

Data Collection by National Regulators

Revision 6
December 20th, 2012

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1 Introduction

This document describes a data structure for the standardised reporting of oil production and associated data to national regulators. It can also provide a convenient structure for the storage and transmission (typically via PRODML) of such data.

Each country has slightly different approaches to the regulation of its petroleum industry, which leads to variations in the type of data required and collected to meet national objectives.

Following the March 2011 National Data Repository conference in Rio (NDR10), the NDR production data reporting group was constituted to develop common reporting standards between countries.

The datasets collected in the following countries were initially considered by the NDR production reporting group in this report: - *Malaysia, Argentina, UK, Azerbaijan, Nigeria, Netherlands.*

The data structure was derived using the following methodology:-

1/ The various national objectives were considered ('Why collect production data'). A data item was included only if it was important to at least one of these national objectives. For example, 'Bottom hole pressure' is not directly a production data item (a hydrocarbon flow rate), but this value is essential in estimating the decline of a reservoir, so is relevant to the estimation of future production through reservoir surveillance (one of the national objectives that most countries choose to implement). The relevant national objectives considered to be important to regulators were:

- Corporation Tax
- Royalties
- Auditing
- Statistics and Public Relations
- Production Targets
- Geophysical archive
- Reservoir Surveillance.

2/ Data items were considered to be 'out of scope' if they were typically collected in other national reporting systems. For example, details on well construction were considered to be out of the scope of production reporting as this information was typically collected along with well logs etc, in other systems. From the production reporting point of view, it is necessary to understand the details of the flow from each reservoir that is contacted by the well, but not the details of how the well construction achieves this.

3/ To bring structure to the data, and also streamline data collection, data types were organised into logical groups, based on how, where and when that data arises within the oil industry. For example, all the operators worldwide run a monthly hydrocarbon accounting cycle, the 'allocation process'. Allocated data is hence available on a calendar month basis. This defines a category of data (Allocated data) and a natural reporting interval (monthly). Other types of data arise asynchronously, and other data sets just occur at the start of a well's life. This sort of process leads to the data categories as set out in this document.

For document revision history and acknowledgements please see the "Document History and Acknowledgements" section.

2 National Regulatory Objectives

National regulators may collect production data for different purposes. It is useful to categorise different types of production data sets by the objectives that each set will help to fulfil. Once a regulator has clearly defined what its objectives are, then it can easily determine what data it should collect. We consider in turn the objectives of the National Regulator with regards to the collection of production data.

2.1 Corporation Tax

It is relevant to note here that no production reporting is required in order to levy a corporation tax on oil companies. This tax can be assessed based on the profit in the audited accounts in the same way as any other company.

The UK is currently an example of a country that collects revenue in this way. However it still collects production data, due to some other national objectives.

Production data required for this objective: None

2.2 Royalties

It is common for Production Sharing Contracts and other royalty schemes to levy taxes that are calculated directly from production rates. If such schemes are operated, production data must be collected to support these calculations. Legislation will specify the nominal point of measurement of the production flows.

Production data required for this objective: oil flow, oil density (at well, field or terminal, depending on legislation)

2.3 Auditing

Some countries may largely depend on the normal company auditing process to ensure compliance with regulations, but most want to conduct additional petroleum specific auditing.

The highest level and most important petroleum audit is to balance production from the wells with exports or transfers (taking into account stock changes). 'Production figures' and 'Export figures' are generally produced by different groups within the operator organisation, and so comparing the one with the other and trending differences over time is a very effective high level check.

Some production sharing agreements allow the operator to claim a proportion of start-up costs from the government, which are later recovered once a field reaches certain production targets. Trustworthy production data is a key element in this cost recovery process.

Wherever production can be inferred from two different data sources, powerful surveillance reports can be generated. Examples are the comparison of pre and post allocation data, and comparison of reported data, and data sampled directly from SCADA systems.

Production data required for this objective: oil flow from wells, oil exports, oil transfers, stock, pre-allocation production, allocated production.

2.4 Statistics and Public Relations

Data must be gathered in order to provide information for policy decisions and for public information. Increasingly data needs to be collected to address environmental concerns

Production data required for this objective: daily and monthly oil production, gas flaring and disposal, water disposal, exports.

