Guidelines

for

Real Time Measurement of Petroleum

for

DSF

1. Overview

On 02nd Sep 2015 Government of India approved the Discovered Small Field policy with a prime objective to bring Discovered Small Fields to production at the earliest, to enhance domestic production. The Discovered Small Field policy provides for; single uniform license for producing all kinds of hydrocarbon, zero cess on the oil production, moderate royalty structure, customs duty exemptions and complete marketing and pricing freedom for the sale of produced crude oil and natural gas.

Under this policy, Government of India has offered 46 Contract Areas with 67 oil and gas fields through Discovered Small Field (DSF) Bid Round-2016. On completion of bid round, a total of 30 DSF Contract Areas are awarded to successful bidders and Contracts were signed on 27th March, 2017. Out of 30 awarded Contract Areas, 23 are in Onland and rest 07 are in offshore areas.

The Discovered Small Field policy is based on easy to administer Revenue Sharing Contract (RSC) model. Thus, accurate measurement of hydrocarbons produced and saved from the Contract Area assumes an important role because quantity & quality of petroleum will have direct impact on earnings of each stake holder.

2. MRSC and Petroleum measurement

Article-13 of Contract for Discovered Small Field Bid Round-2016, elaborates the measurement of petroleum wherein it is stated that, "*Petroleum used for internal consumption, Petroleum Operations, flared, saved and sold from the Contract Area shall be measured for volume, weight, energy value and quality by methods and appliances generally accepted and customarily used in Modern Oil Field and Petroleum Industry Practices and approved by the Management Committee"*.

Further, as per RSC, the Contractor should maintain all the records of analysis and measurement of hydrocarbons, calibrations and proving of measurement systems and make available such records on request.

Additionally, as per Article 13.7 of the RSC, "*……the Government may issue directions to the Contractor on the methodology of measurement, the equipment used for the measurement and the points of measurement of petroleum and the Contractor shall be bound by such directions"*.

In keeping with the above RSC provisions, following draft guidelines for measurement of Petroleum Produced and saved from the DSF Contract Areas have been formulated as brought out below:

3. Measurement guidelines

3.1. *Introduction*

Accurate and reliable measurement system assumes utmost importance for a fair revenue calculation. Therefore, measurement of hydrocarbons produced and saved/sold from the Contract Area at the agreed points must meet the highest accuracy standards. Other measurement points but not limited to, that play important role in the overall accounting process, such as internal consumption, flared gas, produced water etc. are also need to be taken into account. The proposed measurement system is expected to have all statutory, technological and functional relevance to modern upstream Oil & Gas industry measurement system.

Further, keeping in mind the importance of measurement of petroleum produced and saved under Revenue Sharing Contract, it is intended to have **"Real Time Measurement System"**"in fields/blocks under DSF Contract Areas which enable online data transfer to DGH Server in real time.

Therefore, to meet the above stated objectives, "**Guidelines for Measurement of Petroleum for DSF"** are being formulated for the compliance of all concerned. These Guidelines should be interpreted as representing general minimum requirements. Operators are encouraged for implementing newer technologies in measurement, provided that they can be shown to give a similar or greater level of accuracy and reliability.

3.2.Monitoring Agency: Director General of Hydrocarbon (DGH) will be the agency on behalf of Govt. of India to monitor, system for petroleum measurement and reporting as well as its Real-Time monitoring, in pursuant to the Article 13 of Revenue Sharing Contract.

3.3. ***Scope of petroleum Measurement and Data transfer on real time basis***

The **"Real Time measurement data access System"** collects petroleum measurement data in real time, and facilitate to communicate it through appropriate communication channels from various "Discovered Small Fields" for monitoring and archiving purpose at DGH. The system aims at capturing and transmitting field

measurement data generated from the DSF as part of the petroleum operation.A typical schematic of the planned system is given at Appendix –A.

3.3 Real Time Monitoring System (RTMS)

A. Operator's Role

(i) In each producing well, at well level, the well head pressure, temperature and well fluid flow indication (for oil well) / value (for non-associated gas well)are to be measured and communicated to RTMS. Accordingly, operator needs to install suitable instruments in each well for measurement of these parameters.

(ii) For Sub-Sea Wells, Well head parameters as mentioned in (i) will be preferred, however operator may represent the case to DGH for getting exception with justification based on techno-economic reasons.

