DISKOS

NORWEGIAN PETROLEUM DATA

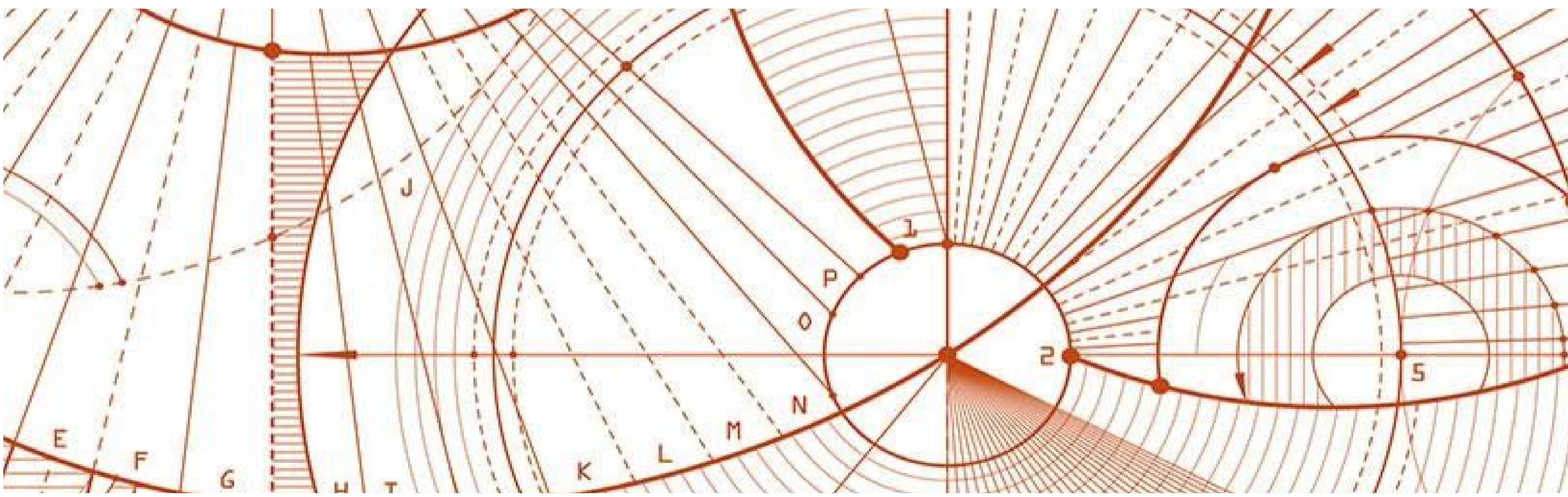
Diskos 2.0

Request for Proposal (RFP)

Seismic, Well and Production modules

Attachment 4A:

Guidelines for reporting well data to authorities after completion (Blue book)



30.12.2019

NPD

20. November 2019

Version 11.1

Guidelines for reporting well data to authorities after completion

"Blue Book"

NORWEGIAN PETROLEUM
DIRECTORATE

Revision control matrix:

Version 11.1	November 2019	• Changed requirement for producing digital images from minimum 200-dpi to 300-dpi
Version 11.0	October 2019	• Corrected reference to regulation in chapter 4.1.3 • Removed the requirement of submitting pdf/A as previous stated in Appendix C • Changes in Table A-1 (separate file)
Version 10.0	September 2018	• New text in chapter 1 and 6 explaining how reports regarding more than one well shall be handled. • New text (Chapter 6) about splitting Drilling Program into several documents • Some clarifications on when the specified confidentiality period starts • A new appendix G with a link to the completeness report template • Removed requirements in chapter 6 for reporting site survey reports • Removed unnecessary section about ASCII in Appendix C • Updated the file containing table A-1
Version 9.1	January 2018	• References to Resource Regulations are corrected to reflect the latest 2018-version chapters • More about Multi Well Study reporting in Chapter 1, Chapter 1.4 and Chapter 6
Version 9.0	September 2017	• Included reference to Resource Regulation §25 in the Introduction • The three groups in chapter 1.4 are now reduced to two.

		• A new chapter 2.2.4 have been introduced to specify reporting requirements for core photos • Chapter 2.4 Wellbore seismic data has been modified according to a proposal from a working group of companies • The name of chapter 3 has been changed to be called Other non-interpreted data • Chapter 4.2 (Well path data) has been moved into Chapter 3 and become 3.3 • Chapter 4.3 (Core data) has been moved into Chapter 3 and become 3.4 • Chapter 4.4 (Processed wellbore seismic data) has been moved into Chapter 3 and become 3.5 • Chapter 3.5 on Processed wellbore seismic data has been modified according to a proposal from a group of companies • Included chapter 4.3 and 4.4 to specify expected content of Final Well Report and Discovery Report (Used to be called Well Evaluation Report) • Modified the text of Appendix E (no change in the reality of the requirements) • Made several changes in Table A-1. The latest Table A1 is version 9.0
Version 8.0	September 2016	New line added in Chapter 1.4 for ED50 Corrected numbering of sections in Chapter 1.4 and 1.5 New section added in Chapter 6 on Site Survey reports Changes in Table A1 (see separate Excel file) Removed Table 6.1 New appendix F on template for

		content in Well Positioning Report New text in Appendix C - Data Formats for Text Data and Documents
Version 7.0	September 2015	Revised Table 6.1 Reports and datasets. The table is now sorted according to data set ID. Table A1 has been updated: Modified rows 2,15 and 2,16 Two new rows 15,08 & 15,09
Version 6.0	September 2014	The NPD has included decisions and advice from the Blue book meeting on 16 June 2014. The NPD has also made additional adjustments to the text, including splitting 1.4 into two parts (new 1.4 and 1.5)
Version 5.2.Rev 1	25 February 2013	The NPD has included decisions made in the Blue book meeting on 22 February 2013
Version 5.2 Rev 0	21 February 2013	The NPD has accepted minor improvements in the text (KRK)
Version 5.2	20 February 2013	Included all comments from Blue Book committee members as of 13 February 2013
Version 5.1	22 January 2013	Draft document prepared by the NPD and sent to "Diskos" Blue Book Committee" for comments
Version 4.0 Rev 02	August 2006	This is the current version on the NPD's website - "Regulations" tab as of January 2013

Reporting requirements for digital well data
(Resource Management Regulations, Section 30 and 31)

1. Introduction

This document explains the Regulations relating to resource management in the petroleum activities, 13 December 2017, Section 30 and Section 31 ("Resource Management Regulations") on reporting well data to the Diskos NDR (National Data Repository).

https://www.npd.no/en/regulations/regulations/resource-management-in-the-petroleum-activities/

(Quote: "Individual reports on biostratigraphy, geochemistry and other special studies shall be submitted separately.")

In this context," special studies" incorporates all important reports, information files and datasets that are normally shared with production licence partners. This also includes studies for more than one well.

Details on file names etc of of the reported digital files are specified in:

https://www.npd.no/globalassets/1-npd/regelverk/forskrifter/en/wells-table-a-1-blue-book.xlsx

In addition to sending the information specified in Section 30 of the Resource Management Regulations to Diskos, the final version of the drilling programme mentioned in Section 14 of the Resource Management Regulations must be sent to Diskos within 6 months after finalising the wellbore. Finalising in this context means the "completed date" noted in the NPD's FactPages.

1.1. Objectives

The main objective of these Reporting Requirements from the Norwegian Petroleum Directorate (NPD) is to clarify the general provisions in Section 46 of the Regulations to the Act relating to petroleum activities and Section 30 and 31 of the Resource Management Regulations. After being uploaded to Diskos, the data will be available for use by the NPD and also by oil companies according to the established rights in the Diskos NDR. Unrestricted data will be generally available according to the terms stipulated in the agreement between the NPD and the Diskos Database Operator (DBO).

It is a basic requirement that all items contained in the Diskos NDR are clearly identified, are of known quality, and are stored in a secure environment. Therefore, these reporting requirements are designed so that reported data are structured and labeled in a way that reflects their position in the Diskos NDR.

1.2. Regulatory requirements regarding delivery

The Diskos NDR is operated on behalf of the NPD by a Diskos Database Operator (DBO).

Data delivered to the Diskos NDR in accordance with the reporting requirements shall be deemed to be in compliance with regulatory requirements for data delivery to the NPD.

It is expected that most operational issues encountered in fulfilling the regulatory requirements will be resolved by the oil company/operator or their authorised representative and the Diskos Database operator (DBO).

The licensee is responsible for ensuring that data are delivered to the Diskos NDR within the required timeframes and that they are of appropriate quality and completeness. There will be no formal 'approval' process involving the NPD. Any deviations from these regulations must be agreed between the NPD and the licensee.

These Reporting Requirements can never provide an exhaustive list of all conceivable geological and technical reservoir data types that are subject to the reporting requirement, but they do constitute a detailed framework for the reporting of such data. The aim is to capture and store all useful data delivered to the operator from service companies, in addition to data generated by the operator (such as edited and, to a certain extent, interpreted data).

Interpreted data should not be reported in the same file as the original raw data due to data release mechanisms.

1.3. Reporting guideline principles

Throughout these procedures, the emphasis is on the use of 'good practice' rather than detailed and prescriptive processes. In other words, the focus is on the outcome of the process rather than its details. However, this in no way reduces the requirement for reporting high-quality datasets.

These procedures are valid for new data only, i.e. they are forward-looking. It is recognised that different approaches may be required for historical data.