2.5 Production Targets

National production targets may exist, either by international agreement (for example OPEC quotas) or due to national policy decisions. Where monthly targets have to be met, daily production data will be required to manage production prior to month end.

Production data required for this objective: Daily and monthly oil production. Exports.

2.6 Subsurface Data Archive

Hydrocarbon reservoirs are an enormously valuable national asset. The value of that asset is influenced by the quality of the subsurface data that is available to describe them. It is therefore in the national interest to ensure the best possible subsurface data archive is maintained. Production and time series reservoir data (eg. pressure and temperature) is an important part of the subsurface archive in its own right, along with seismic, coring and well log data.

Production data required for this objective: reserves, production, injection, reservoir fluid and formation properties.

2.7 Reservoir Surveillance

In some situations the national regulator may want to monitor production at a well or reservoir level in order, for example, to ensure that production rates are being chosen that avoid or minimize formation damage and increase prospective total recoverability rather than satisfy short-term production targets. The need for reservoir surveillance depends to a large extent on whether the objectives (particularly time horizons) of the operators are the same as those of the nation. Reduced government royalties for an initial period serve to incentivise early overproduction to the detriment of long-term performance for example.

Production data required for this objective: reserves, well production and injection, reservoir pressure and fluid properties, well tests.

3 Asset Identification

It is assumed the following items can be uniquely identified within the regulator's jurisdiction:

It should be noted that there are benefits if common standards can be used for defining this meta data, and that Energistics is a reference site for this.

3.1 Operator

An entity that operates wells, pipelines and/or storage facilities or other oil production infrastructure. An operator may operate one or more Asset Groups (defined below).

3.2 Field

A defined area on the earth's surface above a subsurface hydrocarbon accumulation. (note: The precise definition may vary from country to country).

3.3 Reservoir

A subsurface body of rock having sufficient porosity and permeability to store and transmit hydrocarbon fluids.

3.4 Well

The well is defined as a wellhead that is connected to one or more subsurface reservoirs. Details of how this connection is made (eg single or multiple strings, multilaterals, downhole valves etc) are out of scope. Every well must be uniquely identified.

3.5 Storage Facility

Anywhere that significant amounts of oil are stored. This includes Land Based Terminals, FSOs and some Gathering Stations.

3.6 Export Facility

A Storage Facility from where oil leaves the jurisdiction of the petroleum regulator. Typically by export to another country but also for use downstream (refinery etc)

3.7 Asset Group

Interlinked system of reservoirs, wells, pipelines, storage facilities, export facilities and static tanks or mobile tankers owned/leased/administered by an Operator.

4 Material Flows

In this context “material” includes Oil, Condensate, Gas, Water and Sand, or mixtures of all of these.

4.1 National Flows

Consider the flow of material through the national oil production infrastructure. A generalised diagram of the flow is given in figure 1.

