Guidelines to the Petroleum Regulations

REPORTING REQUIREMENTS FOR DIGITAL WELL DATA
“Blue Book”

(Regulations relating to resource management in the petroleum activities, 18 June 2001 Section 24. Final reporting of geological and reservoir technical well data)

See also Table A-1

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REPORTING REQUIREMENTS FOR DIGITAL WELL DATA
(Drilling Regulations, Section 12)

CONTENTS

1. INTRODUCTION

By virtue of Section 12 of the Drilling Regulations and in accordance with Guidelines to Section 12 sub-section h, digital reporting of all geological and reservoir technical data is required within the timeframes defined in Section 1.1(b).

The present version constitutes a comprehensive update of version 3.1. The intention of the new version has been to improve on known deficiencies in the previous standard and to increase the flexibility to accommodate a variety of reporting needs and "best practices" within the reporting companies.

The enhancements are based on the following underlying general guidelines.

- All files are consistently numbered (versioned), starting with suffix '_1' on first occurrence, to ensure correct versioning.
- Improved user friendliness. To facilitate the data searching process in the DDB a grouping of data and accompanying information files is achieved by changing the naming principles of the information files.
- Information files may cover either a single data file, or two or more data files. This should be reflected in the name of the information file. See Table A1 for examples.
- For well log and well log composite data files from electric wireline (EWL) logging the acquisition method (i.e. EWL) has previously been implicit. Thus, similar data acquired while drilling has had the string '_MWD' attached to the file name, e.g. 'WL_RAW_XXX…_MWD…'. To avoid such implicit naming a similar naming for EWL data has been adopted, e.g. 'WL_RAW_XXX…_EWL…'.

The present revision has been focused on updating Table A1, and subsequently, the Blue Book text has been updated accordingly. If, however, any contradiction should arise between this text and the Table A1 the tabular version should be considered the valid one. This pertains particularly to some of the Appendices which may still contain obsolete or non-relevant information. Future updates will primarily be done to Table A1. To reduce the possibility of inconsistencies between the text and Table A1 as well as facilitating future Blue Book updates, the previous format and structure sections pertaining to each data type have been removed from the text. Hence, the user should refer directly to Table A1 for data formatting and structuring issues.

1.1. OBJECTIVES

The main objective of these Reporting Requirements from the Norwegian Petroleum Directorate (NPD) is to support the efficient exploitation of the country's hydrocarbon reserves. The data will be available for use by the NPD and oil companies with appropriate entitlements in the Diskos Database (DDB)

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

1.2. REGULATORY REQUIREMENTS ON DELIVERY

The DDB will be operated on behalf of the NPD by a DISKOS Database Operator (DDO), currently SINAS. Data delivered to the DDO in compliance with the reporting requirements will be taken as meeting the regulatory requirements for data deliverance to the NPD.

It is expected that most operational issues incurred in meeting the regulatory requirements will be dealt with between the oil company operator (or their contracted representative) and the DDO.

It is the operators' responsibility to ensure that data are delivered to the DDO within the required timeframes and that they are of appropriate quality and completeness. There will be no formal 'approval' process involving the NPD.

These Reporting Requirements can never provide an exhaustive list of all conceivable geological and reservoir technical data types required to be reported, but constitute a detailed framework within which any such data is able to be reported. 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 interpreted data).

Interpreted data must not be reported in the same file as raw data due to data release mechanisms. This applies to data fields, not to reports.

Further requirements may be specified by the NPD in collaboration with DISKOS and the DDO to be published as "DISKOS Guidelines".

Further releases of this document and attachments or links will attempt to detail new data types as they occur.

1.3. REPORTING GUIDELINE PRINCIPLES

Throughout these procedures, the emphasis is on the use of 'good practice' rather than detailed and prescriptive processes. That is, the focus is on the outcome of the process rather than its details. However, this in no way reduces the requirements on the reporting of high quality data sets.

The previous reporting requirements[1], with some minor modifications, will continue to provide 'minimum quality' guidelines for the reported data sets and should be used if no higher quality guidelines are available.

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

In general, the creator[2] of the data should add all associated parameters and information 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 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[3] and PPDM[4] standards bodies.

The ultimate aim is to create data sets together with associated information that can be used to populate the DDB with as little intervention as possible, apart from the usual operational checks and QC processes, and which do not deteriorate over time, thus making future retrieval and use as simple as possible.