In general, the creator[1] of the data should add all associated parameters and information (metadata) to the data sets produced. If possible, this should be encoded, with attributes when appropriate, within an industry standard format. If this is not possible, then additional "Information Files" must be created which support the data (cf. Table A1 for details).

All log data curves reported should include a complete set of attribute information. These attributes and their associated reference values are being developed for raw well-log data, and are being published by the Energistics[2] and PPDM[3] standards bodies.

The ultimate aim is to create data sets together with associated information that can be used to populate the Diskos NDR with as little intervention as possible, apart from the usual operational checks and QC processes.

1.4. General requirements for all reporting

All locations/positions must be referenced to the ED50 including the EPSG-Code used See http://www.iogp.org/pubs/373-10.pdf

Reporting applies to both exploration and production wells.

Data reporting dates:

1. For data collected up to the time that drilling and logging are completed[4], reporting must take place as soon as possible and no later than six (6) months after this date. This constitutes the majority of the data.
2. Data collected after that date (for example, production-log surveys or special core

[1] This could be an acquisition contractor, a value-add interpreter or a contractor collating data sets for delivery to the NPD.

[2] Energistics – see www.energistics.org

[3] PPDM – Professional Petroleum Data Management Association

[4] Date when the drilling and logging activity is completed. For an exploration or observation wellbore it is the date when drilling or logging activity is completed. For a development wellbore it is the date when the wellbore is at total depth. A practical approach to this is to use the "Completed date" as noted in the NPD's fact pages.

analysis data) must be reported no later than six (6) months after data has become available for the owner. These are maximum reporting periods – all data and reports are to be submitted as soon as these are made available to the operator.

3. In the event that the wellbore completion or abandonment is delayed, this must not delay reporting of other data. The additional information must be provided in a separate report when available (for example testing or delayed operation activity to hand over well to production).
4. In the event that reports listed in table A-1 are made on the basis of data from several wells, such reports shall be copied and indexed in Diskos to all wellbores involved. Such reports shall be reported no later than 6 months after they become available to the owner.

Datasets are divided into two main categories:

1. Non-interpreted data
    - Raw data
    - Other non-interpreted data

2. Interpreted data

Different confidentiality periods apply for each of these groups according to the Regulations to the Act relating to petroleum activities (the Petroleum Regulations), Section 85.

1.5. Guidelines for all reporting to Diskos

a) Information Files are used to carry information about dataset files such as their content, processing or acquisition parameters, data manipulations, etc. Wherever possible, this type of information should be encapsulated ("headers") within the data files in an industry standard format in such a way that it is readable by the Diskos NDR. However, it is acknowledged that there are only a few industry standards that support the addition of such further information; therefore, separate Information Files should be used (for example, for audit trail information for log-compositing). Table A1 shows which Information files are mandatory, and in which cases an information file may cover several data files. Use of PDF format files is preferred for Information Files (although ASCII will be accepted for the time being).

b) A hierarchical folder structure should be used when delivering data to the Diskos Database Operator (cf. Table A1, column D). All files should be placed within a top-level directory identifying the well. This directory should be named by appending the official well name to the string "WELL_", but with the slash '/' or SPACE being replaced by an underscore '_' to accommodate directory-naming conventions,
e.g. WELL_6506_12-A-1.

The next level in the folder hierarchy will comprise one sub-directory for each wellbore, named by concatenating the string "WB_", and the part of the official wellbore name that follows the mandatory space, and then the permit number. This is a 3 or 4-digit drilling permit number (xxxx) with no leading zeros, and an alphanumeric suffix, e.g. WB_Y1_1234-P1

'P-number' for development wells (xxxx-Pz)

'L-number' for exploration wells (xxxx-Lz)

'G-number' for other wells (xxxx-Gz)

'T-number' for test production (xxxx-Tz)

For more information about registration of wellbores, see NPD website

The numeric (z) indicates either re-entries or multilateral wellbores. For technical sidetracks the numeric (z) will be the same as the parent wellbore. Throughout this document, xxxx-Pz is used in examples.

The data folder structure is closely linked to the various data types, although a one-to-one relationship between folder and data type does not necessarily exist. The Table A1 numbering, however, corresponds to the folder structure.

If possible, it is recommended that the data folders should be transmitted to the DDO as they become complete, thus facilitating the timely release of final well data.

Further details on the naming convention are provided in Appendix A and Table A1. Also, each individual data set, as outlined in Sections 2 to 5 below, has filename information relevant to the data being reported.

c) All well branches / sidetracks except technical (T-) sidetracks shall be reported from kick-off for the branch / sidetrack to TD for the same. For T-sidetracks the reporting should extend to kick-off for the original sidetrack.
For final T-sidetracks the Completion Plot and Completion Report shall be reported under "Final Wellbore".

d) All files shall be clearly marked with the official wellbore name in the file header.

e) The Norwegian Petroleum Directorate standard for well reference shall be used, i.e. the NPD wellbore classification system and the NPD guidelines for designation of wells and wellbores.

f) Deletion/Replacement of Data. Only final quality-controlled data is to be submitted to the Diskos NDR, i.e. data sets that are described as "Preliminary" should not be reported. Such final data sets must not be deleted. If, however, the operator detects data sets or reports that are incorrect, then corrected versions must be submitted as soon as possible. In such cases the original data sets will be retained. The operator must provide a separate signed information file, 'REPLACEMENT_INF_#.PDF', with the following information:

- Files to be replaced (including INF-files if any)
- Reason for replacement ('Not valid' is NOT sufficient)
- New data file

The new data sets should be numbered according to standard reporting requirements. The replacement information file should be reported in the same folder as the incorrect data and loaded together with the incorrect data to the DDB as information to the end users.

File replacements due to changes in data formats may be accepted for data technical reasons, even though only legal data formats (as stated in Table A1) will be readability checked by the DBO. In such cases, previous data may be deleted after replacement, but the operator must document why replacement formats were necessary.

g) Renaming of wells. In cases where all data in a well must be reloaded, e.g. when changing a wellbore name, it is sufficient to provide a single information file explaining why data has been removed, and the new location. The information file must contain both the previous and the new (correct) wellbore name in an easily identifiable manner, and be reported in the wellbore folder. During loading, this information file will then be propagated to every archive object in the Diskos NDR wellbore data structure

h) Generally, plots should be reported in mMD, but mTVD-indexed plots may be included additionally.

1.6. Logdata curve specific requirements

a) Depth reference of all reported log data shall be given in relation to the rotary table drill-floor (DF) or rotary Kelly bushing (RKB) in measured depth (MD). The depth reference (DF or RKB) and its height above mean sea level (MSL) are mandatory information.

b) Keep original (as recorded by the service company) values of:

- Depth units: these should be meters for all new data.
- Sampling rate including high sample rates (so-called fast channels). In other words, no re-sampling should be applied.
- Curve mnemonics
- Curve units. However, the use of volume fraction for porosities (including neutron) is recommended.

c) The null data value shall be the service company standard of -999.25.

2. Raw data

2.1. Well-log data

2.1.1. Content

All raw well-log data recorded from all data acquisition passes in both open and cased-hole sections shall be reported, whether acquired by electric wireline (EWL), MWD/LWD methods (including time/depth based Drilling/Mud data), or associated surface systems (e.g. Mud log data). It should include all data curves as delivered to the oil company by the acquisition contractor.

All appropriate 'API Header' and support attribute information must be completed. See Appendix B-2.1 for details.

No additional editing, filtering, environmental or other corrections are to be applied to the data set delivered from the contractor.

All field prints at 1:200 and / or 1:500 scale (or key print sections) must be reported digitally. See Section 5.0 for further details.

A ‘Logging Summary’ document must be created for each well. This document shall contain summary information for ALL well-logging operations in the well. The information content is described in Appendix B-2.1. Please refer to the ‘LOGGING SUMMARY (Template)’ sheet in Table A1.

2.1.2. Quality

All standard well-site QC procedures are to be applied and any issues that arise should be noted in the 'Remarks' section of the header.

All header data must be completed.

All operational factors that could impact the quality of the acquired data must be captured in the 'Remarks' section of the header. This includes information on borehole conditions, tool calibrations, and items not likely to be captured by other means if DLIS is not used (e.g. equipment numbers).

For the MWD raw composited data (created from individual bit runs) a FULL audit trail showing all operations carried out on data from the original bit runs (edits, shifts, splice points, etc.) must be included as an Information File.

2.1.3. Format and Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type.

To reduce the number of possible tool string permutations in the file name, the generic tool names in tool strings may be listed alphabetically. Also, since AUX and GR are always part of the tool strings, these could also be omitted, thereby shortening the tool strings. E.g., under these rules, the tool string GR-RES-DEN-NEU-SON-AUX should be rendered DEN-NEU-RES-SON.

The Logging Summary document should be reported in a PDF format file (PDF is preferred, otherwise an ASCII format file) and be called LOGGING_SUMMARY_#.PDF. It should be placed in a directory named WELLBORE_DOCUMENTS. If possible, include original log name from log header.

A strictly sequential file numbering scheme has been introduced, replacing the old standard under which both bit run (for MWD logs) and main/repeat run (for EWL logs) information was contained in the file name. According to the current numbering scheme, all run information must be located in both the associated information file and the logging summary file, thereby improving the detailing and the flexibility of the reporting.

Please note that the logging summary file should be cumulatively generated, i.e. just one (the latest) version of the file is to be stored (LOGGING_SUMMARY_1.PDF), incorporating all logging activities in the well. The previous version must be deleted. The only exception to this rule is in the event of a change in the data reporting contractor.