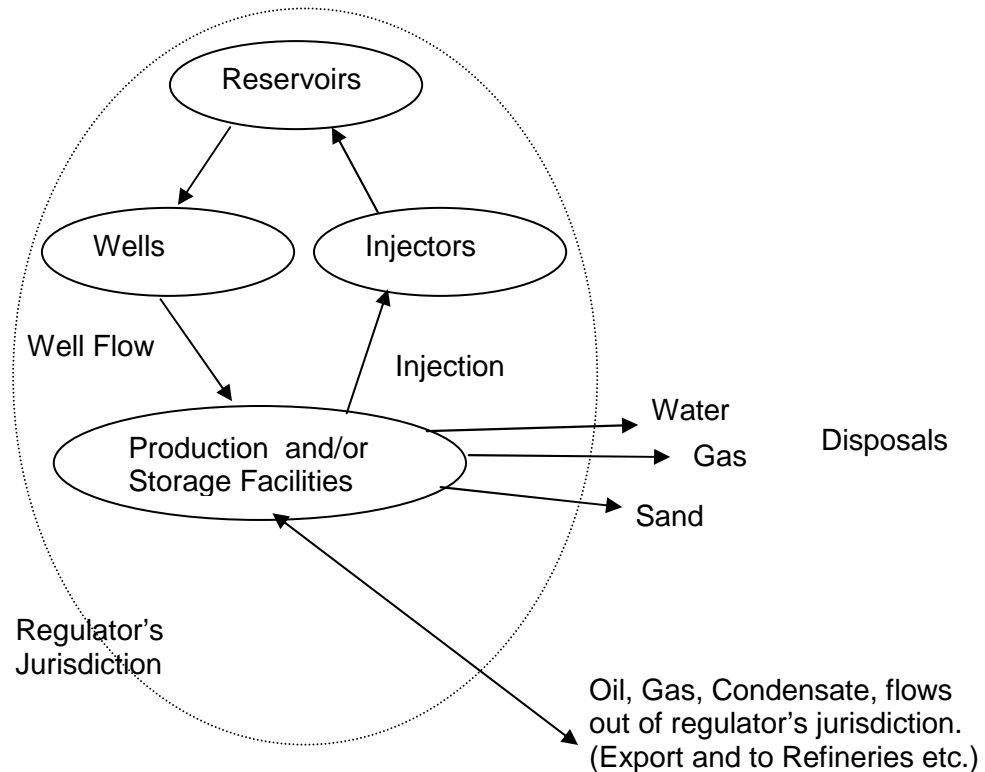


Fig 1. National Flows

The flow starts at reservoirs, and comes to the surface through wells.

The material flow is processed in production facilities, which may also include storage.

The production facilities dispose of some water, sand and gas.

Oil, Condensate and Gas are exported or used at refineries etc, where they pass out of the regulator's jurisdiction.

Imports are out of the scope of production data reporting, as they generally do not fall under the production regulators jurisdiction.

Table 1 considers the national material flows and volumes described and which objectives are served by measuring these.

4.2 Asset Group Flows

In general the national infrastructure will consist of largely discrete Asset Groups, administered by different operators. This means that reported flows will be measured for these various Asset Groups. Importantly, the financial imperative of custody transfer will ensure that any inter-Asset Group transfer flows, or exports, are also measured and to a high standard.

An Asset Group in this context is a set of interlinked oil production infrastructure administered by a single operator.

Figure 2 shows the generalised Asset Group flow.