1.4. GENERAL GUIDELINES FOR ALL DIGITAL REPORTING

a) Reporting applies to both exploration and production wells.

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[1] Regulations Relating to Resource Management in the Petroleum Activities, Section 24, June 2001

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

[3] Energistics – see www.energistics.org Previously POSC - Petrotechnical Open Software Corporation

[4] PPDM – Public Petroleum Data Model Association

b) For digital data collected up to the completion date[5] reporting shall take place as soon as possible and at the latest six (6) months after the completion of the well. Digital data collected after that date (for example, production-log surveys or special core analysis data) shall be reported at the latest six (6) months after receipt of the data set by the operator. These are maximum reporting periods – all data and reports are to be submitted as soon as these are made available to the operator. This is essential if well data is to be traded "digitally".

c) Data are grouped into three (3) process stage groups which contain all relevant digital data and associated information documents (including associated images)

- 'Raw' data, as acquired or measured, i.e. as delivered by the acquisition contractor
- Edited or Composited data
- Interpreted or Computed data

All data are available for release following expiry of the confidentiality period (currently 2 years for Raw and 20 years for Interpreted data, based on the wellbore completion date for openhole data, and, for cased hole data, the 'acquisition job date').

d) Information Files. These are used to carry information about data files such as their contents, processing or acquisition parameters, data manipulations etc. Wherever possible, this kind of information should be encapsulated within the data files in an industry standard format in such a way that it is readable by the DDO. However, it is realized that there are few industry standards that support the addition of such additional information and 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. Information files are documents; hence the use of PDF format files is preferred (although ASCII will be accepted for the time being).

e) A hierarchical folder structure should be used when delivering data to the DDO (cf. Table A1, column D). All files should be placed within a top-level directory identifying the well. This directory should be named using the <u>official well name</u> being appended 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 shallow drillings (xxxx-Gz)
- 'T-number' for test production (xxxx-Tz)

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.

[5] Completion date: Date when the drilling activity is completed. For an exploration or observation wellbore it is the date when the plugging is completed or wellbore is suspended. For a development wellbore it is the date when the wellbore is at total depth and the last casing or liner is set.

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 given 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.

f) 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".

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

h) The Norwegian Petroleum Directorate standard for well reference shall be used.
NPD guidelines for designation of wells and wellbores

i) Deletion/Replacement of Data. Only final quality controlled data is to be submitted to the DDB, 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 given by Table A1) will be readability checked by the DDO. In such cases previous data may be deleted after replacement, but the operator must document why replacement formats were necessary.

j) 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 DDB wellbore data structure.

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

1.5. DATA CURVE SPECIFIC REQUIREMENTS

a) Depth reference of all reported 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 metres for all new data.
- Sampling rate including high sample rates (so-called fast channels). That is, 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 methods, or associated surface systems. 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 or environmental or other corrections is to be applied to the data set delivered from the contractor.

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

For each well, a ‘Logging Summary’ document is to be created. This document contains 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 arising noted in the 'Remarks' section of the header.

All header data must be completed.

All operational factors that could impact on 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 the 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 well be listed alphabetically. Also, since AUX and GR are always part of the tool strings these could as well be left out, 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 and should be placed in a directory named WELLBORE_DOCUMENTS.

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 new numbering scheme all run information should 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 should be stored (LOGGING_SUMMARY_1.PDF), incorporating all logging activities in the well. The previous version should be deleted. The only exception to this rule is for the case of a change in the data reporting contractor.

Further details on file naming are given 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.

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-2.2

2.2.3. Format and Structure

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

The generally agreed image format for core and core related data is TIF unless otherwise specified in Table A1. This means that even though other image formats may be delivered a TIF version of the same images should always be included, and only the TIF files will be checked by the DDO before loading.

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: 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/).

2.3.2. Content

All geochemical data collected, as far as they can be represented by the NPD-GC-95 v.2.0 data transfer format.

2.3.3. Format and Structure

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

2.4. WELLBORE SEISMIC DATA

2.4.1. Content and Quality

All Raw VSP surveys shall be reported. All relevant acquisition information should either be contained in the header structures or presented as additional Information Files.

2.4.2. Structure

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

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 and remarks should be included with the data files or in separate Information Files.

