

GUIDELINES FOR DRILLING

EXPLORATION

1988
(2009)

Guidelines for Drilling – Exploration

Reprint of the Guidelines from September 1988, however, the names and addresses of authorities mentioned have been updated. As the guidelines have otherwise not been updated for more years, the Danish Energy Agency should be consulted before using the drilling guidelines.

Table of Content

| | |
|---|-----------|
| EXPLORATION AND APPRAISAL WELLS | 3 |
| 1. DRILLING PERMIT | 4 |
| 2. DRILLING PROGRAMME | 5 |
| 3. SITE AND SUBSOIL SURVEYS | 10 |
| 4. DRILLING EQUIPMENT AND SUPPLIES | 11 |
| 5. DRILLING ACTIVITIES | 12 |
| 6. SAFETY PRECAUTIONS AND DRILLS | 15 |
| 7. ABNORMAL FORMATION PRESSURE AND HYDROCARBON DETECTION | 16 |
| 8. TEST PRODUCTION | 17 |
| 9. EXPLOSIVES AND RADIOACTIVE MATERIALS | 18 |
| 10. CHANGES IN THE DRILLING PROGRAMME | 19 |
| 11. ABANDONMENT OF WELLS | 20 |
| 12. DAILY REPORTS | 22 |
| 13. DRILLER'S LOG | 25 |
| 14. FURTHER REPORTING, SUBMISSION AND STORING OF SAMPLES | 26 |
| 15. SAMPLING AND MEASUREMENTS | 32 |

MINISTRY OF CLIMATE AND ENERGY

Danish Energy Agency
44 Amaliegade
DK- 1256 Copenhagen K
Denmark

Telephone (+ 45) 33 92 67 00

Facsimile (+ 45) 33 11 47 43

UNOFFICIAL TRANSLATION

EXPLORATION AND APPRAISAL WELLS

These guidelines apply to approval and supervision, which in consequence of the Danish subsoil Act have been delegated to the Danish Energy Agency. These guidelines relate to exploration and appraisal wells for hydrocarbons and other minerals, offshore and on land as specified in Section I of the subsoil Act. However, some specifications have specific relevance for offshore wells or wells drilled to hydrocarbon targets, and may to a certain degree be irrelevant for other purposes. Normally jack up platforms are used for Danish offshore drilling operations. These guidelines are therefore primarily adapted to jack up operations.

For offshore drilling operations approval and supervision for matters concerning safety and health (also covering crew-regulations for the drilling related personnel) are regulated through the Act on Certain Marine Installations. For such matters only limited topics are covered by these drilling guidelines.

Reference is made to decrees No. 539 dated November 29, 1985 and No. 656 dated December 30, 1985 concerning stand-by boats and safety zones respectively. Administration of these decrees is handled by the Danish Energy Agency. For drilling operations on land other central and local authorities will have permitting and supervising functions concerning the various work operations.

Furthermore attention should be given to rules about discharge of chemicals to the sea. Administration of these rules is handled by the Danish Environmental Protection Agency.

It must be noted that specifications are given as guidance and that other means of achieving corresponding conditions regarding safety and information might be approved.

1. Drilling Permit

Drilling shall not commence until a drilling permit has been granted by the Danish Energy Agency.

- 1.1 Well in advance of the requested time for a drilling permit, the Danish Energy Agency is to receive a detailed drilling programme for the work in question and detailed documentation for the drilling platform/rig to be used shall be presented. Furthermore, the Agency shall receive a drilling application, information on the expected timing of the drilling operations and economic outlines for the planned operations.

Information described above may be forwarded to the Danish Energy Agency as it becomes available. All essential parts of the information must be forwarded well in advance of the start of the operation.

2. Drilling Programme

The drilling programme shall (together with manuals) state unambiguously how the operations connected to the well are expected to be carried out. Parts of the information required concerning the drilling programme may be forwarded as separate appendices and, where relevant, reference may be made to other documentation material such as the operator's general operation manual, general safety regulations, general regulations for test production, etc. Material referred to must be available in the Danish Energy Agency.

