
- “national measurement standard” means a measurement standard recognised by a national authority to serve in a State or economy as the basis for assigning quantity values to other measurement standards for the kind of quantity concerned;

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- “place of manufacture” means a place where fabrication, assembly and testing of one or more of the main components of the metering system takes place;
- “place of operation” means a facility or terminal where the metering system is in service;
- “pressure measurement point” means the physical location at which pressure is measured;
- “prover based metering system” means a single phase liquid metering system in which a proving device forms part of the metering system;
- “proving” means the procedure used to determine a meter factor or a k-factor;
- “proving device” means a displacement prover or master meter used for proving flow meters;
- “quality management system” means a part of a management system with regard to quality;
- “repeatability” means the quality, which characterizes the ability of a measuring instrument to give identical indications or responses for repeated applications of the same value of the measured quantity under stated conditions of use;
- “response factor” means the ratio between the concentration of a compound being analysed and the response of the detector of a gas chromatograph to that compound;
- “representative measurement” means a measurement that is representative of the quantity intended to be measured;
- “retention time” means the time taken for a particular gas compound to travel through the column to the detector of a gas chromatograph;
- “Reynolds number” means the ratio of inertial force to viscous force and is a dimensionless number used in fluid mechanics to indicate whether fluid flow in a pipe is steady or turbulent;

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- “S.I. units” mean the system of units of measurement recommended by the International System of Units;
- “sampling” means all the steps required to obtain a sample that is representative of the contents of a pipe, tank or other vessel;
- “sampling receiver” means a container, for collecting a fluid sample when indirect sampling is necessary;
- “sampling receiver filling monitoring” means a system to monitor the filling ratio of the sampling receiver;
- “sampling system” means a system for the extraction of a sample from the fluid flowing in a pipe and which consists of sample probe, transfer lines and pressure reduction facility and sampling receivers where applicable;
- “single phase liquid” means oil, condensate and liquefied petroleum gas;
- “site acceptance test” means a test that is carried out on an equipment at the place of operation before start-up;
- “stability” means the property of a measuring instrument, whereby its metrological properties remain constant in time;
- “standard” means a specification, technical recommendation, or similar normative document prepared under the auspices of national or international standardization organisations;
- “start-up” means introduction of petroleum to the metering system for the first time;
- “temperature measurement point” means the physical location at which temperature is measured;
- “testing” means determination of one or more characteristics of an object of conformity assessment, according to a procedure;
- “traceability” means ability to trace the history, application or location of that which is under consideration;
- “verification” means provision of objective evidence that a given item fulfils specified requirements;
- “verification certificate” means a document certifying that the verification of the measuring instrument was carried out and compliance with statutory requirements was confirmed;
- and

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FIRST SCHEDULE

(Regulations 9(1), 16 (2)(a), 21(2), 25(1)(b) and 34(1)(a) and (b))

Maximum allowable measurement uncertainty at ninety-five percent confidence level

The maximum allowable measurement uncertainties at ninety-five percent confidence level are specified below:

| | Measurand | Maximum allowable uncertainty |
|----|--|--|
| 1. | Metering for sales and custody transfer of | |
| | (a) oil by ship loads | 0.25 % of net standard volume per ship load |
| | (b) oil via pipeline | 0.30 % of net standard volume per production day |
| | (c) Liquefied Petroleum Gas and Condensate | 0.30 % of dry mass per ship load or production day |
| 2. | Metering for sales and custody transfer of gas | 1.0 % of mass per production day |
| 3. | Metering for sales and custody transfer of Liquefied Natural Gas | 0.50 % of measured energy content per ship load |
| 4. | Fuel gas consumption | 1.5 % of standard volume per month |
| 5. | Flared gas | 5.0 % of standard volume per month |

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SECOND SCHEDULE

*(Regulations 9(4), 10(3)(b), 17(1)(a), 17(4), 17(7), 19(3)(a), 21(2),
21(5), 23(2), 25(4)(a), 28(1)(b), 29(2)(b) and 29(3))*

Uncertainties related to a metering system

The following maximum uncertainty limits at ninety-five percent confidence level apply for the different parts of a metering system:

1. Instruments for metering system for sales, custody transfer and allocation of liquid petroleum

| Instrument | Total Uncertainty Limit | Component Specification | Maximum permissible error at calibration | Linearity band at calibration | Uncertainty related to repeatability |
|---------------------------|---|--------------------------|--|---|--------------------------------------|
| (a) Displacement prover | 0.04 % for all 4 volumes | | | | 0.011 % for all 4 volumes |
| (b) Ultrasonic flow meter | 0.20 % of actual volume in working range of flow rate, minimum (10:1) | Minimum 4 acoustic paths | 0.20 % | 0.30 % in range of flow rate (10:1) | 0.027 % |
| (c) Turbine flow meter | 0.20 % of actual volume in working range of flow rate, minimum (10:1) | - | - | 0.50 % in range of flow rate (10:1) 0.30 % in range of flow rate (5:1) | 0.027 % |
| (d) Coriolis flow meter | 0.20 % of mass in working range of flow rate, minimum (10:1) | - | - | 0.30 % in range of flow rate (10:1) | 0.027 % |

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| | | | | | | |
|-----|-----------------------------------|---|---|---|---|---|
| (e) | Displacement flow meter | 0.20 % of actual volume in working range of flow rate, minimum (10:1) | - | - | 0.50 % in range of flow rate (10:1) 0.30 % in range of flow rate (5:1) | 0.027 % |
| (f) | Pressure measuring instrument | For pressure above 5 bara: 0.30 % of measured absolute pressure. For pressure below 5 bara: 15 mbar. | Stability equal to or better than ± 0.1 % of upper range level per 12 months. | 0.10 % of measured pressure before adjustment | - | - |
| (g) | Temperature measuring instrument | 0.30 °C | Stability equal to or better than ± 0.1 °C per 24 months. | 0.20 °C before adjustment | - | - |
| (h) | Density measuring instrument | 0.50 kg/m ³ | - | 0.20 kg/m ³ before adjustment | - | - |
| (i) | Water in oil measuring instrument | For water content 0 to 1.0 volume %: 0.05 volume % absolute. For water content above 1.0 volume %: 5.0 % of measured value. | - | - | - | 0.50 % of measured value at water content over 0.01 volume %. |

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2. Instruments for metering system for sales, custody transfer and allocation of gas

| Instrument | | Total Uncertainty Limit | Component Specification | Maximum permissible error at calibration before adjustment | Linearity band at calibration | Uncertainty related to repeatability |
|------------|--------------------------------------|---|--------------------------|--|---|--------------------------------------|
| (a) | Ultrasonic flow meter, 12" or larger | 0.70 % of actual volume in working range of flow rate, minimum (20:1) | Minimum 4 acoustic paths | Within ± 0.7 % of measured value when average flow velocity is larger than or equal to 1.5 m/s. Within ± 1.4 % of measured value when average flow velocity is less than 1.5 m/s. | 0.7 % over flow rates where average flow velocity is larger than or equal to 1.5 m/s. | 0.22 % |
| (b) | Ultrasonic flow meter, less than 12" | 0.70 % of actual volume in working range of flow rate, minimum (20:1) | Minimum 4 acoustic paths | Within ± 1.0 % of measured value when average flow velocity is larger than or equal to 3 m/s. Within ± 1.4 % of measured value when average flow velocity is less than 3 m/s. | 1 % over flow rates where average flow velocity is larger than or equal to 3 m/s. | 0.22 % |
| (c) | Turbine flow meter | 0.70 % of actual volume in | | | 1 % in range of flow rate | 0.22 % |

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| | | | | | | |
|-----|--|---|---|--|------------------------------------|---|
| | | working range of flow rate, minimum (10:1) | - | - | (10:1) | |
| (d) | Coriolis flow meter | 0.70 % of mass in working range of flow rate, minimum (20:1) | - | - | 0.7 % in range of flow rate (20:1) | 0.22 % |
| (e) | Orifice flow meters | 1.0 % of mass in working range | 0.5% uncertainty in discharge coefficient | - | - | - |
| (f) | Pressure measuring instrument | 0.30 % of measured absolute pressure | Stability equal to or better than ± 0.1 % of upper range level per 12 months. | 0.10 % of measured pressure | - | - |
| (g) | Temperature measuring instrument | 0.30 °C | Stability equal to or better than ± 0.1 °C per 24 months. | 0.20 °C | - | - |
| (h) | Density measuring instrument | 0.30 % of measured value | - | 0.15 % of measured value | - | - |
| (i) | Differential Pressure measuring instrument | 0.30 % of measured value | Stability equal to or better than ± 0.1 % of upper range level per 12 months. | 0.10 % of measured differential pressure | - | - |
| (j) | Online gas chromatograph | Uncertainty in measured components small enough so that uncertainty in calorific value is 0.30 % (MJ/Sm ³) or less. | - | - | - | Gas components with molar fractions 0-25 %: 0.02 mol%. Gas components with molar fractions 25-100 %: 0.05 mol%. |