2.5.2. Structure

Please refer to the 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 like 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 the 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 the 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 wellpath 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. EDITED RAW 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, Item No. 14.07). 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 will be held in a ‘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 artefacts 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 given 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 previous 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 0.5m.
- 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 1m)
- No additional environmental corrections need be applied.
- Curve data recorded before "Pick-up" from the <u>lowermost</u> 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>uppermost</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 the 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 are strongly recommended to 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. This 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 are refer to.

3.2.4. Format and Structure

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

4. INTERPRETED or COMPUTED DATA

This section outlines the requirements for reporting of interpreted or processed 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 so as to be 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 should 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 should 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 about the interpretation should 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 (Drilling Regulations Section 12, Geological and reservoir technical reports, sub-sections a-h).

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

4.2. WELLPATH (or WELLTRACK) DATA

4.2.1. Purpose

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

4.2.2. 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.

4.2.3. 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).

Well path 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 metre (1.0m) or less would be acceptable.

Typical content and structure are described in Appendix B-2.6. The algorithm being 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.

4.2.4. Format and Structure

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

4.3. CORE DATA

4.3.1. Purpose

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

4.3.2. 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, unshifted (Driller's Depth) data set. As with the original raw core data, depths will be discretely sampled (that is, no re-sampling to regular depth increments should be undertaken). These data will not normally be corrected for overburden pressure but if they are then both the uncorrected and corrected sets should be reported as separate data files with suitable documentation, held in an information file

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

4.3.3. Format and Structure

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

4.4. PROCESSED WELLBORE SEISMIC DATA

4.4.1. Quality

All processing methods, parameters and remarks must be captured in Information Files.

4.4.2. Content

All available processed VSP data.

4.4.3. Format and Structure

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

4.5. TIME-DEPTH-VELOCITY (TDV) DATA

4.5.1. 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.

4.5.2. 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.

4.5.3. Format and Structure

Please refer to the 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.

4.6. FORMATION PRESSURE DATA

4.6.1. Purpose

A set of build-up formation and wellbore hydrostatic pressures, for fluid gradient, type and contact determination. 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.

4.6.2. 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'.

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.

4.6.3. Format and Structure

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

5. DIGITAL IMAGES[6] OF RAW, WELL, COMPLETION AND PETROPHYSICAL 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 ever 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 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

[6] 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 200dpi 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 400dpi should be used to prevent data loss.

usable image it should be the processed image that is reported.

5.2. Content and Format

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

6. REPORTS

All reports relating to wells are to be reported, and a list of such reports is provided in Table A-1 This also holds for reports compiled or received after completion date.

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

The following list of reports constitutes a guideline only and is not to be considered exhaustive:

- Biostratigraphical Data Report
- Completion / Workover Programme
- Completion / Workover Report
- Computed Well Log Report - Wireline (EWL)
- Core (conventional / special) Report
- Core Analysis Report
- Coring Operations Report
- Drilling Cement Report
- Drilling Programme
- Drilling Recommendation
- End of Well Drilling Report
- Fluid Analysis Report
- Formation Pressure Report
- Geological Report
- Lithological Report
- Mud Log Report
- MWD Report
- Organic Geochemical Report
- Petrophysical Interpretation Report
- Production Log Report
- PVT Analysis Report
- Sedimentological Report
- Site Survey Navigation Report
- Site Survey Report
- Stratigraphical Report
- Time-Depth-Velocity Report
- Well Completion - Final Well Report
- Well Evaluation Report
- Well Logs - MWD Report
- Well Logs - Wireline Logging Report
- Well Proposal
- Well Test Report
- Wellbore Seismic Report

- Wellpath (Deviation Survey/computed) Report

APPENDIX A

File Naming Convention and File Structure for Well Data Files

Purpose

A file naming convention serves to inform a user of the contents of a file without special applications that look into 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.

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 conveys clearly the file contents.

File Name Structure

File names should have the same basic structure:

NAME(Contents 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 'Contents Information' see Table A-1.

APPENDIX B

Content Information for Specific Data Sets

Purpose

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

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 become adopted by a global standards organisation these local standards will be modified where appropriate.

2. RAW DATA

2.1. WELL-LOG DATA

As well as 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.