The drilling programme must state whether hydrogen sulphide preparedness will be needed and if this is the case the programme must state how and when it will be established.

6 copies of the drilling programmes, (some information in fewer copies, e.g. detailed geological information in 4 copies, and site surveys in duplicate) shall be submitted at least 3 weeks before drilling is scheduled to start. The programme shall contain the following:

- 2.1 The well number in the Danish Energy Agency numbering system.
- 2.2 The name of the well. Wells not named by the operator will be named by the Danish Energy Agency.
- 2.3 Name of operator and information on the operator's organisation in connection with the drilling operations. (For offshore operations reference may be made to a separate manning-/organisation-plan).
- 2.4 Well surface position and maximum tolerance on this position. The position shall be given in geographical and Universal Transverse Mercator (UTM) co-ordinates.
- 2.5 Ownership and name of drilling platform/rig. (This information may be submitted later, cf. section 1.1).
- 2.6 Water depth/ground level elevation.
- 2.7 Expected rotary kelly bushing (RKB) elevation above reference level when platform/equipment is ready to start drilling. For jack up platforms the elevation shall be measured from mean sea level (msl).
- 2.8 Estimated total well depth, positions for targets and planned well trajectory.

Guidelines for Drilling – Exploration

- 2.9 Depth to and description of the anticipated geological horizons and eras.
- a) Stratigraphic column showing and describing anticipated lithology, as well as stating the planned casing points.
 - b) Representative, interpreted seismic sections near the planned well (normally 2 intersecting lines).
 - c) Depth and time structure maps showing primary and secondary prospects as well as time and possibly depth structure maps for other key horizons with a scale of not less than 1:25,000.
 - d) The velocity functions used in the area.
 - e) A prospect description of primary and secondary objectives.

- 2.10 Programme for the positioning of casing.

The programme shall contain:

- a) Diameter of drilled hole.
- b) Casing dimension.
- c) Weight and quality of casing with reference to recognised standard.
- d) Planned setting depth for the casing.
- e) Strategy for centering of casing, including type of exterior packers, where relevant.
- f) Programme for cementing of casing, including type of cement, estimated height of cement behind the casing, and strategy for calculations of necessary volumes of cement.
- g) Demonstration of the sufficiency of the casing string strength with regard to burst, collapse, and tension. Reference may be made to Company Procedure for casing design calculation, cf. beginning of chapter 2. In this case the parameters used in the design (pressure, cementing height, mud density etc.) must be stated.
- h) Procedure and minimum requirements for testing the formation strength after drilling out the individual casings, including calculations demonstrating that the required formation strength is sufficient for drilling to the next casing setting depth.

Guidelines for Drilling – Exploration

- i) Precautions to be taken if the required formation strength is not obtained.
- 2.11 Drilling fluid programme, containing the following:
- a) A detailed description of the types of drilling fluid to be used specifying density, rheological properties etc.
 - b) A detailed description of the components of the drilling fluids. Reference may be made to relevant chemical data sheets.
 - c) A detailed description of check equipment and procedures for the drilling fluid or reference to relevant standard, which will be, followed (e.g. API RP 13B).
 - d) Procedure for monitoring the drilling fluid volume.
 - e) A list of the quantities of safety related material (e.g. baryte and cement) to be stored on the drilling platform during normal operations and an argumentation for these quantities (cf. section 5.8).
- 2.12 Logging programme, containing information on types of logs to be run at various intervals.
- 2.13 Programme for taking geological samples, including a coring programme.
- 2.14 Tentative programme for test production. Final test programme shall when applicable be submitted and be approved separately (cf. Chapter 8).
- 2.15 Description of method for and maximum vertical interval between measuring the well inclination and direction.
- 2.16 Blow-out preventers, etc. (cf. chapter 4 and 5).
- a) A list of the blow-out prevention equipment available onboard the drilling platform, specifying manufacturer, size, working pressure, and arrangement. Information regarding the control system operating the blow-out preventer stack. A list of the blow-out prevention equipment available on the drill floor ready for mounting on the drill pipe.
 - b) Procedure for kick control, stating i.a., the data and calculations which by routine are updated to ensure the necessary background for handling emergency situations. Information on how blow-out preventers, measuring equipment, drilling fluid circulation and mixing equipment are expected to be used under such conditions.

