

NORSOK I-106 Fiscal metering systems for hydrocarbon liquid and gas – draft

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Bakgrunn

- NORSOK = Industriens system-standard for prosjektering og bygging på Norsk Sokkel
- Supplement/erstatning av selskapsbaserte krav
- Referanse for myndighetskrav
- Krav til jevnlig oppdatering / revisjon - typisk hvert 5. år
- Anbefaling fra brukere om å beholde I-104 og I-105
- ->Rev-vitalisering av EG-IM arbeidsgruppe under Standard Norge – representanter fra operatørene, myndigheter, leverandører og forskning
- Repetering av krav i I-104 og I-105 -> Samle alle krav i en NY standard

Proessen

- 5 samlinger i arbeidsgruppe 2013 (à1-2 fulle dager)
- Bruke I-104 / I-105 som basis
- Revidert oppbygging inkl fjerne skillet mellom tekniske og funksjonelle krav
- Samle system-krav
- Sortere ut og samle komponent-kravene i større grad
- Størst mulig referanse til anerkjente normer
- Klargjøring av krav i anerkjente normer
- Erfaringsbasert
- Norsok standard må sees i sammenheng med prosjektets målebehov og målekonsept;
- Konsensus i arbeidsgruppe

Deltakere & bidragsytere

- Svein Neumann, ConocoPhillips
- Morten Marstein, FMC
- Anfinn Paulsen, Gassco
- Reidar Sakariassen, Metropartner
- Odd Andresen; Aker Engineering
- Dag Flølo, Statoil
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- Sissel Sandgrind, KLIF
- Pål Jaghø, Talisman
- Philip Chan, GDF SUEZ
- Morten Wold, Sørco
- Endre Jacobsen, Statoil
- Jens Gran, Standard Norge (sekretær)

Foreword

Introduction

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- 2.3 Normative references gas systems
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ANNEX D Water in oil calculations (informative)

ANNEX E Guidelines to implementation of ISO 3171 (informative)

ANNEX F Example of performance calculation of online gas chrom

ANNEX G Content of reports (informative)

Kap 1 - 3

- Kap 1: Scope
- Kap 2: Normative and informative references
 - Oppdatert til gjeldene standarder
 - Standard må være henvist til i hoveddelen
 - Ingen bibliografi
- Kap 3: Terms, definitions and abbreviations
 - Små endringer

Kap 4 General requirements

- 4.1 Measurement systems for hydrocarbon liquid and gas include all systems for sales and allocation measurement of liquid, water in oil measurement, oil sampling, sales and allocation measurement of gas, measurement of fuel and flare gas, gas sampling, gas chromatograph.
- 4.1 Additional specific project requirements not covered in this document shall be developed and included in the project specification.
- 4.5 Uncertainty limit (expanded uncertainty with a coverage factor $k=2$) for the measurement system and all components in the measurement system shall be according to the Norwegian Petroleum Directorate (NPD) measurement regulations and the regulations from the Norwegian Environment Agency (NEA).
- 4.6 Condition monitoring – as per Annex A from I-104/I-105 3ed
- 4.2 Documentation:
 - flow calculation;
 - detailed functional design specification and description;
 - P&ID;
 - general arrangement;
 - flow meter sizing and pressure drop calculations;
 - uncertainty analysis calculations;
 - time lag time calculations for analyser systems;
 - fast loop calculation;
 - thermowell vibration calculation;
 - factory acceptance test procedures;
 - factory acceptance test report;
 - geometrical dimensional report;
 - critical parameters relating to electronics and transducers;
 - installation effects which may affect flowmeter performance; such as acoustic noise and flow profile;
 - material constants;
 - prover sizing calculation;
 - mixing calculation for liquid analyser and sampler systems;
 - Spare Parts Interchangeability Records (SPIR);
 - online GC test, documented according to annex F.

Kap 5 System requirements

- 5.2 Sizing:
 - Metering systems shall be designed and calibrated to measure the expected maximum flow within the flowmeters nominal design range
 - The sizing of the meter station shall ensure that the pressure drop from inlet to outlet of the metering station does not exceed 1,5 bar during normal operation and 2,5 bar during calibration of the meters.
- 5.2 Products:
 - For 1st stage separator measurement gas systems it is recognized that process gas may contain liquids; hence flow meter shall be designed to tolerate presence of liquids without significant effect on the gas measurement.