2.1.1. Header data

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

2.1.2. Other Key Attributes

The following Table B2.1 shows other Key Attributes that should be populated. These attributes will facilitate the creation of standard data sets within target databases.

Table B-2.1

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	Service company supplied, see also ENERGISTICS-PWLS	Example: CNT-H (Schlumberger) or CN-2446XA (Baker)
TOOL DESCRIPTION	Service company supplied, see also ENERGISTICS-PWLS	
TOOL GROUP NAME	Service company supplied, see also ENERGISTICS-PWLS	Example: CNT (Schlumberger) or CN (Baker)
TOOL MARKETING NAME	Service company supplied, 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	Service company supplied, 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	

2.1.3. 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.

2.2. CORE DATA

Raw and Computed Core Data

This section is primarily concerned with 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-2.2 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	

2.5 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.

2.5.1 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	

2.5.2 Lithology Coding

The mudlog interpreted lithology description needs to 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 start at depth2 (> depth1). In this way, the lithology descriptions are represented by one continuous depth indexed, regularly sampled curve, which then can be handled similar 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
Fossile 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						

2.6 WELLPATH DATA

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-2.6

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

3.2 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-3.2
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, together with any analysis comments are reported.

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

4.5 TIME-DEPTH-VELOCITY DATA

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

Table B-4.5

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	

4.6 FORMATION PRESSURE DATA

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

Table B-4.6
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 some 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.

The NPD recommendation is that all text documents should be delivered in Adobe's PDF ('Portable Document File') format. PDF documents retain the page layout, fonts and image quality of the original; and enables users to read them across multiple hardware/software systems using a freely available reader (Adobe Acrobat). Most of the Information Files, which provide a vital context for many of the reported data files, are essentially documents, and are best delivered and stored in PDF format.

The situation with ASCII or text-data files is less clear. Whilst it is possible to use PDF files for transferring text data this is not as straightforward as using simple ASCII files. The main problem, however, is the lack of structural and content standards for many of the common data types in the E&P industry. This applies to both PDF and ASCII files. In all cases the structure of these files should be agreed with the NPD before reporting so as to avoid reading problems.

It is recognized that new formats are emerging which may improve the situation. One is XML which can define both the contents and the structure of the data. It is a generic cross-industry standard that is highly portable and can be directly read by many common desktop applications. However, the problem of defining the standard structure on a domain-by-domain basis still exists.

The NPD will monitor the progress of these emerging (XML) standards and will discuss their implications and impact on the reporting of digital data with the operators in a timely fashion.

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 the key measurements like 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 like 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, usually 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, DST's etc.
Wireline logging	The collection of formation data using downhole sensors conveyed by electrical wireline

APPENDIX E

Well-log Compositing Procedures

PROCESSING REQUIREMENT

This Appendix contains an updated version of the previous regulations. Only minor corrections have been made to the original.

1. RAW LOGS

1.1. General Specifications

a) No additional editing following acquisition.

b) No environmental correction.

c) No additional filtering of logs.

d) Corrected and complete LIS header records, including updated remarks sections as per Section 7.1.3

e) Keep original sampling rate including high sample rates (fast channels).

f) Keep original depth units (but should be in metres) and original curve mnemonics used by the Service Company.

g) The tape format should not be altered from that on the original tape.

1.2. Data verification

The Directorate views the requirement for quality control of the raw data tape to be critical. Too often there are inconsistencies with what is presented on the Field Print and what is actually recorded on tape.

The traces originating from the digital tapes are compared to corresponding Field Prints / optical scan traces with the aim of determining data accuracy with respect to depth discrepancies and absolute values. Data gaps and incorrect scales are also recognized and corrected.

Data discrepancies between the tape and Field Print are resolved as follows (note it is the operators responsibility to ensure that reported data are complete and legible):

a) Logs presented on the log prints are, in general, assumed correct. (Note: This assumption is not always true, since some plotting programs incorporate a <u>weak</u> filter for cosmetic reasons. In these instances, tape data is assumed correct and no additional filtering will be applied .

   There is another situation, which warrants special attention. Field prints and tapes are sometimes handed over to the Operator at the well-site, which, in retrospect, are found to contain errors. These erroneous records are often archived before a corrected replacement is received from the Service Company. An archive might become incomplete and can, in the worst case, contain a corrected tape and an outdated and erroneous Field Print.