Guidelines for Drilling – Exploration

- c) Programme for drills in connection with equipment as mentioned in sections 2.16.a and 2.16.b.
- d) Programme for pressure testing of blow-out preventers and casing at different stages in the drilling operations.

(This information may be submitted separately, cf. section 1.1).

2.17 Abnormal pressures.

- a) An evaluation of the possibilities of encountering overpressured zones with the well in question. This should be based on seismic data and/or experience from neighbouring wells.
- b) A description of methods and procedures to be used for detecting any overpressure in the well.

2.18 An evaluation of the possibilities of encountering zones with poisonous gases with the well, including description of methods for detecting and handling of same.**2.19 An evaluation of the possibilities of encountering gas pockets in the well in question based on seismic data and experience from neighbouring wells, including the possibility of encountering shallow as well as deep gas pockets.****2.20 A list of any other possible significant deviations from the geological/drilling prognosis which may be encountered during the drilling of the well, (e.g. saltzones, swelling clay, high pressured zones) and information on precautions planned in this connection.****2.21 A summary sequence of all operations including an estimate of the time required for the different main operations (typical as a time versus depth curve i.e. drilling curve). The summary shall give a general description of the operations, including information on any special safety related requirements (caused by e.g. possible gas pocket or abnormal pressure).****2.22 Information regarding function, name, address and nationality of the contractor companies to be employed for the well in question. Information about companies carrying out less critical functions may be forwarded just before the start of the drilling operation cf. section 1.1.****2.23 Tentative programme for plugging the well and for re-establishing the well site. This programme may be submitted at a later stage, cf. section 1.1 and chapter 11. Final programme must be submitted for separate approval.**

Guidelines for Drilling – Exploration

- 2.24 Description of preparedness for handling hydrogen sulphide and other dangerous gases including information on equipment, supplies, training and drills. Reference may be made to Company Safety Manual, cf. beginning of chapter 2.
- 2.25 Contingency plan for use in the event of major accidents or emergency situations regarding safety as well as environment. Reference may be made to Company Safety/Pollution Manual, cf. beginning of chapter 2.

Guidelines for Drilling – Exploration

3. Site and Subsoil Surveys

Site and subsoil surveys for the well site in question shall at least include the information listed below. Reports containing data from the surveys as well as interpretations and evaluations shall be forwarded to the Danish Energy Agency and the Geological Survey of Denmark and Greenland. When taking samples of material, a separate set of samples has to be taken and forwarded to the Geological Survey. Size and packing according to agreement with the Geological Survey.

- 3.1 Location surveys determining foundation and stability conditions shall be carried out before a drilling permit can be given.
- 3.2 While positioning and operating a drilling platform foundation and anchor stability shall be checked with relevant frequency.
- 3.3 The exact position of any neighbouring cables, pipelines, wells etc. must be determined.
- 3.4 To the extent possible the subsoil from the sea-bed to levels deeper than the anticipated total depth of the well shall be examined by up-to-date - primarily seismic - methods. Data collection and processing are to be adapted to the various depth intervals to obtain optimal information about all intervals.
- 3.5 For the well location in question, an evaluation shall be made of all conditions on the sea-bed and in the subsoil which might be of importance for the safety of the planned drilling operations or for the nearby installations.

The evaluation shall as a minimum comprise:

- a) Any limitations on positioning and anchoring of drilling platforms and auxiliary crafts to avoid damage to pipelines, cables, etc. as well as unnecessary drilling risks.
- b) The possible presence of objects which might affect the drilling operation or the drilling platform (boulders, wrecks, other wells, etc.).
- c) Possibility of penetrating gasbearing zones.
- d) Possibility of penetrating particularly weak zones.
- e) Possibility of penetrating zones with abnormal pressures.