Kap 5 - System requirements meter run

- 5.4 Single meter run

- Use of single metering runs is preferred if supported by a cost benefit analysis, uncertainty analysis, risk evaluation and relevant authority acceptance. Measurement systems with single meter run shall preferably have two flow meters in series to facilitate condition monitoring and provide redundancy. This requirement is not applicable for flare gas meters. For fuel gas metering systems, reference is made to the section for fuel gas.

- 5.3 Multiple meter run

- Use of parallel metering runs may be required by agreements, authority, regularity, turn-down requirements, restrictions in calibration facilities or by a risk evaluation.

Kap 5 – System requirements meter run valves

- 5.4 Single meter run
 - For metering stations consisting of a single metering run, valves may be part of the general process design and not included in the metering system.
- 5.3 Multiple meter run
 - The meter runs shall have at least one remotely operated valve. Health and safety requirements may specify additional needs for actuated valves.
 - Facilities for automatic or manual detection of leakage shall be provided for valves affecting the integrity of the metering system and for valves intended for maintenance during operation.
 - The selection of valves shall be subject to a multidiscipline evaluation in order to meet all relevant requirements.
 - Gas metering run isolation valves shall have double block and bleed functionality in accordance with the project piping and valve specification.
 - Block valves critical for meter calibration and calibration of prover unit, shall be of double-block-and-bleed type, shall have no contact with sealing during operation, and shall have positive shut-off (dual expanding seals).
 - Other types of valves may be considered for the stream inlet valves.

Kap 5 System requirements - maintenance

- 5.5 Maintenance requirements
 - There shall be easy access to any part that requires calibration or maintenance.
 - It shall be possible to maintain and inspect the mechanical part of the system, including internal surface of the meter run, without dismantling the manifolds (or similar).
 - The need for weather protection for maintenance personnel depends on external conditions and maintenance / calibration strategy such requirements should be included in project specific requirements.

Kap 5 System requirements Instrumentation section

- 5.9 Pressure & Diff pressure: Shall be installed according to Norsok I-001
- 5.8 Liquid: If density measurement is required, density shall be measured by two densitometers.
- 5.8 Gas fiscal & allocation:
 - Density determination shall be duplicated, either by: two densitometers; or one online gas chromatograph and one densitometer; or two online gas chromatographs.
- 5.8 Gas fuel & flare:
 - Density for fuel gas may be based on spot sampling and AGA 8 calculation. Density for flare gas may be based on indirect method utilizing measured velocity of sound.
- 5.11 Fuel gas density: If the gas composition varies significantly, the density should be measured or calculated from an online gas chromatograph.
- 5.11: Model uncertainty in Z and/or uncertainty in pressure and temperature measurements may cause calculated density outside the NPD measurement regulations uncertainty requirement for gas density. The uncertainty in total flow rate may, however, still be within requirements. An uncertainty analysis should therefore be performed and the need for densitometer should be clarified and agreed with the customer before the design documents are finalized for review.
- 5.12: All single phase metering stations (except flare metering stations) shall have a facility for manual spot sampling.

Kap 6 Liquid measurement

- 6.1 General: If measurement system does not include proving capabilities, the installation and product effects caused by differences between calibration laboratory and operational conditions shall be documented. Extended testing with different fluids, piping configuration, pressure, temperature and density may be specified.
- 6.x: Flow meters
 - Turbine and PD meters: API MPMS 5.3
 - Ultrasonic meters: API MPMS 5.8 with clarifications
 - Coriolis meters: ISO 10790 with clarifications / API MPMS 5.3 (informative)
 - Valves with leakage monitoring must be installed upstream and downstream the flowmeter to allow in line zero check.
- 6.6 On line water in oil:
 - NPD regulations, NFOGM handbook & ISO 3171 with clarifications (now ½ page – before 2 pages)

Kap 6 Liquid measurement - cont

- 6.5 Proving
 - Pipe prover & compact prover design: API MPMS 4.2 with clarifications
 - Master meter design: API 4.5 with clarifications
 - A flowmeter used as master flowmeter has to perform significant better with respect to linearity (30 %) than the type requirements given in §8 in the NPD measurement regulations

Kap 7 Gas measurement – sales & allocation

- 7.2 Orifice: The orifice meter runs shall be designed in accordance with ISO 5167-1 and ISO 5167-2 without additional uncertainty. If the measurement system has an inlet manifold, it shall be in the same plane as the meter tubes
- 7.3 Ultrasonic: The ultrasonic meter shall be designed in accordance with ISO 17089-1 Class 1 with clarifications
- 7.4 Coriolis: Design consideration for gas coriolis meters is equivalent to liquid coriolis meters. Informative reference is AGA 11 (API MPMS Chapter 14.9)
- 7.5 Other types of meter: Project may specify other meters.