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3. A contractor, licensee or the Corporation shall ensure that
- (a) liquefied natural gas is measured and analysed at the place of loading;
 - (b) the liquefied natural gas measurement and analysis system is in accordance with recognised norms; and
 - (c) include traceable measured
 - (i) vessel tanks; and
 - (ii) calibrated level gauges.
4. Instruments for fuel gas metering

| Instrument | | Total Uncertainty Limit | Component Specification | Maximum permissible error at calibration before adjustment | Linearity band at calibration | Uncertainty related to repeatability |
|------------|--------------------------------------|--|--------------------------|--|---|--------------------------------------|
| (a) | Ultrasonic flow meter, 12" or larger | 1.0 % of actual volume in working range of flow rate, minimum (20:1) | Minimum 3 acoustic paths | Within ± 1.0 % of measured value when average flow velocity is larger than or equal to 1.5 m/s. Within ± 2.0 % of measured value when average flow velocity is less than 1.5 m/s. | 1.0 % over flow rates where average flow velocity is larger than or equal to 1.5 m/s. | 0.22 % |
| (b) | Ultrasonic flow meter, less than 12" | 1.0 % of actual volume in working range of flow rate, minimum (20:1) | Minimum 3 acoustic paths | Within ± 1.5 % of measured value when average flow velocity is larger than or equal to 3 m/s. Within ± 2.0 % of measured value when average flow velocity is less than 3 m/s. | 1.4 % over flow rates where average flow velocity is larger than or equal to 3 m/s. | 0.22 % |

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| | | | | | | |
|-----|----------------------------------|--|---|-----------------------------|-----------------------|--------|
| (c) | Turbine flow meter | 1.0 % of actual volume in working range, minimum (10:1) | - | - | 1.5 % in range (10:1) | 0.22 % |
| (d) | Coriolis flow meter | 1.0 % of mass in working range, minimum (20:1) | - | - | 1.0 % in range (20:1) | 0.22 % |
| (e) | Orifice flow meters | 1.5 % of standard volume in working range | - | - | - | - |
| (f) | Pressure measuring instrument | For pressure above 3 bara: 0.50 % of measured absolute pressure. For pressure below 3 bara: 15 mbar. | Stability equal to or better than ± 0.1 % of upper range level per 12 months. | 0.20 % of measured pressure | - | - |
| (g) | Temperature measuring instrument | 0.50 °C | Stability equal to or better than ± 0.1 °C per 24 months. | 0.30 °C | - | - |

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| | | | | | |
|-----|--|---------------------------|---|--------------------------|--|
| (h) | Density measuring instrument | 0.30 % of measured value | N/A | 0.15 % of measured value | |
| (i) | Differential Pressure measuring instrument | 0.50 % of measured value. | Stability equal to or better than ± 0.1 % of upper range level per 12 months. | 0.10 % of measured value | |

5. Instruments for flare gas metering

| Instrument | Total Uncertainty Limit | Component Specification | Maximum permissible error at calibration before adjustment | Linearity band at calibration | Uncertainty related to repeatability |
|--------------------------------------|--|---|--|-------------------------------|--------------------------------------|
| (a) Ultrasonic flow meter | Better than 5 % of actual volume in working range of flow rate | | | | |
| (b) Pressure measuring instrument | For pressure above 3 bara: 0.50 % of measured absolute pressure. For pressure below 3 bara: 15 mbar. | Stability equal to or better than ± 0.1 % of upper range level per 12 months. | 0.20 % of measured pressure | | |
| (c) Temperature measuring instrument | 0.50 °C | Stability equal to or better than ± 0.1 °C per 24 months. | 0.30 °C | | |