4. Drilling Equipment and Supplies

- 4.1 Before a drilling permit can be given, the Danish Energy Agency must have received general information as well as documentation and certificates for the drilling platform/drilling rig. The acceptability of the platform/rig for the specific operation/location must be documented.
- 4.2 A "Chemical Manual" covering all dangerous substances used while operating shall be prepared. For offshore operations more detailed guidelines are given by the Danish Energy Agency.

Guidelines for Drilling – Exploration

5. Drilling Activities

5.1 During drilling operations, all necessary steps shall be taken to prevent explosion, blowouts, pollution, or other damage. Safety related equipment shall be installed as drilling operations progress and shall comply with the following requirements. Apart from possible drilling when setting the conductor pipe, drilling must not be carried out before blowout preventers/diverter system and related equipment have been installed and tested.

5.2 The well must be cased. The casing shoes shall - with due consideration of geological conditions - be set at depths sufficient to ensure complete control of the well at all times.

- a) Drive/conductor pipe (casing) shall be set at such a depth below seabed that unconsolidated formations are supported and a stable hole ensured for initial drilling operations.

Prior to drilling out from the drive/conductor casing, a diverter system shall be installed and tested operationally.

- b) Surface casing shall be installed in such a manner that a good anchorage of the blow-out preventer is secured. Surface casing shall be cemented to seabed or ground level. The cement shall be given sufficient time to set before further drilling is carried out.

A hardening test for the cement used shall be carried out on the surface.

Prior to drilling out from surface casing, the blow-out preventer and the kill and choke systems shall be installed. These shall normally include at least one annular preventer and a system of ram preventers containing at least one set of pipe rams and one set of blind or shear type blind rams together with kill and choke lines connected to the choke manifold. After the installation, all rams and connections shall be function and pressure tested to pressures approved by the Danish Energy Agency.

- c) Intermediate casing shall be installed and cemented in such a way that full control of the well is maintained at all times.

Intermediate casing shall be cemented at least 200 m into the previous casing but shall if relevant, for instance as protection for ground water, be cemented right to the surface. The cementing and centering programmes shall endeavour to secure that all zones containing hydrocarbons as well as all intervals with abnormal pressures are isolated.

Guidelines for Drilling – Exploration

Prior to drilling out from intermediate and subsequent casings, a complete blow-out preventer, and kill and choke systems shall be installed. Normally the blow-out preventer system shall include at least one annular preventer and a system of ram preventers containing at least 2 sets of pipe rams, 1 set of blind rams and 1 set of shear rams. The last two may be combined in 1 set of shear type blind rams. After installation, all rams and connections shall be function and pressure tested to pressures approved by the Danish Energy Agency.

- d) Production casing must be cemented as stipulated for the intermediate casing.
 - e) A liner must be cemented over its full length. When placing and cementing the liner, consideration shall be given to the best possible isolation of hydrocarbon bearing and/or abnormally pressured zones.
- 5.3 Normally cement bond log or temperature survey must be run when surface or intermediate casing have been cemented without good cement return to surface/sea-bed. The cementation of production casing and liners must be checked with cement bond logging.
- 5.4 Casing strings shall be of such a diameter, weight and grade, as well as designed and installed in such a way that they can withstand any mechanical and chemical influence which may be expected in the well during drilling, testing, and stimulation.
- 5.5 After the casing strings have been installed and cemented they shall be pressure tested in accordance with the approved drilling programme. For each casing the pressure test shall be adapted to the internal pressure to which the casing may be exposed.
- 5.6 The installation of used casings is not permitted unless these have been adequately tested and inspected in advance by an independent inspection company and satisfactory strength of pipes and connections can be documented.
- 5.7 Pressure testing of the formation strength below the casing shoe shall be performed in accordance with the approved drilling programme.
- 5.8 It must be possible to handle drilling fluid loss or to increase the fluid density without delay. During routine operations sufficient spare amounts of mud mixing materials must therefore be stocked on the platform/well site. Furthermore a sufficient stock of chemicals for handling possible hydrogen sulphide must be available (if hydrogen sulphide can be expected, cf. beginning of chapter 2).