Further details on file naming are provided in Appendix A.

2.2. Core data

2.2.1. Quality

Any experimental conditions and procedures must be appropriately documented, and contained in Information Files.

2.2.2. Content

All conventional core analysis data shall be reported, including porosities, permeabilities, saturations, matrix densities, and descriptive lithology text, as well as core images (incl. any micrographs), appropriately grouped in convenient data sets.

Special core analysis (SCAL) data shall be reported, usually as a separate data set (since it is generally available much later than conventional core data). SCAL data includes relative permeability, capillary pressure, fluid property, electrical, clay activity, and wettability data.

Other core data such as petrography, sem, clay analysis and acoustic measurements must also be reported

All data shall be referenced on driller's depths, discretely sampled as measured and shall include appropriate core and plug index information.

Core gamma-ray data (continuously sampled) shall also be included.

All core data curves should have an associated Curve Type as defined in Appendix B-3.

2.2.3. Format and Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type.

2.2.4. Core photo

The generally agreed image format for core photo is TIF according to Table A1. The resolution has to be minimum 9000 pix/m. The format and file names for mandatory reporting must be “open formats” as specified. In addition to the mandatory reporting, extra files in proprietory formats (like CORIMAG) can be reported.

2.3. Geochemical data

2.3.1. Quality

Any experimental conditions and procedures must be appropriately documented, and contained in Information Files or in the NPD-GC-95 v.2.0 format if appropriate.

Where possible and appropriate, the analytical quality must be controlled by analyzing established reference samples according to: Norwegian Geochemical Standard Samples, NGS; http://www.npd.no/) and the results documented.

Analyses must be carried out according to the most recent version of "The Norwegian Industry Guide to Organic Geochemical Analyses" (NIGOGA; available at http://www.npd.no/).

All geochemical data collected, must be reported according to the NPD-GC-95 v.2.0 data transfer format if possible.

2.3.2. Format and Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type.

2.4. Wellbore seismic data

2.4.1. Purpose

Wellbore seismic surveys are conducted mainly as a calibration standard for geophysical well logs and surface seismic. In addition, they may also be designed for near wellbore seismic imaging and in-situ seismic property analysis.

The term checkshot survey, or alternatively velocity survey, is used to denote the simplest wellbore seismic survey with the sole purpose of measuring vertical seismic velocities from the surface down to discrete geological layers.

The term VSP survey is now more commonly used and denotes any type of wellbore seismic survey where the full seismic wavefield is recorded and sampled in depth more regularly and denser than a checkshot survey. It can be thus considered as an enhanced modern checkshot survey.

There are different survey geometries for VSP which depend on the relative positioning of seismic sources and receivers. When both sources and receivers are relatively vertical inline then the survey is the well-known zero offset (ZO) VSP - in deviated wells the term normal incidence (NI) is used. When there are significant lateral offsets forming a range of 2D inline offsets then the survey becomes a walkaway (WA) VSP, which is somewhat similar to a 2D surface seismic survey. In the same analogy, the term 3D VSP is used when there is 3D areal coverage.

The naming of the raw datasets for the different survey geometries is listed in Table A1.

The acquisition method may use wireline, logging while drilling or even permanent sensors in a well.

2.4.2. Content and Quality

The acquisition company's field print or report in PDF format documents the operation, equipment and recording parameters. The Raw Wellbore Seismic dataset shall be reported in fully populated SEGY format with original field records and channels in the headers, and with survey geometry merged.

When a VSP survey is acquired then the Final checkshot dataset is normally delivered by the processing company since it is integrated into the VSP processing workflow. It may also be a composite of survey runs. (see 4.4.2 Time-depth-velocity (TZV) data)

2.4.3. Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for these data types.

2.5. Mudlog data

2.5.1. Content and Quality

All mud, lithology description and hydrocarbon detection and drilling-dynamics data delivered to the well operator shall be reported. Typical content and structure are described in Appendix B-2.5.

Where Mudlog data are collected ‘mixed’ with Formation Evaluation data, they should be separated into ‘Mudlog’ and ‘Raw Well-log’ sets. The Raw Well-logs shall be reported as per Section 2.1, the Mudlogs as per this section.

All relevant acquisition parameters (including drilling/surface logging parameters/hookload) and remarks should be included with the data files or in separate Information Files

2.5.2. Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type.

2.6. Wellpath data

2.6.1. Content and Quality

Raw wellpath data is also traditionally known as 'Deviation Survey Data'. This data set should include all data delivered by the well surveying contractor, including supporting information such as the Azimuth Reference (True North, Grid North or Magnetic North + magnetic declination and grid convergence) for the Azimuth data. The data should not contain dummy points at the surface, wellhead or TD unless the inclination (deviation) is non-zero at such a tie-in point (curved marine riser, for example). The KB elevation and water depth in the DDB should be compatible with the deviation survey data, and will provide the correct basis for calculation of the resulting wellbore path.

Typical minimum content and structure are described in Appendix B-2.6.

2.6.2. Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type.

There are no industry standard formats. Data must be reported in an ASCII structure to be agreed with the NPD.

It is recommended that original survey measurements be reported as a data set containing mixed 'Raw' and 'Interpreted' data combined in a single file. Such files show the original survey measurements (azimuth and deviation) and the computed well path results (such as TVD, coordinates, offsets, and doglegs) sampled at THE ORIGINAL SURVEY DEPTHS only. Coordinates should be corrected for earth curvature.

Any gyro measurements made in addition to the standard magnetic measurements in all or parts of a wellbore will generally comprise a separate report which should also be stored in the DDB.

3. Other non-interpreted data

3.1. Well composite log

3.1.1. Definition

The Composite Log is defined as a set of curves, usually depth-matched and spliced (joined) so that measurements are available over the greatest possible depth interval within a given wellbore. Where necessary, composite curves will be created from different input curves (different contractors or physical measurement methods) spliced together. A deep resistivity curve created from a deep induction and deep laterolog curve would be such an example.

The Composite Log is NOT the graphical 'Composite' or 'Completion' Log that is created at the end of most wells showing, for example, log curves, formation tops, cored intervals, DST intervals, etc. This is reported graphically as a separate item (cf. Table A1). The curves presented on this graphical Log are ideally the same as those in the digitally reported Composite Log, but this is not a requirement.

3.1.2. Purpose

The main purpose of this Composite Log is to provide quality, 'full-depth-range' well-log data to a wide range of E&P technical users. Typical usage would be for geological correlation.

It is recognized that other, more ‘specialized’ curves will also be processed at the same time as those contained in the Composite Log. These should be includedin the ‘Petrophysical Composite’ described in Section 3.2.

Note that composited (and usually environmentally corrected) data prepared specifically for interpretation usage will be found in the 'Petrophysical Interpretation INPUT' data set detailed in Section 4.1.

3.1.3. Quality

The Composite is prepared to a standard that will allow reliable correlation work to be carried out. This means the removal of any artifacts that could cause false correlations, and includes cycle-skip removal and a depth-matching accuracy appropriate to the geological formations.

For detailed guidelines, refer to the previous Reporting Requirements: (See Appendix E). The key points from these guidelines are summarized below (see section below entitled 'Guidelines for Compositing').

All work carried out must be documented in an Audit Trail that must be supplied as an Information File. It shall contain all edits, depth shifts and splice depths applied, as well as any comments on data quality.

3.1.4. Content

The Composite Log should contain all the primary measurements made in a given well/wellbore. Examples of primary measurements and associated standard curve names and curve types are listed in Appendix B-3.2.

A primary measurement may be composed of data taken from different physical tools (for example, it could be made from a combination of EWL and MWD measurements)

For each primary measurement, the 'best version' of that data available over a given depth interval should be used and the resultant spliced curve should cover the greatest possible depth interval. All information on edits, depth shifts, splice points or any other data manipulations should be contained in a suitably structured Audit Trail file.

3.1.5. Guidelines for Compositing

- All work should be done using 'good petrophysical practice', using the Reporting Requirement guidelines (See Appendix E) as the minimum standard. Data shall be 'cleaned-up' during the creation of the Composite Log. That is, sonic cycle skips should be removed, corrupted data due to tool sticking should be replaced by other data or (if no other data exist) by null (not zero) values, SP curves should be normalized etc.
- Depth shifting shall be carried out to ensure good correspondence of data curves within and between log runs. Shifting shall be carried out to an accuracy that reflects the underlying geology, typically 0.2 meter.
- For spliced data curves, where the source data is from different depth intervals, if there are sections with invalid or no data, then null (not zero) values should be inserted (no interpolation will be attempted unless the 'data gap' is larger than a geologically insignificant distance, typically up to 1 meter)
- No additional environmental corrections need be applied.
- Curve data recorded before "Pick-up" from the deepest logging run of each service (normally the final logging runs) shall be removed. Care must be taken to ensure the best assessment of valid formation data.
- Curve data recorded in casing for the <u>shallowest</u> logging run for each service shall be removed. Care must be taken to ensure that valid formation data are maintained. Clearly, data valid behind casing, such as GR, should be kept if it is the best version available.

3.1.6. Format and Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type.

3.2. Additional composited data (petrophysical composite)

3.2.1. Purpose

To preserve ‘specialist’ composited data curves that may be created for a well but which do not fall into the ‘standard’ Composite (Section 3.1) or the ‘Interpreted Data Input’ data sets (described in Section 4.1). These data may have additional work done such as environmental or bed thickness corrections. This data set would normally be used by petrophysicists. Operators must report this data set in order to preserve value-added work.