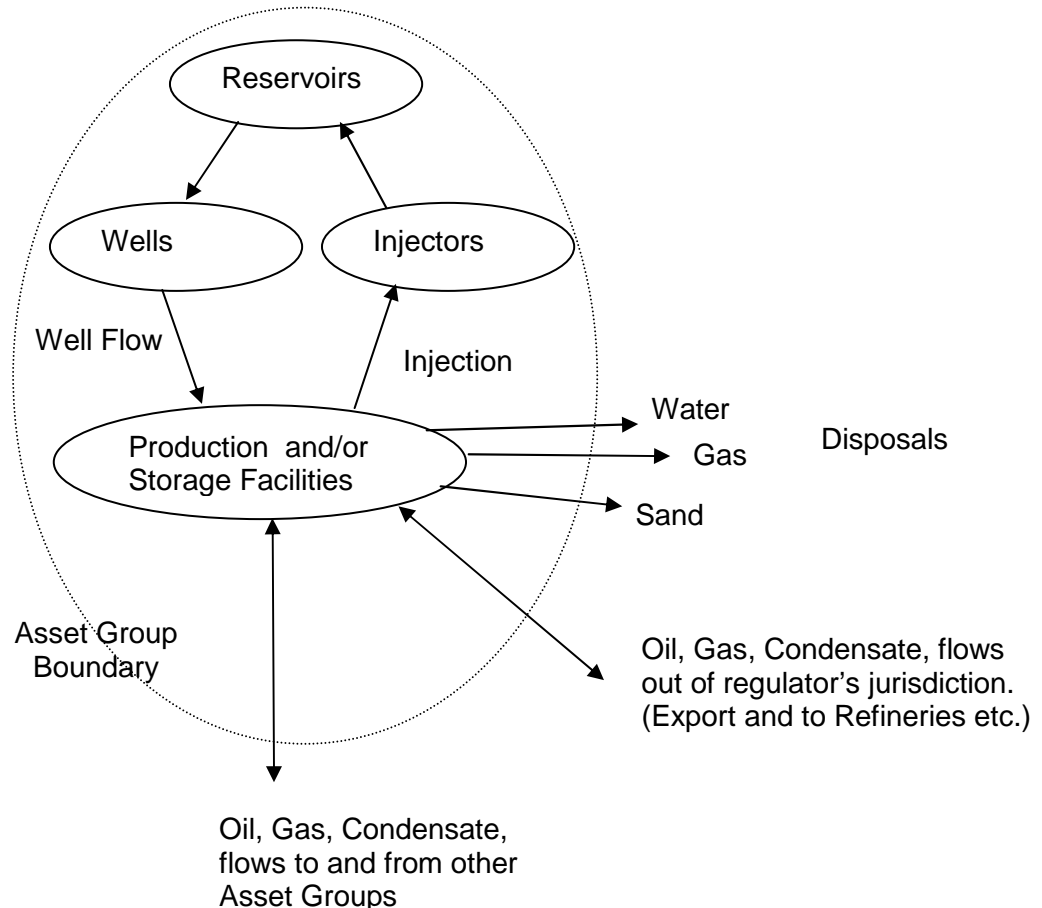


Fig 2. Asset Group Flows

With many operators to monitor, the staff of the national regulator needs to focus on high level surveillance activities. For this reason the national regulator focuses on the flows across the boundary of the Asset Groups, and the flows in and out of the reservoirs, wells and fields. Regulators are not concerned, and do not collect detailed data on either the network topology within each asset group, or intermediate flows at the numerous facilities within an Asset group.

5 Summary of Collected Data

From the sections above, a full list of data collected and the objectives served is shown in Table 1,

Data	Description	Tax	Royalties	Audit	Statistics	Targets	Subsurface	Surveillance
Reserves	Volume of reserves in Reservoirs.		x	x	x		x	
Production	Production flows through Wells.		x	x	x	x	x	x
Injection	Injection flow through Injectors			x			x	x
Disposals	Flow of disposals at production and/or storage facilities.			x	x			
Stock	Volume of stock in storage facilities.			x				
Exports	Volumes exported or used.			x	x	x		
Transfers Out	Volumes transferred to other Asset Groups			x	x			
Transfers In	Volumes transferred from other Asset Groups			x	x			
Test	Test Separator data			x				x
Reservoir	Reservoir fluid and formation properties						x	

Table 1. Data Collected and Objectives

6 Timing

The timing of data collection is largely dictated by industry practices.

Data	Description	Timing
Reserves	Volume of reserves in Reservoirs.	Asynchronous
Production	Production flows through Wells.	Daily (estimated), monthly (allocated + measured).
Injection	Injection flow through Injectors	Monthly.
Disposals	Flow of disposals at production and/or storage facilities.	Monthly
Stock	Volume of stock in storage facilities.	Monthly (fiscalised)
Exports	Volumes exported or used.	Asynchronous (liftings) and monthly (pipeline)
Transfers Out	Volumes transferred to other Asset Groups	Monthly (fiscal)
Transfers In	Volumes transferred from other Asset Groups	Monthly (fiscal)
Test	Test Separator data	Asynchronous
Reservoir	Reservoir fluid and formation properties	Asynchronous

Note that the timing of the reporting is can be controlled by the regulator's requirements.

Also, the "Asynchronous" categories may be subject to regulatory limits. For example, the regulator may require an annual reservoir report to ensure all changes in estimated reserves are caught. Test data may be required for every well at a minimum frequency – for instance, at least one set of test data for every well may be required every month.

7 Sources of Data

Here we consider the origin of the data. In some cases we must consider not only the organisation that provides the data but the source of the data within that organisation.

Information on well production may be 'measured' figures based on (for example) information from down-hole gauges and/or separator tests or be 'allocated' well production figures that are calculated from many sources.

In the case of an offshore installation it would be usual for the same entity to be both the oil field operator and the export facility operator, particularly in the case of an FPSO.

On the other hand, for land terminals the facility operator for the terminal (which is a storage facility) may not operate all the wells that feed that terminal.

8 Deployment of the Standard

It is proposed that the data categories, and the data items within these categories, would form a default template for any national production reporting system

Each country may wish to delete some of the data items. For example, a country that does not target specific monthly production figures, and does not report statistics more frequently than on a calendar month basis, may choose not to collect the daily summary category of data as it is not needed.

A country may wish to collect additional data items and the standard provides the framework for this. In this case, the additional data items should be added to the appropriate category, and reported through the corresponding report.

This approach will assure that the structure, categories and reporting intervals are standardised from country to country, and that the majority of the data collected within each category is standardised, but with some additions or deletions of data items between countries.