(iii) Each well needs to be tested through suitable means at fortnightly intervals and the same test data to be communicated to RTMS.

(iv) For each field/ block, the quantity/ quantities of petroleum produced and saved; and/or petroleum custody transferred shall be measured and communicated to RTMS.

(v) Measured data from well & field locations shall be transferred to DGH Cloud Server through Field Remote Terminal unit (FRTU)placed at any Central data receiving stations(CDRS, Commonly GGS/ Field Office or its Central Control Room /Unmanned platform RTU room or any enclosed safe area)

(vi) Identification and deployment of suitable, communication methodology for bringing field data up to DGH Cloud Server through FRTU (*Specifications and make of FRTU will be provided by DGH*) located at the CDRS lies with the operator. Accordingly operator should design, adopt and install suitable Hardware and Terminal units for facilitating smooth Data transfer to DGH Cloud Server.

(vii) The operator should choose and procure instruments (which will provide online Communication) with compatible communication protocol like inbuilt Modbus or equivalent.

(viii) Complete data involving the field measurements, as well as information specific to the meters are to be brought from the field measuring devices to DGH Cloud Server in electronic form.

(ix) Communication channels and issues related to them such as, availability, latency, interruption, data security or any other similar constraints should be mitigated by careful planning and system design.

(x) Operator should provide basic facilities such as, secured space, power supply, provision for cable laying etc. for the installation and operation of FRTU unit and shall ensure seamless data transfer to DGH Cloud Server at all time.

(xi) Operator should promptly consider all these aspects while preparing for the initial design of surface handling facilities and thereafter during stages of procurement and installation of measuring instruments

(xii) Tap/transfer the DATA received from various field instruments through custom designed Hardware-Software combinations. (Custom Designed FRTU, broad attributes are given at Appendix-B, however make and detailed specifications are to be obtained from DGH, before installation)

(xiii) Remote Transfer of the data thus captured after encryption (password protected) through fully secured High Speed Broad Band, GSM, transmission system like Satellite network etc. to the Cloud storage/internet SERVER of DGH

(xiv) FRTU should have the provision to back up data for at least 30 days. These should have the provision to store and transmit data / information in case of any disruption.

(xv) In case of any fault / malfunction in sensors installed in the field / well head the FRTU should be capable to raise the alarm/ alert in HMI installed at DGH for proper reporting.

(xvi) For **Offshore/Subsea wells,** the FRTU may be placed at a secure place in the offshore installation built by the operator or the NOC-offshore installation through which the well fluid will be delivered. The FRTU should communicate with DGH cloud server via satellite communication.

B. DGH Role

(xvii) DGH shall form Human Machine interface (HMI) stations for monitoring and viewing purposes of field data at its office.

(xviii) DGH will be providing the Specification and make of FRTU, so that the compatibility issues of communication of the field data to DGH cloud server is minimised.

(xix) Data thus received shall be archived by making use of the existing DGH-NDR storage facility.

(xx) DGH will be providing the software system with data analytics facility. Operators will be provided limited numbers of user id and password for their respective contract areas, to access the viewing of these data and downloading of these data for monitoring and making business decisions.

3.4.1 Measurement other than RTMS

(i) The operator has to establish other measurement points also and installation of the measuring instruments as per process and contract requirements.

(ii) These include but not limited to, measurement of internal consumption, flared gas, produced water etc.

NOTE:

I. *Operator shall install all the measurement systems to fulfil the RSC it has signed. This guideline does not absolve operator from any of the conditions of the contract.*

II. *The above responsibilities are a minimum requirement to streamline the petroleum operation under RSC. DGH or the Operator may add on the number of parameters to be measured and reported online for proper monitoring and control of petroleum production and revenue sharing under the RSC if it need be in future.*

3.5 Steps to establish measurement system for a contract area

While planning for development of a field for production, the Operator must incorporate appropriate systems for measurement of hydrocarbons to be produced and saved. Towards this end, the Operator shall submit the plan for

measurement system in accordance with respective Contract and the *Scope of Measurement* and *Data* transfer on real time basis detailed at para 3.3 above along with all relevant information like, standards, procedures & periodicity of meter validation proposed etc to DGH for review and evaluation. After scrutiny of all the documents submitted by the operator, DGH shall call for an initial meeting with the operator to discuss the measurement proposal at length.