Guidelines for Drilling – Exploration

- 5.9 Before the drill string is pulled out of the hole the well shall be observed and found to be stable.
- During tripping the well shall be monitored carefully for fluid loss/gain.
- 5.10 During drilling, the drilling fluid reconditioning equipment shall be used to the necessary extent to separate gas and cuttings from the fluid.
- 5.11 The density of the drilling fluid shall be tested regularly and at least every hour.
- 5.12 Oilbased mud or mud containing chemicals which can be particularly detrimental to the health or environment, can only be utilised when approval is given by the Danish Energy Agency, (approval by other authorities may also be necessary).
- 5.13 The disassembly or other maintenance of blow-out preventers may take place only when the well is secured against blow-out by a minimum of 2 independent and tested barriers, accepted by the Danish Energy Agency in general or specifically.
- 5.14 Pressure or operational testing of the blow-out preventers and the connected equipment shall be carried out regularly and after disassembly, as well as when drilling operations or other conditions make it reasonable.
- 5.15 The hydrostatic pressure in the well may only in connection with testing be reduced to such a level that the formation fluid can flow to the borehole.
- 5.16 During drilling operations the Licensee is required at all times and with necessary accuracy to keep track of the well trajectory.

Measurements which determine inclination and azimuth shall be taken at intervals securing the necessary knowledge of the well course. For deviated wells the measurements shall be taken at intervals not exceeding 100 m, while bigger intervals and possibly omission of azimuth determination can be accepted in the case of almost vertical wells. Such measurements shall be carried out while drilling below the surface casing or from another specified depth approved or required by the Danish Energy Agency.

Guidelines for Drilling – Exploration

6. Safety Precautions and Drills

- 6.1 During the operations there must be preparedness for handling escape of poisonous gases (e.g. in case of a kick). This preparedness can be omitted in cases where it prior to the operation can be demonstrated that no hydrogen sulphide or other poisonous gases can be met in the well. If hydrogen sulphide or other poisonous gases are encountered all necessary safety precautions shall be taken to prevent accidents and the Danish Energy Agency shall be notified.
- 6.2 At the end of each shift, the offgoing crew shall -each within his area of responsibility - inform the oncoming crew of any defects that have been detected but not repaired. The offgoing crew shall furthermore inform the incoming crew about the working conditions and changes that have taken place. The incoming crew shall make certain that the equipment is in satisfactory condition.
- 6.3 For each drilling crew, pit level drills shall be carried out at least once a week.
- 6.4 For each drilling crew, weekly drills shall be carried out covering precautions to be taken in the event of kick.
- 6.5 Training and drills concerning handling of hydrogen sulphide shall be conducted to the degree relevant.
- 6.6 Safety meetings and drills shall be recorded.
- 6.7 During inspection, inspectors from the Danish Energy Agency may in consultation with the operator require drills as mentioned in items 6.3, 6.4 and 6.5 to be conducted.

7. Abnormal Formation Pressure and Hydrocarbon Detection

- 7.1 Monitoring and registration of data for evaluation of formation and pore pressures and for determination of hydrocarbon content in relation to the drilling fluid density, drilling rate, etc. shall be carried out from the drive/conductor pipe shoe and shall be continued till the well has been plugged.
- 7.2 Recognised measuring methods, parameters, and calculation methods shall be used at all times in evaluation of the possibility of encountering abnormal pressures.