3.2.2. Quality

Similar quality guidelines apply to the compositing work as described in Section 3.1.3 above. All work that is carried out must also be documented in an Information File.

Operationally, it is expected that both the ‘standard’ Composite Log and this ‘specialized’ Composite Log would normally be created in the same process, but split into 2 data sets for reporting purposes. This ensures that the same depth shifting is applied to both data sets – an important quality requirement.

3.2.3. Content

Data that are not part of the ‘Composited’ or ‘Interpretation Input’ data sets may include

- additional composited resistivity, NMR or other specialized curve data
- composited data at high sampling rates for thin-bed analysis
- a good guide is to include all ‘presentation curves’ from log prints (apart from those already included in the ‘standard’ composite). If quality curves such as tension or cable speed are included (not a requirement), information must be included in the Information Files to show which data curves they refer to.

3.2.4. Format and Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type.

3.3. Wellpath (or welltrack) data

3.3.1. Purpose

This data set is the FINAL computed wellpath, approved by the operator. This should be the primary source of ALL subsequent activities that require wellpath positional information (including the True Vertical Depth). All users, whether oil company or external service providers, should use this as their reference data set.

3.3.2. Quality

It is critical that all calculations are documented with appropriate methods used and reference and projection information (see notes below) contained in Information Files.

3.3.3. Content

Each wellbore path shall be a continuous set of final, quality-controlled positional data points from the top to the bottom of that wellbore path/well track.

Note that various additional calculations are often employed: projections to a mapping plane (UTM co-ordinates) or a vertical plane (section) are common. Co-ordinates may also be given both absolutely and relative to the wellhead. When reporting, it is important to distinguish between true X, Y, Z co-ordinates and projection values used for map-making. Differences in X, Y values between the projection plane and the wellbore path are often significant.

Note the need for high (double) precision in the numerical digital format used for some of these results (not normally important for log measurements).

Wellpath data is calculated using a documented method, preferably Minimum Curvature. The increment should be sufficiently small to ensure that no significant errors would occur if linear interpolation were used. Any increment of one meter (1.0 m) or less would be acceptable.

Typical content and structure are described in Appendix B-2.6. The algorithm used in the calculation must be documented, preferably within the data file, otherwise in a suitably formatted Information File. Only one set of FINAL computed wellpath data should exist.

3.3.4. Format and Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type.

3.4. Core data

3.4.1. Purpose

Conventional core data matched to the well logs is often used in calibrating petrophysical analyses.

3.4.2. Content

Conventional core data curves shifted to Logger's Depth, and including shift information. These should be the same data curves as contained in the raw, un-shifted (Driller's Depth) data set. As with the original raw core data, depths will be discretely sampled (i.e, no re-sampling to regular depth increments should be undertaken). These data will not normally be corrected for overburden pressure. However, if they corrected, then both the uncorrected and corrected sets must be reported as separate data files with suitable documentation, reported in an information file

Typical content and structure, including standard curve type designations, are described in Appendix B-2.2.

3.4.3. Format and Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type.

3.5. Processed wellbore seismic data

3.5.1. VSP

3.5.1.1 Purpose

Raw Wellbore Seismic requires various degrees of processing before it is workstation ready. The initial step for VSP data is the checkshot velocity analysis, described in 4.4.2 Time-depth-velocity (TZV) data. Basic processing, often described as 1D processing, is then carried out to produce the corridor stack. A summary plot of the end result together with well log synthetics and seismic is called the Interpreters composite, or sometimes the 3-way tie.

Advanced processing is made on 2D or 3D VSP and involves the analysis of the recorded compressional and shear wavemodes. Generally, a structural image is the end result of standalone VSP processing. Often the advanced processing is a part of an integrated special study, for example, to improve understanding of velocity anisotropy, seismic amplitude attenuation and reflection amplitude variation with angles.

3.5.1.2 Content and Quality

All processing methods, parameters and remarks shall be documented in a PDF format processing report. The seismic data output from the sequential processing workflow shall be delivered in fully populated SEGY format (as described in the Yellow Book and table S1), including survey geometry. It is important that polarity and domain (such as two-way-time or depth etc.) is described in the header.

Basic 1D processing is expected for each well with VSP, derived from the zero offset component.

Advanced surveys may be processed to 2D or 3D seismic images and with associated 2D or 3D property models. Relevant time picks and angles should be stored in the SEGY format extended headers.

3.5.1.3 Format and Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type.

3.5.2 Time-depth-velocity (TZV) data

3.5.2.1 Content and Quality

A final checkshot data table of depth-time and velocity attributes shall be delivered in ASCII (LAS preferred). Only high-quality data at original depth samples shall be included. The method to pick and correct the times vertically to seismic datum will be fully reproducible from the table attributes and header alone.

When processing contractor has worked with well logs for checkshot calibration and synthetic seismic generation, this will be reported as computed datasets in LAS format. It is normally expected that input well logs are edited and extended to seismic datum and are presented in original well log measured depth. The synthetic seismic inputs and products are generally indexed in two-way-time and presented in LAS format as seismograms.

3.5.2.2 Format and Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type. LAS 2.0 is the recommended format for the geophysical composite curves which for guidance include standard curve type designations, as described in Appendix B-4.5.

3.5.3 Time-depth-velocity (TVD) data

3.5.3.1 Quality

All processing information and remarks should be captured in Information Files.

For spliced data curves, where the source data is from different depth intervals, if there are sections with invalid or no data then it is normal to use interpolation or estimation methods to create a continuous data set over the entire interval of interest. Such methods should be reported in Information Files.

3.5.3.2 Content

The following data types should be included as available:

- Calibrated sonic and density curves
- Derived calculations such as acoustic impedance, reflectivity and synthetic seismograms (with appropriate documentation in the data or Information Files)
- Time/depth/velocity measurements (for example check-shot data)
- Drift data: the difference between interval integrated sonic and check level times
- Estimated Q-factor from ref. point (source/ref. geo) to every VSP level

Two data sets may be presented as two separate files: one indexed on measured depth (any TVD data used must come from the definitive TVD set for the well) and the other indexed on time.

Typical content and structure, including standard curve type designations, are described in Appendix B-4.5.

3.5.3.3 Format and Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type. LAS 2.0 is the recommended format for velocity logs.

4. Interpreted data

This section outlines the requirements for reporting interpreted well data.

4.1. Petrophysical interpretations

4.1.1. Purpose

The data contain the final petrophysical interpretation(s) for the well, structured and named in a way that is understandable by any technical E&P user. The key to achieving this is the generic Curve Type (ENERGISTICS-PWLS standard) that must accompany each computed curve.

4.1.2. Quality

The 'Petrophysical Interpretation Input' data set must be accompanied by a full Audit Trail in the form of an Information File giving details of all preparatory work: editing, depth matching, environmental and other (e.g. bed-thickness) corrections.

The 'Petrophysical Interpretation Output' data set must have an associated Information File that contains details of processing methods, parameters and any other relevant information associated with the interpretation process. All relevant summaries and comments regarding the interpretation are to be included.

4.1.3. Content

Petrophysical interpretations should be reported for all reservoir and other zones of interest, and the data shall be consistent with the interpretation presented in the final report (Resource Regulations § 30 and 31).

The data shall be contained in two separate file sets:

An INPUT file(s) containing all the curves used as input to the reported Petrophysical Output data set. This input file should be accompanied by an Information File giving details of all preparatory work.

An OUTPUT file(s) giving all relevant interpreted output curves. This output file should be accompanied by an Information File giving details of processing methods, parameters and any other relevant information associated with the interpretation process.

An appropriately scaled graphical depth plot of the final interpreted (often including key input) curves should be reported. See Section 5 for details.

Typical content and structure, including curve types, are described in Appendix B-4.1.

4.1.4. Format and Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type.

4.2. Formation pressure data

4.2.1. Purpose

A set of build-up formation and wellbore hydrostatic pressures for fluid gradient, type and contact determination should be reported. Pressures are normally those determined by inspection of pressure build-up at acquisition time, but more formal techniques may be used (for example, Horner Build-up Analysis). In either case, the method should be documented.

4.2.2. Content

Data curves corresponding to the operator's interpreted formation and hydrostatic pressure before/after the test shall be included for all tests attempted. It is desirable that the quality of the pressure test be estimated on a 0 to 4 scale:

0 = "Lost Seal"

1 = Tight Formation

2 = Poor Permeability

3 = Good Permeability and

4 = Very Good Permeability

This is entered into a curve called 'QUAL'. The Operator must add a quantification table, explaining the ranges used for the 0-4 scale.

In addition to the above, the operator may wish to include a short comment or remark text 'curve' that contains a text version of the above numbers ('NO SEAL', 'TIGHT', 'POOR K', 'GOOD K', 'VGOOD K') or other information on the test (such as 'SEAL FAILURE', 'SUPERCHARGED', 'GOOD TEST'). This curve should be called 'REM'.

Typical content and structure, including standard curve type designations, are described in Appendix B-4.6.

4.2.3. Format and Structure

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type.

4.3. Final well report

In addition to all digital datasets outlined in table A1, a final report is to be submitted in respect of all types of wells. This report can, if the license operator find it practical, be submitted as two separate pdf documents, A Drilling Operations part (dataset 14.31) and a Geology part. (dataset 14.33). In addition a Discovery Evaluation Report (dataset 14.24) is to be submitted for exploration wells where hydrocarbons have been discovered.