At this stage Operator should provide the following information:-

- A process schematic, indicating the location of the proposed metering and sampling points. This information shall carry geographic location in respect of the contract area specifying the point of sales/custody transfer location.

- Details of the proposed measurement methodologies and allocation modality, if any, including the metering and sampling techniques.

- The operator should provide measurement uncertainty involved in each measurement systems/points and shall strive to ensure that each measurement equipment/or procedure are capable of producing measurement results within such stated uncertainties.

- The methods to be used for determining and combining uncertainties are found in the latest edition of American Petroleum Institute (API) *Manual of Petroleum Measurement Standards (MPMS), Chapter 13, "Statistical Aspects of Measuring and Sampling" or in the latest edition of the International Organization for Standardization ISO Glossary, Standard 5168: Measurement of Fluid Flow – Estimation of Uncertainties of a Flow – Rate Measurement or any similar standards.*

- Technical Details of the measuring instruments and FRTU along with methods and frequency of proposed meter validation are to be firmed up initially. It is desired that the periodical meter validation/calibration/Laboratory retest etc and FRTU periodic inspection shall be held on fixed frequency chosen based on the technical requirements and measurement risk involved in each application.

- 'Condition-based monitoring/maintenance' strategy, wherever applicable or required, may be conveniently utilized for an early detection of potential failure of such devices, affecting the accuracy of the measurement.

Contractor shall keep such records and should invariably report the same to DGH, so that such meter can undergo early re-verification and error rectification.

3.6. *Approval to Proceed with Design*

Once the measurement approach has been agreed in principle, the operator shall submit the final proposal as revised/modified/moderated and agreed upon which would then be put up to MC for approval as per Article 6.5 (c) of RSC. Supporting documentation required along with final proposal will be deliberated in final guidelines.

3.6.2 *Selection of instruments*

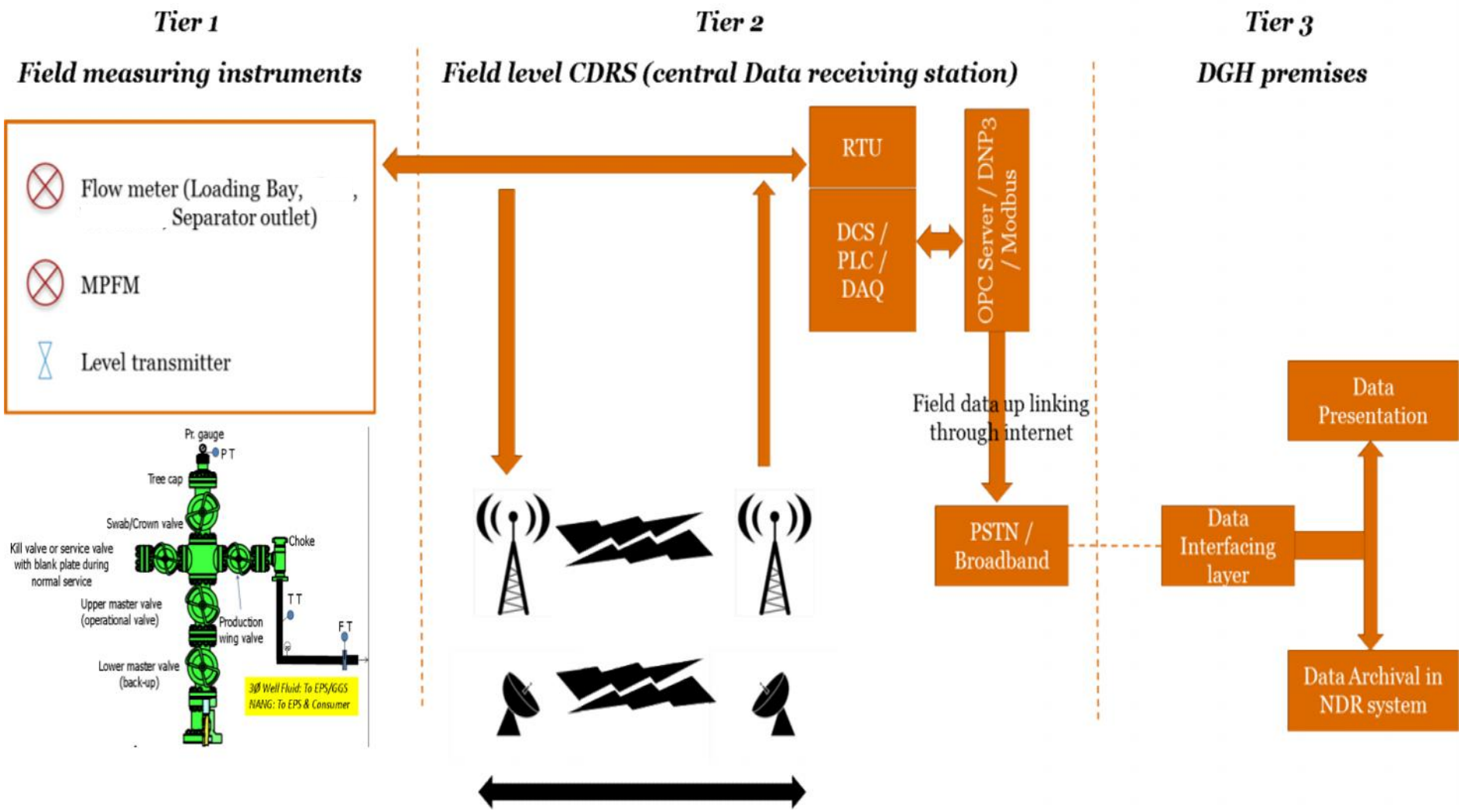
All measuring instruments for RTMS and their output data format shall be electronic and support popular industrial inter-operative communication protocol like MODBUS, Profibus or similar. Instruments/DAQ/DCS supporting of such inter operative communication protocols are a must to facilitate communication/data transfer to DGH Servers.