Kap 8 Gas measurement – fuel

- 8.1 Meter run: For single meter configuration, a bypass line shall be installed. Alternatively two ultrasonic flow meters can be installed in series without bypass line
- 8.2 Orifice: The orifice meter runs shall be designed in accordance with ISO 5167-1 and ISO 5167-2
- 8.3 Ultrasonic: The ultrasonic meter shall be designed in accordance with ISO 17089-1 Class 2 with clarifications
- 8.4 Coriolis: Design consideration is equivalent to coriolis meters for allocation. Informative reference is AGA 11 (API MPMS Chapter 14.9)
- 8.5 Other types of meter: Project may specify other meters.

Kap 9 Gas measurement – flare

- Ultrasonic transit time flow meter according to ISO 17089-2 Class 4.
- Minimum distances to upstream and downstream disturbance shall be according to ISO 17089-2 and in accordance with vendor recommendation. The piping configuration shall ensure that the uncertainty requirement will be fulfilled
- An alternative system for determination of flare gas volumes shall be installed if the operating range of the flare gas system is outside the flow range of the ultrasonic meter.

Kap 10 Computer part

- 10.1 The metering system shall provide remote access to all computer parts / user interfaces of the metering system including relevant flow meters in order to facilitate remote support and maintenance.
- 10.1 Diagnostic software, as available for field instruments, shall be part of the scope of supply. Diagnostic software shall be installed on a separate service computer apart from the metering system
- 10.1 Parameters indicating the condition of each field tag (i.e. deviations from reference values or other deviations) shall be stored and trended graphically.
- 10.3 Proving repeability: by statistical method or 5 consecutive runs
- 10.5 Prover calibration of meters: A reference K-factor shall be calculated = Avg of 30 last accepted

Kap 11 Liquid sampler

- I all hovedsak videreføring av Kap 7 "Oil sampler system" i Norsok I-105 (3 ed)

Kap 12 Gas chromatograph

- Based on I-104 chapter 9 "Gas chromatograph"
- The temperature in all parts of the sample lines including sample conditioning equipment shall be kept at a temperature minimum 10 °C above the hydrocarbon dew point temperature. The temperature and pressure at critical points in the sampling system shall be indicated.
- Slope of at least 1:12 should be maintained along the sample line from the probe to the pressure reduction system in order to avoid liquid traps.
- Different sample streams, carrier gas streams and calibration gas streams shall be separated by a double block and bleed function in order to avoid cross-contamination of any gas.
- The chromatograph shall use carrier gas in accordance with requirement given by the application. Helium is the preferred carrier gas for offshore installations

Kap 12 Gas chromatograph - performance

- Calibration gas: No change in certified uncertainty & blending tolerance
- Repeatability: As per NPD regulation (corrected from I-104 3ed). Expressed as standard deviation: Conc 0-25 mol%: 0,01 mol% Conc 25-100%: 0,025 mol%
- Gross Calorific Value: Uncertainty less than 0,30% (no change)
- Molecular Weight: Uncertainty less than 0,20% (new parameter)
- CO2 emission factor (mole basis): Uncertainty less than 0,30% (new parameter)
- Component uncertainty if relevant for mass per component allocation (project specific requirements may apply): No change from I-104
- Calculation example given in Annex F

Kap 13 Automatic gas samplers

- I all hovedsak videreføring av Kap 8 "Gas sampler system" i Norsok I-104 (3 ed)

Annex A Testing and inspection (normative)

- General: Videreføring av "System test requirements" i Annex B (I-104/I-105)
- Project specific test procedure shall be developed including
 - purpose of testing,
 - definition of test runs and repeats,
 - define method for calculation of acceptance criterias,
 - define acceptance criterias for repeatability, linearity and zero (as applicable),
 - relevant test certificates,
 - description of test set-up and piping configuration,
 - define need for inspection before start of test,
 - implementation of calibration results.

Annex A Testing and inspection (normative)

- Spesifikke tillegg for
 - Total system test for liquid
 - Coriolis
 - Provers
 - Ultrasonic meters
 - Flare gas meters
 - On line gas chromatigraph

Annexes B – G

- ANNEX B Statistical evaluation of repeatability (normative)
- ANNEX C System selection criteria (informative)
- ANNEX D Water in oil calculations (informative)
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- ANNEX F Example of performance calculation of online gas chromatograph (informative)
- ANNEX G Content of reports (informative)

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time for **good ideas**

Presentation title

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