PRODML will be extended to encompass the structures outlined in the sections below giving a convenient common data exchange standard between regulators and operators.

9 Production (Upstream) Reporting Structure

The term “operator” is used to denote an organisation or company that is responsible for reporting exports from, transfers into or out of, and stock levels within one or more Asset Groups. Stock levels reported should include all stock within the Asset Group, but exclude export terminal stock which is reported through the Terminal Reports.

9.1 Daily

This report is submitted by each upstream operator on a daily basis, and hence is necessarily prior to the allocation process.

For each Asset Group administered by the operator:

- Measured/Estimated production for each day (sum of all producing wells)
 - Oil Volume
 - Condensate Volume
 - Associated Gas Volume,
 - Non-Associated Gas Volume
- Measured/Estimated stock at upstream facilities in the Asset Group
- Remarks (relating to any significant events impacting daily production)

9.2 Monthly

This report is submitted by each upstream operator after the end of each month following the allocation process. This report is used for royalty and tax computations.

For each Asset Group administered by the operator

For each field producing into this Asset Group

- Production (Production at Field level - see Production Volume Reporting)
- Gas Flared
- Gas Vented
- Gas used in production operations
- Gas lift volume
- Water disposal volume
- Oil stock
- Condensate stock
- For each production well in this field

For each reservoir that feeds this well

For each production period during the month

- Number of days in production period
- Choke (constant during production period)
- Bottom hole pressure & temperature
- Tubing head pressure & temperature
- Shut-in bottom hole pressure
- Daily Production rate

(- see Production Volume Reporting)

For each injection well in this field

For each reservoir that this well injects in to

- Monthly Water volume injected.
- Monthly Gas volume injected.

Remarks (relating to any significant events impacting this field's production)

9.3 Asynchronous

Asynchronous reports are driven by events in the oilfield (eg. a well test). They are not reported according to a regular timetable (daily or monthly).

9.3.1 Reserves

Reserves in this context relate to reservoirs in producing fields (reserves in fields not currently in production are out of scope).

Reported for a reservoir:

- Initial Oil Reserves (ST Volume)
- Current Oil Reserves (ST Volume)
- Initial Gas Reserves
- Associated Gas Reserves
- Non Associated Gas Reserves
- Condensate Reserves

9.3.2 Formation and Fluid properties

These are reported as measured at a particular well, for an individual reservoir.

- Initial Pressure (and gauge depth)
- Current Pressure (and gauge depth)
- Bubble point pressure
- Datum
- RSi (Initial Gas/Oil Ratio)
- Porosity
- Permeability
- Cumulative production
- Oil API
- Viscosity
- Oil Formation Volume factor. Ratio of volume of oil in reservoir to volume at standard conditions.
- Gas Formation Volume factor.
- Water Formation Volume factor.
- Condensate/Liquid Content in Reservoir bbls

9.3.3 Well Initial Purpose

Reported when the well is initially proposed. Reports the intention for the well.

- Gas Injector
- Water Injector
- Oil Producer
- Gas Producer.

9.3.4 Well Type

Normally reported at well start up, and whenever the function of the well changes.

- Gas Injector
- Water Injector
- Oil Producer
- Gas Producer.

Exploration
Development

9.3.5 Well Status

Normally reported at well start up and whenever status changes, this denotes a well as:

Shut in
Flowing
Abandoned.

9.3.6 Well Test Data

For a well

- Remarks
- Reservoir from which well produces
- For each choke setting tested
 - Timestamp when the well test starts
 - How long the test lasted
 - Choke
 - Oil rate (volume/time)
 - Gas rate (volume/time)
 - Water rate (volume/time)
 - Condensate rate (volume/time)
 - Sand rate (mass/time)
 - Bottom hole pressure
 - Well head pressure
 - Gas Oil Rate. (Volume of gas)/(Volume of oil)
 - BSW BS&W % by volume
 - Density
 - Flowing tubing pressure
 - Drawdown
 - Casing Head Pressure

10 Terminal Reporting Structure

Terminals are part of an Asset Group, but Terminal Stock levels are reported here. The rest of the stock in an Asset Group is reported in the Production (Upstream) Report. These reports are per-terminal