Further, testing and calibration activities, Periodical meter Verification/Calibration, Meter Redundancy and Error handling etc. will be deliberated in detail in final guidelines.

Appendices

Appendix-A

Schematic for Real Time Data Transfer(Typical)



Appendix - B

Common methods of measurement

The petroleum produced, internally used, flared and sold are to be measured by using appropriate methods in accordance with internationally recognized practices and standards. Identified points and suitable instrument typically in use are given below

Well flow/production.

- Multiphase flow meter : Quantification purposes
- Coriolis mass flow meter: Quantification purposes
- Orifice Flow meters with DPTs or equivalent, along with pressure gauge upstream
- Flow switches,
- Pressure transmitters, Temp transmitters

Internal consumption

- Orifice or V-cone meter as per the relevant standards.
- Turbine flow meter
- Multipath ultrasonic flow meter
- Any equivalent Measurement system recognized by API,ISO or equivalent

Flare meter

- Thermal mass flow meter,
- vortex flow meter
- Multipath ultrasonic flow meter
- Any equivalent Measurement system recognized by API, ISO or equivalent

Sales meter.

- Multipath ultrasonic flow meter
- Turbine flow meter
- Orifice meter
- PD meter.

- Any equivalent Measurement system recognized by API, ISO or equivalent
- Radar type tank level monitoring or any other suitable tank volume measurement

Produced water.

- Coriolis mass flow meter.
- Magnetic flow meter.
- Radar type tank level monitoring or any other suitable tank volume measurement.

Tank Gauging Techniques

- Float and tape Gauges
- Servo Gauges
- Guided wave Radar Gauges

Well Fluid pressure

- Pressure Gauge of suitable range at well head
- Pressure transmitter of suitable range at well head.
- Pressure Gauge of suitable range at flowline

Well Fluid Temperature

- Temperature Gauge of suitable range in flow line
- Temperature transmitter of suitable range at flowline

Quality Parameters

- **Oil:** API gravity, water content, salt content, sulfur content, vapor pressure, pour point etc.
- **Water:** Hydrocarbon content, salinity, sulfur content, radioactivity, etc.
- **Sales Gas:** Dew point, Moisture Content, composition, Heating value, specific gravity etc.