4.3.1. Content

The contents of the final reports are:

a) general information, the geographical position of the well, its purpose and result,

b) lithostratigraphic description and indications of hydrocarbons, if any,

c) overview of logs, core intervals and fluid samples,

d) description of conventional cores and side wall cores,

e) results from testing, if any,

f) for exploration wells: updated prospect map,

g) overview of type of mud, commercial name, producer, base (oil/water), additives and an evaluation of the possible effect of the drilling mud on collected data,

h) digital format of all geological and reservoir technical data, where type of data and format correspond to the Norwegian Petroleum Directorate's guidelines on digital reporting of well data, including a composite log with interpreted formation tops in depth and time, a pressure evaluation log and a formation evaluation log,

i) temperature logs shall indicate measured and corrected value, and all relevant data for determination of local geothermal gradients in a well at thermal equilibrium,

j) all depths shall be related to the drill floor/ rotary table (RKB), and the logs shall indicate measured depth (MD) and true vertical depth (TVD). Information enabling the conversion of measured depth into vertical depth, as well as the wellbore geometry, shall also be included,

k) biostratigraphic range charts in digital format are to be enclosed with the biostratigraphic report. Preferred file formats are StrataBugs or S.I.S. (Stratigraphic Information System).

With regard to wildcat wells the Norwegian Petroleum Directorate also wants the prognosis and the result submitted on a specific form in digital format as enclosure to the final report. Specific form for this purpose may be acquired from the Internet site of the Norwegian Petroleum Directorate, http://www.npd.no/

4.4. Discovery Report

A discovery evaluation report is to be submitted in respect of exploration wells where hydrocarbons have been discovered. Separate reports on biostratigraphy, geochemistry and other special studies shall be submitted separately.

4.4.1. Content of the Discovery report

The content of the discovery report is:

a) results from data collected from test activities. Should contain relevant test data such as Pi (initial reservoir pressure), PIi (initial productivity index), S (skin factor), permeability, fluid contacts if any, effects resulting from stimulation and evaluations relating to formation strength,

b) overview of fluid samples with test intervals, test number, type of test (production test, RFT, MDT etc.) fluid type, and an evaluation of whether the tests are representative of the tested formations,

c) geological and reservoir technical results, including ac) description of method of petrophysical analysis bc) reservoir geological updating, including updated seismic velocity functions cc) updated depth charts of petroleum bearing structures in case of significant deviations from the prognosis dc) results from PVT analyses,

d) results from core analyses,

e) size of petroleum deposit if any, indicated by P10, P-expected and P90 to the extent possible.

5. Digital images[5] of interpretation logs

5.1 Purpose

To act as an easily accessible archive record of the digital data recorded at acquisition time and a record of the graphical representation.

For modern computer-generated acquisition systems, where graphical images are created directly from the digital data, there are increasingly fewer good business reasons to maintain graphical images of simple curve data since these can easily be re-generated from the data. However, not all users (especially non-expert ones) will have access to, or have the expertise to use, the specialized graphical plotting packages required. For this reason, there is a requirement to report the FULL graphical image of each recorded well log. This situation will be kept under review as newer technologies (e.g. XML) allow generic and easy-to-use methods for graphically presenting curve data. High sample-rate well-log data prints created by what are often referred to as 'wellbore image' tools should be reported graphically if the data are in a 'final' state. This would include cement-bond prints, dipmeter plots, and some borehole image plots where the raw data image is usable without further processing (such as speed correction). Where further processing is required to create a usable image, it should be the processed image that is reported.

5.1.1 Content and Format

Please refer to Table A1 for a listing of the naming, formats and structuring preferred for this data type.

6. Reports and datasets

All reports and datasets relating to one or several wells that the operator has and shares with licence partners are to be reported. This also applies to reports compiled or received on data acquired after completion date. A list of such reports is provided in Table A1 (separate excel-document). The table also explains naming conventions for the file names and how they should be organized for transmittal to Diskos. The datasets are to be accompanied by information files as specified in table A1 . Datasets related to more than one well can be submitted to Diskos once, but will be loaded and linked to each of the wells included. The confidentiality period is counted either from the completion date for the wellbore or from the date when the report was made. This is specified further in Table A-1.

In addition to the data reporting requirements according to Section 30 of the Resource Management Regulations, the Drilling Program (Dataset ID 14.13) shall always be reported to Diskos NDR. For development wells, the Drilling Program Document may cover several wellbores. These will be copied and indexed to all relevant wellbores in Diskos.

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Note that the digital image will normally be created directly by a computer system for newly acquired data, and this is the preferred method for producing the digital image. As a minimum, a 300-dpi image is required. Optical scanning of a hard-copy item may be necessary where the original graphical image is created by 'traditional' methods' (for example, some final well-composite logs). In this case, a higher resolution, such as 400-dpi, should be used to prevent data loss.

Appendix A - Diskos File Naming Convention and File Structure for Well Data Files

1.0 Purpose

A file naming convention serves to inform a user of the contents of a file without special applications to examine the file contents. As such, it should be possible to identify files within standard file/directory browsers used by common operating systems. The file name is NOT intended to replace or augment information contained in the file that may be used by database loading applications. The name contains no format information: that is the purpose of the file extension.

2.0 Conventions

A set of naming conventions is given below for 'standard' situations. There are many data files, especially graphical or Information Files where the content is such that a standard name is not appropriate. In such cases, the file name should be chosen so that it clearly conveys the file contents.

3.0 File Name Structure

File names should have the same basic structure:

NAME(Content Information).EXTENSION

The use of UPPER-CASE characters throughout is mandatory.

- All files are consistently numbered (versioned), starting with '_1' on first occurrence, to ensure correct versioning.

The extension gives information about the format of the file. The following codes are recommended:

- DLIS, LIS, or SEGY for industry standard binary formats (encapsulated for disk storage where appropriate)
- LAS or SPWLA for such 'standard' ASCII formats
- ASC for other non-standard ASCII files
- For 'general industry standard' graphics files, use the commonly adopted extensions: PDF, (Adobe's 'Portable Document File'), or TIF (here .TIF is 'Tag Image File Format' and NOT 'Tape Image File' as sometimes used for encapsulated log data files).

For specific examples, including 'Content Information' see Table A1.

Appendix B - Content Information for Specific Datasets

1.0 Purpose

This Appendix shows what specific attributes (information fields) need to be populated for each of the data sets being reported to Diskos.

2.0 Layout

Each specific data set is referenced using the same number used in the main sections of this document. For example, Raw Well-log data that is in Section 2.1 is also in 2.1 in this Appendix. Exceptions are where both raw and computed data share the same basic contents and structure (core and wellpath data). In these cases, the raw data section number is used.

Note: This Appendix makes reference to the use of 'Curve Type' as a generic alias name for specific data curves. Reference values for Curve Type for RAW Well-logs (RAW only at this stage) are the subject of the ENERGISTICS PWLS project. This project is working with TWO related Curve Type attributes: a 'Curve Type' and a 'Property Type' (based on Schlumberger work). It is an abbreviated version of the 'Curve Type' that is used throughout this document.

Also note that lists of Curve Types and other attributes contained in many of the tables in this Appendix may be subject to on-going standards initiatives (ENERGISTICS SIG work). The intention is to maintain these tables as a 'local' Norwegian reporting standard in the short-term. If they are adopted by a global standards organisation, these local standards will be modified where appropriate.

3.0 RAW DATA

3.1 WELL-LOG DATA

In addition to using well-log naming standards at the acquisition stage, service companies should be encouraged to unify the way in which these standards are encoded into industry standard formats, particularly DLIS, the recommended delivery format.

3.1.1 Header data

All standard API well-log header data must be completed and coded into the acquisition data format. If this is not possible due to format limitations, or commonly used write and read applications, then a separate ASCII Information File, in an NPD-approved format, should be used.

Particular attention should be paid to filling in the following:

- The NPD well naming convention shall be used as the main header entry
- Remarks should be fully populated
- Service (the tool/software combination used for acquisition)
- Program Version (the acquisition software version)

3.1.2 Other Key Attributes

The following Table B3.1 shows other Key Attributes that should be populated. These attributes will facilitate the creation of standard data sets within target databases.

Table B-3.1 **Key Attributes**		
Attribute Name	**Values**	**Comments**
Tool String Attributes		These are attributes at the Tool String level that are inherited by all tools and curves from that tool string. In some database implementations, these attributes may be set at the Tool, Log (curve set) or Curve level.
GENERIC TOOL STRING	Created from Tool Types (see entry below) present in tool string using concatenation rules	E.g. DEN-NEU-GR
TOOL STRING	Tool String name as it appears on well-log print headers (usually from the HIDE attribute in LIS/DLIS)	
TECHNICAL TOOL STRING	Created from the service company Tool Names present in the tool string using concatenation rules.	
Tool Attributes		These are attributes at the Tool level that are inherited by all curves from that tool. In some database implementations, these attributes may be set at the Curve level.
TOOL MNEMONIC	Supplied by service company, see also ENERGISTICS-PWLS	Example: CNT-H (Schlumberger) or CN-2446XA (Baker)
TOOL DESCRIPTION	Supplied by service company, see also ENERGISTICS-PWLS	
TOOL GROUP NAME	Supplied by service company, see also ENERGISTICS-PWLS	Example: CNT (Schlumberger) or CN (Baker)
TOOL MARKETING NAME	Supplied by service company, see also ENERGISTICS-PWLS	
TOOL TYPE	see also ENERGISTICS-PWLS	Example: NEU for Neutron
OPERATION MODE	see also ENERGISTICS-PWLS	Values are Wireline or MWD

Curve Attributes		
CURVE NAME	Service company/tool specific	
CURVE DESCRIPTION	Supplied by service company, see also ENERGISTICS-PWLS	
CURVE BUSINESS VALUE	see also ENERGISTICS-PWLS	
CURVE TYPE SHORT	see also ENERGISTICS-PWLS	Curve Type Short is a token-based classification using 2 to 4 character tokens with ‘dot’ separators. They map 1-to-1 with the Curve Type Long, which is the same as Schlumberger’s ‘Property Type’
CURVE TYPE LONG	see also ENERGISTICS-PWLS	The Curve Type Long is a full-length text classification which maps 1-to-1 on the Curve Type Short.
CURVE UNIT TYPE	see also ENERGISTICS-PWLS	

3.1.3 Logging Summary Document

Please refer to the ‘LOGGING SUMMARY (Template)’ sheet in Table A1 for an example.