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6. Fluid quality and water content determination

| Fluid | | Measurand | Uncertainty limit |
|-------|---|---------------------------------------|--|
| (a) | Oil, Liquefied Petroleum Gas and Condensate for custody transfer and allocation measurement | Density | 0.50 kg/m ³ |
| | | Water in oil | For water content 0 to 1.0 volume %: 0.06 volume % absolute. For water content above 1.0 volume %: 6 % of measured value. |
| (b) | Gas and Liquefied Natural Gas for custody transfer and allocation measurement | Density | 0.30 % |
| | | Calorific value (MJ/Sm ³) | 0.30 % |
| (c) | Liquefied Natural Gas for sales measurement | Calorific value (MJ/kg) | 0.20 % |

7. Data transmission and calculations

| Subject | | Total Uncertainty Limit |
|---------|---|-------------------------|
| (a) | Pulse transmission | 0.001 % |
| (b) | Calculations, Computer part | 0.001 % |
| (c) | Calculated gas density for custody transfer and allocation purposes | 0.3 % |

8. Flow calibration laboratory

| Flow calibration laboratory | | Total flow laboratory uncertainty |
|-----------------------------|--|-----------------------------------|
| (a) | Liquid petroleum flow meter for custody transfer and allocation purposes | 0.10 % of actual volume |
| (b) | Gas flow meter for custody transfer and allocation purposes | 0.30 % of actual volume |

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THIRD SCHEDULE
(Regulation 6(2))

Risk Cost-benefit Analysis for Metering System Selection

1. A risk-cost-benefit analysis for selection of a metering system shall include
 - (a) capital expenditures;
 - (b) operational expenditure;
 - (c) costs related to risk of loss due to increased measurement uncertainty during normal operation; and
 - (d) costs related to reduced regularity of the metering system, including
 - (i) costs related to risk of loss in time periods where the metering system operates with increased uncertainty; and
 - (ii) costs related to loss due to production stops caused by total fall-out of the metering system.
2. The operational expenditure and the costs related to loss or risk of loss shall using a net present value approach, be calculated over the period of time expected to be the lifetime of the metering system.
3. The costs referred to in subparagraph (d) of paragraph 1, shall be calculated as consequences associated with a state multiplied with the probability for the metering system to be in such a state, where
 - (a) the consequence related to measurement uncertainty is normally taken as 0.2 times the absolute expanded measurement uncertainty at ninety-five percent confidence level; and
 - (b) the consequence of a production stop is the cost of postponed production.
4. The probability estimate shall be based on
 - (a) mean time to failure; and
 - (b) mean time to repair.
5. For an allocation measurement between two production licences, the risk-cost-benefit analysis shall take into account that some of the partners may have ownership interests in both production licences.

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FOURTH SCHEDULE

(Regulation 25(5))

Frequency for inspection and re-calibration

The period of verification and calibration or proving of an instrument

| Instrument | | | Default period | Maximum period |
|------------|--|--|----------------|------------------------|
| 1. | Proving device | Stationary displacement prover | 12 months | 60 months |
| | | Portable displacement prover Master meter | 12 months | 36 months 12 months |
| 2. | A liquid flow meter in operation in a prover based liquid single-phase metering system | Export through a tanker | - | Each batch loading |
| | | Export through a pipeline system | 4 days | 14 days |
| 3. | A liquid flow meter without the possibility of being calibrated on site | Allocation | 12 months | - |
| 4. | Ultrasonic gas flow meter | Condition monitoring | - | - |
| 5. | Orifice plate gas flow meter | Sales | - | 12 months |
| | | Export through a pipeline system | 12 months | 24 months |
| 6. | Coriolis gas flow meter | No condition monitoring | 12 months | 24 months |
| | | Condition monitoring | 24 months | 36 months |
| 7. | Turbine gas flow meter | | - | 60 months |
| 8. | Gas chromatograph | Condition monitoring | 1 week | - |
| 9. | Temperature measuring instrument | Single instrumentation | 12 months | 60 months |
| | | Double instrumentation | 36 months | - |
| 10. | Pressure measuring instrument | Single instrumentation | 12 months | 60 months |
| | | Double instrumentation | 36 months | - |
| 11. | Differential pressure measuring instrument | Single instrumentation | 12 months | 60 months |
| | | Double instrumentation | 36 months | - |
| 12. | Gas density measuring instrument | | 12 months | - |
| 13. | Liquid density measuring instrument | | - | 12 months |
| 14. | Reference and test equipment | | 12 months | - |

HON. EMMANUEL ARMAH-KOFI BUAH
Minister responsible for Petroleum

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