Gas Chromatography

In case of sale of gas from the field, determination of gas composition at the measurement station shall normally be achieved via the use of gas chromatography. However, Periodical analysis of Gas compositions and Calorific value should be done at standard labs for places where Online GC are not installed .Sampling points should be provided, so that online or offline gas chromatography could be carried out. Gas chromatographs are to be tested against certified calibration gas and the results are to be compared against the standard acceptance criteria. (ISO 6976 or equivalent)

MultiPhase Flow Measurement

The use of multiphase flow meters (MPFMs) in fiscal applications is now well established. The uncertainty level that can be achieved by MPFMs are typically application-dependent and may not always be quantifiable. However, measurement uncertainty can be minimized by the adoption of best practice in meter selection, maintenance, operation and verification.

Typical Fiscal MPFM Applications

Fiscal multiphase measurement may be appropriate in production allocation applications where hydrocarbons from more than one field are commingled in a shared production facility, and where cost-benefit considerations indicate that single-phase measurement of each field cannot be economically justified. There are number of challenges surrounding the use of MPFMs, most notably associated with sampling and meter verification.

Meter Selection

The process of meter selection is one where close co-operation between vendor and Operator is required. To facilitate meter selection, the Operator must establish the production profile and the range of pressures, temperatures and compositions that will be measured by the MPFM during its period in service. This should permit the vendor to determine the size and specific configuration of the meter. Section 3.6 of API MPMS Chapter 20.3 provides valuable guidance in this area.

During the field life, fluid composition may change sufficiently to necessitate a change in the meter type. It is recognized that the different

multiphase measurement technologies are each better suited to some applications than to others. Vendors' performance data should be compared in order to select the optimal MPFM for a particular application.

Attributes of the Field remote terminal unit (FRTU)

- The Architecture should be based on Internet of Things (IoT) protocols and prevent data loss in absence of network connectivity.
- The FRTU should use internet as backbone network for connectivity between the FRTU and cloud servers.
- The software application of the FRTU should provide persistent two way connectivity between the FRTU and the DGH Cloud Server.
- The FRTU should allow troubleshooting via the web interface to resolve Issues remotely and online configuration.
- The FRTU should follow wider range of operating conditions i.e Operation over a wide temperature range and humidity.
- Lower power consumption, Capable of being driven by wider range of power sources.
- High reliability -Maintenance-free reliability for FRTUs installed over wide spread field areas.
- Easy maintenance, remote monitoring and preventive maintenance of widely used remote techniques.
- The FRTU should generate automated alerts on exceeding parameter threshold, data connectivity failure, flow meter failure etc.
- Made of suitable hardware –software combination with secured access.
- To be kept in each Declared CDRS/Fields under safe and secure custody providing constant power supply
- Bear unique Field ID and shall work as intermediate Data server between operators owned proprietary and non- propriety devices.

- Expected to hold a single unique design comprising common hardware-software combination for all the fields.

- Capable of communicating to instruments from different manufacturers and vendors by making use of any common industry standard communication protocol.

- To ensure Seamless data flow and synchronization of data for visualization and archival process at DGH

Appendix-C

Standards and Guidance Documents

There is a noticeable lack of international Standards in the area of wet gas flow measurement. However, the following publications contain extremely valuable practical information:

ISO/TR 11583: 2012 Measurement of wet gas flow by means of pressure differential devices inserted in circular cross-section conduits.

API MPMS Chapter 20.3 'Measurement of Multiphase Flow' (1st. Ed., Jan 2013).

International standards for meters

a. **Orifice meters**: ISO Standard 5167 and AGA Standard 3.
b. **Turbine meters**: ISO Standard 9951, Measurement of Gas Flow in Closed Conduits: Turbine Meters and OIML R32, Rotary Piston Gas and Turbine Gas Meters.
c. **Ultrasonic meters**: ISO Standard TC30/SC5/WG1 and AGA Report 9 &10, Measurement of Gas by Multipath Ultrasonic Meters.
d. **Coriolis meters**: ISO Standard TC30/SC12 and AGA Report, Coriolis Flow Measurement for Natural Gas Applications.
    - The meter measurements should be within the specified operating range for the quoted accuracy of the meter.
e. **Multiphase meters**
    - Typically used for replacement of a well test separator rather than for custody transfer. In some instances of commingled production, they may be used for production allocation.
    - Continually being developed and improved.
    - Accuracy is less than single phase meters.

f. V-cone meters may be used for wet gas metering in non-custody transfer applications.