10.1 Daily

- Parent Asset Group
- Measured/Estimated stock (note: excluding stock reported by upstream)
- Oil volume
- Condensate volume
- Gas volume

10.2 Monthly

- Parent Asset Group
- Water disposed volume
- Gas flared
- Gas vented
- Fiscalised Stock
- Oil end of month volume
- Condensate end of month volume
- Gas end of month volume

10.3 Asynchronous

10.3.1 Liftings

- For an export by ship out of jurisdiction (Lifting)
 - Date
 - Vessel
 - Destination
 - Certificate number
 - Quantity
 - Oil volume (incl. API)
 - Gas volume

11 Transfer Reporting

When any materials cross the boundary between Asset Groups, or leave the jurisdiction of the regulator, these material flows must be reported.

This monthly report is concerned with inter-Asset Group transfers and with other “exports” from the regulator’s jurisdiction which may include both pipeline exports and supplies to (for example) refineries, power generation or liquefaction facilities.

Tanker Liftings from Terminals are handled separately and reported asynchronously in the Terminal Liftings reports.

For each Asset Group administered by the operator

For each output to another Asset Group

Destination Asset Group

Oil volume

Condensate volume

Gas volume

For each input from another Asset Group

Source Asset Group

Oil volume

Condensate volume

Gas volume

For each pipeline export out of jurisdiction (to other countries, refineries etc.)

Destination

Oil volume

Condensate volume

Gas volume

12 Production Volume Reporting

This standard allows a degree of flexibility in the granularity of the reported data.

There is a common data set that can be reported at the field and well/reservoir levels. This is:

Production:

Measured Production:

Oil volume

Gas volume (including gas lift volumes)

Gas lift volume

Water volume

Condensate volume

Sand mass

Allocated production

Oil volume

Gas volume(excluding gas lift volumes)

Condensate volume

The standard defines the hierarchy of reporting, but it is left to the regulator to determine which levels it requires to be filled.

Since Production can be reported at any level in the hierarchy, there is potential for inconsistency.

Users of the standard should seek to avoid this by only reporting production at the lowest level required.

At the well/reservoir level, production can be accompanied by some extra information. Also, at this level, periods of production may be sub-divided by “days on production” within each month.

This allows the reporting of periods of different choke settings within a month.

13 Document History and Acknowledgements

Acknowledgements:

Nelly Francis, Petronas, Malaysia

Eric Atherton, DataHorizon Limited, Oxford, UK.

Tony Sullivan, DataHorizon Limited, Oxford, UK

Laurence Ormerod, Energistics, USA.

Stewart Robinson, UK.

Participants at NDR11 steering committee, The Hague, 25th July 2012.

Participants at NDR11 production breakout sessions, KL, October 2012.

Ugur Algan, Volantice Ltd.

History

1. Precursor XLS document 'ProductionKeyDataTypes.xls' assembly of *Malaysia, Argentina, UK, Azerbaijan, Nigeria, Netherlands* data. (Nelly Francis)

2. 4th July 2012. Meeting at Petronas. Review data in light of government objectives. Classify data in terms of source and natural timing. Update XLS precursor document. (Nelly Francis, Eric Atherton).

3. DataStructureForNationalRegulators-V1 (now a word format). More rigorous classifications and definitions. (Tony Sullivan)

4. DataStructureForNationalRegulators-V2 Various updates (EA, TS). Review in Holland 25th July 2012 AM (Eric Atherton, Laurence Ormerod). Review (PM) by various participants in NDR11 steering committee.

5. DataStructureForNationalRegulators-V3 Updated to include feedback from July 25th reviews (Eric Atherton). Circulated to Nelly Francis, Laurence Ormerod, Stewart Robinson, Rico Tonis.

6. DataStructureForNationalRegulators-V4 Updated to include feedback from Stewart Robinson (Eric Atherton). This document released for wider circulation.

7/ DataStructureForNationalRegulators-V5 Updated to include detailed feedback after circulation within Petronas and collation of comments by Nelly Francis. (Document updated/issued by Eric Atherton). Issued 16th October 2012.

8/ DataStructureForNationalRegulators-V6 Updated to include feedback and comments from regulators at NDR11 meeting, KL. Also review by Ugur Algan post NDR11. (Document updated/issued by Eric Atherton) Issued 17th December 2012.