   In summary, if there is a discrepancy between the Print and the Digital record it must be investigated and corrected. Differences are due to a process error and either could be wrong.

b) Depths discrepancies between Field Prints and digital tape data are corrected through depth shifting or in severe cases by digitizing the Field Prints / optical scan images.

c) Logs shall be digitized from Field Prints / optical scan images if the digital tape containing the raw data is invalid or contains corrupted records.

1.3. Header information

All header information is checked against the Field Print for completeness and correctness. The header information is updated when necessary. Special emphasis is given to the information given in the remark section. The "equipment" section must be accurate with respect to instrument types used (i.e. epithermal v.s. thermal neutron, litho Vs standard density, phasor Vs standard induction, etc.).

The Directorate's well naming convention shall be used as the main header entry.

2. COMPOSITE LOG

The editing, depth-shifting and tie-in / merging procedures detailed below is of utmost importance and determines the degree of consistence and the future usefulness of the established database.

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

Sonic/acoustic <u>waveform</u> logs (note: The log traces recorded in combination with the waveform data (i.e. gamma-ray, etc) and traces derived from the waveform data (i.e. Δt compressional etc) shall be included when available.

Dipmeter logs.

Wireline formation pressure tester.

VSP, Check-shots.

Cased Hole logs such as PNL (pulsed neutron), PLT (production logs) and cemented bond logs (although Open Hole logs recorded in casing may have valid formation data which may be used for compositing).

2.1. General specifications

a) Detailed description of the requirements to perform editing, depth shifting and tie-in / splicing are set forth in the Sections 7.2.2, 7.2.3. and 7.2.4. Parameters used and details regarding the processing shall be registered and documented in an Audit file.

b) No environmental corrections.

c) Keep original depth units (should be metres).

d) No re-sampling of the original data should be carried out. If multiple sampling of the same data curves are available then the ‘standard’ sample rate (0.1524 or 0.15m) should be used.

e) Standard absent value : -999.25.

f) Keep original curve mnemonics as used by the Service Company.

2.2. Data editing

The editing requirements include the following:

a) Remark Section. Check the information given in the "remark" section of the Field Print header and edit or replace all <u>known</u> bad data (including, among others, memory/delay problems).

b) Inclusion repeat section / down-log. 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 Section(s) and/or “Down-logs” whenever improved accuracy and quality can be achieved.

Repeat section is here defined more broadly 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 section(s) and/or down logs often contain data from intervals which are missing on the main log. (Example: “Could not reach TD after logging the Repeat Section”). The main log will be edited to include this data in order to obtain a log as complete as possible.

c) Editing of gaps between logging runs

The before “Pick-up” recordings for the <u>lowermost</u> logging run of each service (normally the final logging runs) shall be removed (the original raw data will contain the pre pick-up data).

The part of the log recorded in casing for the <u>uppermost</u> 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 “nulled” with -999.25 values.

The gap often consists of a logging signal recorded through casing. The Resistivity logs (recorded with present technology) are considered invalid in casing and should always be nulled over the gap interval. 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.

The process of merging curves into a composite log is further described in Section 7.2.4.

d) AC/DT Editing. Sonic/acoustic log is editing 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 in order for 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.

f) Reporting. All anomalies, missing data, poor quality sections etc, which cannot be improved with replacement data and/or editing, shall be reported in the Audit File.

2.3 Depth Shifting

The gamma-ray of the induction log will serve as the preferred base log assuming that this trace is on depth with the deep induction. Should the induction log be unavailable, will the first gamma-ray run in hole normally become the reference trace. 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 - 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 critical and should be performed when depth discrepancies between log traces in excess of 0.5 m occurs (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 is 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.

2.4 Tie-ins and merging

All primary measurements shall be contained in the composite log data set (generally these are the curves presented on the field prints but should not include tension, cable speed or other log-run specific curves that have no meaning on the composite)

Any well logged by more than one Service Company shall have their respective traces merged into one trace. The traces inherit the log mnemonics of the Service Company recording the lower section, i.e. the Reservoir section or the total depth (TD) section. Tie-in and merging details shall be documented.

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 trace from one service run will be individually merged with traces 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 valid responses 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 openhole sections, therefore, often results in a gap between two logging runs. The editing requirements for the gap interval are described in Section 7.2.2.c.