Please note that the logging summary file should be cumulatively generated, i.e. just one (the latest) version of the file should be stored (LOGGING_SUMMARY_1.PDF), incorporating all logging activities in the well. The previous version should be deleted.

3.2 Core data

Raw and Computed Core Data

This section primarily concerns defining Curve Types for conventional core data, although some SCAL measurements are included.

Accompanying information, such as experimental confining pressures, saturation/de-saturation methods and drying, cleaning and fluid extraction methods should be included, in Information Files if necessary.

Table B-3.2 **Curve Types for Core Data**		
Curve Type	**Description**	**Comment**
CAPI.PRES.	Capillary pressure	
CEC.	Cation exchange capacity	
DEN.MAT.	Matrix density	
DEN.GRN.	Grain density	
VF.MIN.	Mineral volume	Volumes from mineralogical measurements
VF.MIN.DOL.	Dolomite Volume	
VF.MIN.CALC.	Calcite Volume	
VF.MIN.SND.	Sand Volume	
PERM.	Permeability	
PERM.HOR.	Horizontal permeability	
PERM.RADI.	Radial permeability	
PERM.VERT.	Vertical permeability	
SAMP.NUM.PLUG.	Sample (plug) number	
POR.	Porosity	
POR.HE.	Helium Porosity	
POR.EFF.	Effective Porosity	
POR.TOT.	Total Porosity	
SAMP.NUM.CORE	Core Number	
REL.PERM.	Relative permeability	
SAT.GAS.	Gas saturation	
SAT.HYD.	Hydrocarbon saturation	
SAT.OIL.	Oil saturation	
SAT.WAT.	Water saturation from core	
SAT.WAT.BND.	Bound water saturation	

3.3 Mudlog data

This section defines Curve Types for common mudlog data. This includes drilling dynamics, mud, lithology and hydrocarbon data (Table B-2.5). Section 2.5.2 covers Lithology coding.

3.3.1 Curve Types

Table B-2.5

Curve Types for Mudlog Data

Curve Type	**Description**	**Comment**
Mud Data		Mud circulation densities, flows and pressures are under Drilling Dynamics data
MUD.RES.	Mud resistivity	
MUD.RES.IN.	Mud resistivity - inflow	
MUD.RES.OUT.	Mud resistivity - outflow	
MUD.DEN.	Mud density	
MUD.FLOW.IN.	Mud flow – inflow	
MUD.FLOW.OUT.	Mud flow – outflow	
Drilling Dynamics Data		
BIT.SIZE.	Bit size	
DEPTH.	Depth	Probably of little direct use in this context since this implies wireline depth
DEPTH.BIT.	Bit depth	
DEXP.	Drilling exponent	
BIT.VEL.	Drilling penetration rate	
MUD.DEN.ECD.	Effective Mud Circulation Density at TD	
MUD.FLOW.	Mud flow	
MUD.FLOW.IN.	Mud flow – inflow	
MUD.FLOW.OUT.	Mud flow – outflow	
MUD.PRES.	Mud pressure	
MUD.PRES.BTHL.	Mud pressure - bottom hole	

MUD.PRES.SRF.	Mud pressure - surface	
PRES.	Pressure	
PRES.PUMP.	Pressure – mud pump	
ROP.	Rate of Penetration	
RPM.	Revs per minute	
RPM.BIT.	Revs per minute - drill bit	
RPM.BIT.CUM.	Revs per minute - drill bit, cumulative	
TIME.	Time	
TIME.BIT.	Time - on bit	
TIME.CRC.	Time – circulation	
TIME.CRC.TOT.	Time - total circulation time	
TIME.CRC.BTUP.	Time – bottoms-up circulation time	
TORQ.	Torque	
TVD.DRIL.	TVD depth from driller	
VOL.	Volume	
VOL.TANK.	Tank Volume	
WGT.	Weight	
WOB.	Weight on bit	
WGT.HK.	Hook load	
Gas and Hydrocarbon Data		
GAS.	Gas	
GAS.C1.	Gas-methane	
GAS.C2.	Gas-ethane	
GAS.C3.	Gas-propane	
GAS.C4.	Gas – iso butane	
GAS.C5.	Gas – iso-pentane	
GAS.C6.	Gas – iso-hexane	
GAS.TOT.	Total gas	
GAS.RAT.	Gas ratio	

GAS.RAT.C12.	Gas ratio – methane/ethane	
GAS.RAT.C13.	Gas ratio – methane/propane	
HYD.SHOW	Hydrocarbon show data	Text
Lithology Data		
LITH.	Lithology	NPD Codes (see Section 2.5.2)
LITH.DESC.	Lithology description	

3.3.2 Lithology Coding

The mudlog interpreted lithology description must be coded and assigned a unique number at each depth according to the NPD "official" lithology definition and nomenclature, a copy of which is shown below. It is assumed that a lithology-type that starts at depth1 has a constant code until a new lithology type starts at depth2 (> depth1). In this way, the lithology descriptions are represented by one continuous depth indexed, regularly sampled curve, which can then be handled similarly to any of the curves from the mudlog. The lithology description of the cuttings, the one representing the "average" description of the cuttings directly from the mud returns, does not need to be digitised.

NPD Coding System

A digital code has been assigned to the main lithologies as shown. Lithology = (Main lithology * 10) + cement + (modifier / 100). Example: Calcite cemented silty micaceous sandstone: (33 * 10) + 1 + (21 / 100) = 331.21.

Main Lithologies			Cements			Modifiers	
None	0		None	0		None	0
Conglomerate (general)	10		Calcite	1		Concretions general	10
Grain supported conglomerate	11		Dolomite /Ankerite	2		Calcite concretions	11
Muddy congl.	12		Siderite	3		Dolomite concretions	12
Muddy, sandy, congl.	13		Quartz	4		Siderite concretions	13
Sandy congl.	14		Kaolinite	5		Ooid / pisolite	14
Conglomeratic sandstone	15		Illite	6		Tuffite	15
Conglomeratic muddy sandstone	16		Smectite	7		Bitumenous	16

Sedimentary breccia	20		Chlorite	8		Glauconite	17
Sandstone	30					Halite pseudomorph	18
Clayey sandstone	31					Pyrite	19
Muddy sandstone	32					Siderite	20
Silty sandstone	33					Mica	21
Siltstone	40					Kaolinite	22
Sandy siltstone	41					Carbonaceous	23
Fossil siltstone	45					Chamosite	24
Mudstone	50					Phosporite	25
Sandy mudstone	51					Argillaceous	26
Conglomeratic mudstone	52					Calcareous	27
Fissile mudstone	55					Chert	28
Claystone	60					Sulphate	29
Sandy claystone	61					Arenaceous	30
Silty claystone	62					Bioclastic	31
Shale	65					Chalky	32
Silty shale	66					Ferruginous	33
Limestone	70					Fossils	34
Dolomitic limestone	72					Plant Remains	35
Dolostone	74					Lignite	36
Calcareous dolostone	76					Feldspar	37
Chalk	78					Fissile	38
Marl	80					Silty	39
Gypsum	85					Dolomite	40
Anhydrite	86						
Gypsum / Anhydrite unspecified	87						
Halite	88						
Salt, general	89						

Coal	90						
Brown coal	91						
Volcanic rock gen.	92						
Intrusive rock gen.	93						
Silicic plutonic rocks	94						
Mafic plutonic rocks	95						
Dykes and sills gen.	96						
Metamorphic rocks gen.	97						

3.4 Wellpath data

3.4.1 Raw and Computed Wellpath Data

This section defines the Curve Types for common wellpath data. The requirement on data completeness is that the data shall uniquely define the entire well (and wellbore) trajectory from a known surface location. Data in the 'interpreted' set should be sampled at regular increments of 1m or less, compatible with standard well-log sample rates (typically from 0.10 m upwards).

For raw data sets, all important acquisition parameters and directional/elevation information should be included with the data, in Information Files if necessary.

For computed data sets, the computation methods and parameters (including full surface location information) should be reported.

Table B-3.4
Curve Types for Wellpath Data

Curve Type	Description	Comment
BH.AZIM. *	Borehole Azimuth	
BH.CURV. *	Borehole Curvature	
BH.DEVI. *	Borehole Deviation/Inclination	
DEPTH.MD.*	Along-hole depth	
DEPTH.TVD.	True Vertical Depth	
DEPTH.TVD.KB. *	True Vertical Depth, KB Ref	
DEPTH.TVD.SS.	True Vertical Depth, SS Ref	

COORD.X.GEO.	X Geographical Coordinate	
COORD.X.OFF. *	X Offset	
COORD.X.UTM. *	X UTM	
COORD.Y.GEO.	Y Geographical Coordinate	
COORD.Y.OFF. *	Y Offset	
COORD.Y.UTM. *	Y UTM	

* Mandatory curves

3.5 Composite well logs

This section defines the Standard Curve Names and Curve Types to be used for Composited Well-log data. Note that because the Standard Curve Names are generic, there is nearly always a one-to-one correspondence with the Curve Type.

Table B-3.5

Standard Curve Names and Curve Types for Composited Well-log Data

Standard Curve Name	**Curve Type**	**Description/Comment**
Primary		
AC	AC.	Sonic
BS	BS.	Bit Size
CALI	CALI.	Caliper
DEN	DEN.	Density
GR	GR.	Gamma Ray
NEU	NEU.	Neutron
RDEP	RES.DEP.	Deep Resistivity
RMED	RES.MED.	Medium or Shallow resistivity*
RMIC	RES.MIC.	Microresistivity
SP	SP.	Spontaneous Potential
Secondary		
PEF	PEF.	Photoelectric Factor
K	K.	Potassium
TH	TH.	Thorium

U	U.	Uranium

* For normal composite usage, differentiation between medium and shallow resistivities is not necessary

4.1 Computed well log data

This section defines the 'Recommended Standard Curve Names' and Curve Types to be used for Computed Well-log data. Given that commercial software often imposes curve names, it is not the intention to modify them if they are pre-assigned: curve name recommendations are there to be used in the **absence of any other system-imposed names**.

For input sets to computed data sets, the same Curve Types as for Raw Well-logs should be used (Appendix B-2.1).

For computed output curves, is important that computation methods and parameters are reported, together with any analysis comments.

Table B-4.1

Standard Curve Names and Curve Types for Computed Well-log Data

Standard Curve Name	**Curve Type**	**Description/Comment**
Undefined	DIP.	Calculated Dip
Undefined	FLAG.	Flag
FCOL	FLAG.COAL.	Coal Flag
FDOL	FLAG.DOL.	Dolomite Flag
FLIM	FLAG.LIM.	Limestone Flag
FSND	FLAG.SND.	Sand Flag
Undefined	FVOL.	Fluid Volume
Undefined	VOLF.HYD.	Hydrocarbon Volume
Undefined	VOLF.HYD.FM.	Formation Hydrocarbon Volume
Undefined	VOLF.HYD.FZO.	Flushed Zone Hydrocarbon Volume
Undefined	LITH.	Lithology (description or code)
PERM	PERM.	Permeability
KRAT	PERM.RAT.	Permeability Ratio
POR	POR.	Porosity
PORE	POR.EFF.	Effective Porosity
PORT	POR.TOT.	Total Porosity

Undefined	SAT.	Saturation
Undefined	SAT.HYD.	Hydrocarbon Saturation
SH	SAT.HYD.FM.	Formation Hydrocarbon Saturation
SHR	SAT.HYD.FZO.	Flushed Zone Hydrocarbon Saturation
Undefined	SAT.WAT.	Water Saturation
SW	SAT.WAT.FM.	Formation Water Saturation
SXO	SAT.WAT.FZO.	Flushed Zone 'Water Saturation
DESC	TEXT.	Text Description
VMN	VOLF.MIN.	Mineral Volume
VDOL	VOLF.MIN.DOL.	Dolomite Volume
VLIM	VOLF.MIN.LIM.	Limestone Volume
VSND	VOLF.MIN.SND.	Sand Volume
VSH	VOLF.SH.	Shale Volume
Undefined	VOLF.WAT.	Water Volume
BVW	VOLF.WAT.FM.	Formation Water Volume
BVXO	VOLF.WAT.FZO.	Flushed Zone Water Volume

4.2 Time-depth-velocity data

This section defines the Curve Types for common Time/Depth/Velocity data (key values are in bold text).

Table B-4.2 **Curve Types for Time/Depth/Velocity Data**		
Curve Type	**Description**	**Comment**
AC.	Acoustic	
AC.CLBR.	acoustic – calibrated	
AC.IMP.	acoustic impedance	
AC.ITT.	acoustic integrated slowness (time)	

AC.REFL.	acoustic reflectance	
AC.VEL.	acoustic velocity	
AC.VEL.ITV.	interval velocity	
AC.VEL.RAT.	acoustic velocity ratio	
DENS.	Density	
DENS.CLBR.	density – calibrated	
TIME.	Time	
TIME.ONE.	one-way time	
TIME.TWO.	two-way time	

4.3 Formation pressure data

This section defines the Curve Types for common Formation Pressure data (key values are in bold text).

Table B-4.3 Curve Types for Formation Pressure Data		
Curve Type	**Description**	**Comment**
DEPTH.MD.	Measured (along-hole) depth	
DEPTH.TVDSS.	True Vertical Depth Subsea	
GRAD.	Gradient	
GRAD.FLU.	Gradient - fluid	
GRAD.FLU.GAS.	Gradient - fluid - gas	
GRAD.FLU.OIL.	Gradient - fluid - oil	
GRAD.FLU.WAT.	Gradient - fluid - gas	
GRAD.NAME.	Gradient name	
MOBL.	Mobility	
MOBL.OIL.	Oil mobility	
PERM.	Permeability	
PERM.FPT.	Permeability from FPT (Formation Pressure Tool)	

PERM.FPT.BU.	Permeability from FPT – buildup	
PERM.FPT.DD.	Permeability from FPT – drawdown	
PRES.	Pressure	
PRES.FM.	Pressure - formation	
PRES.FM.BU.	Pressure - formation - build-up	
PRES.FM.EXT.	Pressure - formation - extrapolated	
PRES.FM.HRN.	Pressure - formation - Horner	
PRES.HDR.	Pressure - hydrostatic	
PRES.HDRA.	Pressure - hydrostatic - after	
PRES.HDRB.	Pressure - hydrostatic - before	
TEST.NUM.	Test Number	
TEST.QUAL.	Test Quality	
TEST.TIME.	Test buildup time	

Appendix C - Data Formats for Text Data and Documents

This Appendix contains notes and guidance on formats for ASCII or text data, as well as for documents (text, graphics or mixed). Formats shall be either PDF, ASCII or other approved graphical formats (specified elsewhere in these Requirements), other proprietary formats are not accepted.

All text documents should be delivered in PDF.

Table A-1 provides additional instructions on naming of files and structure for the digital files which are to be submitted to Diskos for loading. The filters and sorting functionalities in the spreadsheet can also be used to give an overview of the data types and assist in navigating in the Diskos NDR front end, to locate the data when these have been loaded into the database.

Appendix D - Definitions

TABLE D-1 Definitions	
Item	**Definition**
Cased-hole Log	A log recorded in its entirety in cased-hole (that is, no open-hole section)
Composite Log	A log composed of individual logging runs spliced together, including Repeat Sections and "Down-logs" where necessary, to form the most accurate and complete record of key measurements such as example, sonic, density, neutron and various resistivities. Logging run data may be either wireline, MWD or both.
Field Print	A graphical representation of the data curves and supporting information such as headers, tool diagrams and calibration records. Usually created on two depth scales, 1:200 and 1:500
Hybrid Curve	A log-curve, possibly created from individual log-curves of the same curve type, but from different physical measuring devices spiced together to form the most accurate and complete record of some primary measurement. The Hybrid curve names were used to identify the 'best' curves available. This convention has been dropped in favour of grouping all 'best' curves in the 'Composite Log'
Mud Log	The collection of mud, hydrocarbon, lithology and drilling-related data, traditionally using surface sensors. However, downhole measurements (MWD/LWD) are becoming commonplace.
MWD Logging	The collection of formation and other drilling-related data using down-hole sensors located on the drill string. The term is intended to include LWD Logging.
Operator	The oil company that operates a licence.
Raw Log	Operator's official release of original field logs recorded by the Service Companies. It may contain data curves that have been corrected or had some processing applied.
Service Company	A company that provides services under contract to another company, usually an oil company. In the context of this document, the service company will be either an acquisition or data processing company.
Well	The well drilled under one drilling permit, which may consist of multiple tracks. Reference is made to the publication: NPD-Contribution No 33, June 1992.
Well Completion Log	The Operator's graphical log showing primary well-logs, geological zones, lithology cored intervals, DSTs etc.
Wireline logging	The collection of formation data using downhole sensors conveyed by electrical wireline

Appendix E - Well-log Compositing Procedures

It is the operator's responsibility to provide a complete and high quality ensured composite log data set (See Blue Book section 3.1).

This data set is neither the MWD raw composite log (provided by the contractor) described in section 2.1.2, nor the graphical composite/completion log (provided by the operating company). Two sets of data should be generated:

Petrophysical Composite data set:

- Includes all logging curves presented on field prints in original increments
- All NMR & High Resolution data
- Data at high sampling rates for thin-bed analysis
- MWD data depth shifted to match EWL data (if needed) & vice versa
- No editing applied to the curves except
  - Constant/straight lines are removed in top/bottom of the log curves
  - First readings (EWL data)/last readings (MWD data) are removed between runs
- MWD & EWL data runs are merged from top to TD in separated files

Composite data set:
The input logs used is taken from the petrophysical data set. The Composite set is defined as a set of curves, usually depth-matched and spliced so that measurements are available over the greatest possible depth interval within a given wellbore.

The Composite set should contain all the primary measurements made in a given well/wellbore. Examples of primary measurements and associated standard curve names and curve types are listed in Appendix B-3.5. These logs should be the best version of the logs presented/generated in the petrophysical composite set.

- Includes Standard curves in 0.1524m (6 inch) increment
  - GR (API)
  - RDEP, RMED & RMIC (OHMM)
  - CALI & BS (IN), DEN & DENC (G/CC), PEF (B/E) & NEU (V/V)
  - AC & ASC (US/FT)
  - K, TH & U (% & ppm, respectively)
  - ROP (m/h)
- Includes the best data from MWD & EWL, merged from top to TD
- Logs are edited for washouts & casing effects
- First readings (EWL data) & Last readings (MWD data) are removed at the top/bottom of logged interval
- Might be used as CPI input

The general procedure for finalizing both data sets should follow the steps below.

1. Raw logs:

Raw logs (MWD and EWL) that have passed the high quality insurance procedure should be used as input for compositing; see section 2.1 for details.

Not all raw logs need to be merged into a composite log. The compositing of logs specifically excludes the following services:

Sonic/acoustic waveform traces (note: The log recorded in combination with the waveform data (i.e. gamma-ray, etc.) and logs derived from the waveform data (i.e. Δt compressional and shear, etc.) shall be included when available).
Formation Image logs.
Formation pressure data.
VSP and velocity data.
Cased Hole logs such as production and cement bond logs (although Open Hole logs recorded in casing may have valid formation data which may be used for compositing and/or as depth reference for MWD logs).

2. Depth shifting:

The gamma-ray of the induction log will serve as the preferred base log assuming that this log is on depth with the deep induction. Should the induction log be unavailable, the first gamma-ray run in hole will normally become the reference log. In severe "stick & pull" conditions, the gamma-ray least affected should be selected as reference.

The sonic/acoustic, density/neutron, dual laterolog and gamma-ray spectral log, etc., when recorded separately, may initially be depth-shifted through gamma-ray – to gamma-ray correlations. A subsequent check will be made to insure that the sonic/acoustic, laterolog deep, density/neutron, etc. are within the established depth tolerances when compared to the induction deep log.

Depth shifting of log data is viewed as critical and must be performed when depth discrepancies between log traces in excess of 0.5 m occur (excluding local depth discrepancies observed in a "stick & pull" situation occurring over shorter intervals, i.e. in severe borehole conditions where the logging instrument often gets stuck and subsequently jumps free. In these intervals, data is likely lost and cannot reliably be corrected for).

The 0.5-metre tolerance is intentionally set with the objective of obtaining robust, quality- controlled and consistent depth shifts that minimize the need to load the raw data.

Both block (linear) and continuous (dynamic) depth-shifts are acceptable.

It is important that depth-shifted logs provided on digital tapes are in agreement with the depth shifts shown on the operator's completion log, in order to maintain consistent depth reference with the established formation tops.

3. Tie-ins and merging

All logs (MWD/EWL) should be on depth prior to merging.

a) Merging when overlap section exist:
Tie-in each subsequent logging run by comparing the gamma-rays in the overlap sections and make depth-shifts when necessary. The depth shifts used for tie-ins shall only be applied locally and close to the merge point.

Each log from one service run will be individually merged with logs from similar service runs. The merge depth should be selected where the two curves reads approximately the same values ("Steps" should be avoided, if possible).

Merge depths will be selected visually. Every effort will be made to eliminate the "end & beginning" of a logging run at the splice between runs (i.e. the casing and the "before pickup" responses). It is stressed that "automatic" splicing cannot be accepted where often a valid response from one run is replaced with invalid data from another run.

The preferred merge depth, assuming everything equal, is to splice the logs at its deepest possible point in an overlap section between runs. This ensures that the uppermost run is emphasized.

b) Merging when overlap section does not exist:
No tie-in or depth shifting will take place over intervals where no overlap exists between successive logging runs and where both open hole and cased hole log data is missing, unless other indications such as badly marked cable has been found to cause depth discrepancies.

The merging of two open hole sections, therefore, often results in a gap between two logging runs. The editing requirements for the gap interval are described in the editing section below.

4. Data editing

4.1 Petrophysical composite set

Depth shifted and merged logs are joined in sub files with original increments. Minimal editing is performed in order to keep the data as original as possible

Editing may be applied to the data sets such as removal of constant/straight lines in top/bottom of logs and first readings (EWL data)/last readings (MWD data).

4.2 Composite set

A selected number of logs already depth shifted, merged and organized in the petrophysical composite set are used to generate the composite set. The 'best version' of these logs available (MWD and/or EWL) over a given depth interval should be used and the resultant spliced curve should cover the greatest possible depth interval.

Additional editing applied (if applicable):

a) Invalid/bad data removal:
Check the information given in the "remark" section of the Field Print header and edit or replace all known bad/invalid data (including e.g. memory/delay problems).

b) Invalid/bad data replacement:
Sections of the main log featuring poor log quality, due to, for example, stick & pull or excessive cycle skips on the Acoustic/Sonic log shall be replaced by data from the repeat, reaming and down-log section(s) whenever improved accuracy and quality can be achieved.

Repeat section is defined more broadly here to include multiple logging runs over the same interval. (e.g. intermediate logging and subsequent final logging runs may log the same interval twice). The repeat and/or down-log section(s) often contain data from missing intervals in the main logged section. (Example: "Could not reach TD after logging the Repeat Section"). The main logged section will be edited to include this data in order to obtain a log that is as complete as possible.

c) Editing of gaps between logging runs:
The before "Pick-up" recordings for the lowermost logging run of each service (normally the final logging runs) shall be removed (the original raw data will contain the pre pick-up data; usually called first readings for EWL and last readings for MWD).

The part of the log recorded in casing for the uppermost logging run for each service shall be removed unless it contains the best version of valid formation data (e.g. GR behind casing on surface logging runs).

The merging of two open hole sections may result in a gap between two successive logging runs. The first valid reading of the shallower run and the last valid reading of the deeper run must be identified. In general, invalid logging responses in the gap interval are removed.

The resistivity logs (recorded with present technology) are considered invalid in casing and should always be removed. The gamma-ray and the neutron logs, however, should normally be left intact. In the case of density and sonic/acoustic (array) logs, they respond, at times, correctly to the formation through casing, in which case the recording should be left intact.

Gaps in data curves of 1m or less may be straight-line interpolated. Larger gaps should contain null values.

d) AC/ACS editing:
Sonic/acoustic log is edited for cycle skips and noise. Cycle-skips are edited considering other log responses such as from density and resistivity logs. "Tight streaks" should, for example, be identified to ensure that incorrect sonic/acoustic editing is avoided. When the sonic / acoustic signal is affected by "noise", filtering may be used in an attempt to improve the appearance.

e) SP editing:
The SP log needs to be shifted in order to eliminate mechanical shifts made by the logging engineer at the time of logging and to eliminate the shift between logging runs when spliced.

The SP scale shall also be normalized to a default 0-100 mV plot scale to encompass most of the SP log(s). Note: Original mV span must be maintained at all times.

All editing shall be reported in the audit/information file.

5. Output logs

5.1 Petrophysical composite set

The petrophysical composite set is generated to preserve 'specialist' composited data curves. This data set is not same as the interpreted data set (Section 4.1). A good guide is to include all 'presentation curves' from log prints.

The depth-shifting, tie-ins/merging and editing are of outmost importance and should be documented in details in the petrophysical composite information file. In addition, remarks and log comments from both digital file(s) and field print(s) including cleaning, editing and correction details should be listed in the information file. This determines the degree of consistency and quality.

The output results should be in accordance with the requirements as listed in table A-1:

- WLC_PETROPHYSICAL_COMPOSITE_#. DLIS(,LAS,LIS)
- WLC_PETROPHYSICAL_COMPOSITE[_#[-#]]_INF_#. PDF(,ASC)

5.2 Composite set

A primary measurement may be composed of data taken from different physical tools (for example, it could be made from a combination of EWL and MWD measurements). For each primary measurement, the 'best version' of that data available over a given depth interval should be used and the resultant spliced curve should cover the greatest possible depth interval.

The depth-shifting, tie-ins/merging and editing are of outmost importance and should be documented in details in the composite information file. In addition, remarks and log comments from both digital file(s) and field print(s) including cleaning, editing and correction details should be listed in the information file. This determines the degree of consistency/quality and the future usefulness of the established database.

The output results should be in accordance with the requirements as listed in table A-1:

- WLC_COMPOSITE_#. DLIS (,LAS,LIS)
- WLC_COMPOSITE[_#[-#]]_INF_#. PDF(,ASC)
- WLC_COMPOSITE{_MD}|[_TVD]_PLOT_#. TIF(,PDF,CGM)

Appendix F - Template for Final Well Position Report

Final Well Position Report

Wellbore Name: *Exploration wellbore/Development wellbore*

Date:

Field:

Rig:

Licence:

RECIPIENT:

COPY TO:

FROM (Printed):	CONTROLLED BY (Printed):
Signature	Signature

Final Well Surface Position

Geographical Co-ordinates:

Latitude:	DD°	MM’	SS.SS”	N
Longitude:	DD°	MM’	SS.SS”	E
Spheroid:				
Datum:				

UTM Co-ordinates:

Northing:	X XXX XXX	m
Easting:	XXX XXX	m
UTM Zone:	XX	N
Central Meridian:	XX	E

Datum Shift Parameters WGS84 to ED50 (EPSG YYYY)

Deviation:
The surface position was observed to be X.X meter on a bearing of XXX.X° (G) from the intended location.

Accuracy:
± X,XX meters.

Appendix G - Template for Completeness report

Table A-1 – See separate tab named COMPLETENESS (template)