Guidelines for Drilling – Exploration

8. Test Production

- 8.1 Before test production of a well can be carried out all relevant logs shall be submitted to and the test programme be approved by the Danish Energy Agency.
- 8.2 Test production, perforating, hydraulic fracturing, acidizing or other chemical treatment of the well may only take place when special safety precautions, relevant for the operation, are observed. The above-mentioned operations shall normally be started and preferably take place in daylight. Test production is not to take place when safety is adversely affected by weather and wind conditions.
- Test production in open hole is normally not allowed if the packer is in direct contact with the formation.
- Test production shall be performed in such a way that the well is not damaged unnecessarily.
- Caution shall be exercised to prevent accidental escape of chemicals and hydrocarbons to the environment.
- 8.3 Before start-up of test production, the drilling platform/drilling site shall be specially prepared for the operation:
- All necessary fire precautions shall be taken. The fire fighting equipment shall be ready for immediate use.
- Valves, lines, and vessels in the entire production system and where relevant blow-out preventers shall be pressure and function tested.
- Where relevant stand-by vessels/nearby inhabitants shall be alerted. Before the operation commences, all persons who are to participate in the test operation shall take part in a safety meeting.
- 8.4 Well perforation may be carried out by experienced personnel only. Extreme caution shall be exercised to prevent accidental firing. Perforation of a completed well shall take place under safety conditions corresponding to daylight (e.g. illumination of equipment, manning and possibilities for safe evacuation).
- 8.5 If radio transmitters or other equipment may constitute a hazard in connection with the use of explosives, this equipment must not be used while such operations are in progress. Non drilling related radio equipment, e.g. transmitters onboard vessels, helicopters and radio stations, which are not at a safe distance from the drilling site must be considered.
- 8.6 The burners may be ignited by remote control systems only.

9. Explosives and Radioactive Materials

- 9.1 Explosive charges for the perforating guns shall be stored in properly earthed metal containers. Explosives shall be stored in rooms specially approved for this purpose. Detonators, prima cord and perforation charges shall be stored separately.

Explosives shall be handled by specially trained personnel only.

- 9.2 Radioactive materials shall be stored in an approved way and handled by specially trained personnel only.

10. Changes in the Drilling Programme

- 10.1 Changes concerning safety and other substantial changes relative to the existing drilling programme must not take place without prior consent from the Danish Energy Agency.
- 10.2 In emergencies the drilling programme may be altered without prior consent. In such cases, the Danish Energy Agency must be notified immediately of the alterations and the reason for them.

Guidelines for Drilling – Exploration

11. Abandonment of Wells

Prior to the abandonment of a well the hole must be plugged according to procedure approved by the Danish Energy Agency.

11.1 Normally, an exploration well shall be abandoned permanently when drilling operations as well as relevant logging and test production have been carried out. Under special circumstances the Danish Energy Agency may permit a well to be abandoned temporarily without permanent plugging. To obtain such permission the Licensee must submit an application indicating how and when the well is to be abandoned permanently or operations will be resumed. Furthermore, the application must describe the responsibility and supervision situation during the temporary abandonment.

11.2 Application for permission to stop operations and to plug (permanently or temporarily) and abandon a well, shall together with a copy of essential logs and other relevant documentation material, if any, be available to the Danish Energy Agency at least 24 hours before estimated commencement of the actual abandonment activities.

In the application the Licensee shall give the reasons for the planned plugging and specify how the plugging will take place and how the plugs will be checked. The well site condition after the abandonment and procedures for verification of this must furthermore be stated.

11.3 In cases where the well is uncased opposite permeable zones, plugging shall be carried out so that there can be no flow of fluid through the hole (normally by cementing at least 50 m below and above the individual zones).

11.4 Where there is an open hole below the deepest casing, a cement plug shall be placed in such a manner that it extends at least 50 m above and below the casing shoe.

The top of the cement plug shall be located by load testing. Where the condition of the formation makes cementing difficult, a mechanical plug may be positioned in the casing, within 50 m from the shoe as an alternative to the cement plug below the shoe. In addition, a cement plug, at least 50 m long shall be placed on top of this plug.

The performed plugging of the open hole section shall be pressure tested for sufficient time and with enough differential pressure to detect a possible leak or mechanical failure of the plug.

Guidelines for Drilling – Exploration

- 11.5 Perforated zones must be plugged with cement so that no fluid flow to or from the well is possible. Where possible perforated intervals shall be isolated with cement plugs through the individual perforated zones and with 50 m long cement plugs below the lowermost perforation and above the uppermost perforation. Alternatively the perforated zones can be isolated by a combination of a mechanical plug squeeze cementing of the perforations and cement plugging above the mechanical plug.
- 11.6 If a liner has been used, a cement plug shall be placed in such a manner that the plug extends 50 m above and below the point of suspension. Alternatively a mechanical plug followed by a 50 m long cement plug can be set just above the liner hanger. The top of the plug shall be located by load testing and the plug shall be pressure tested as specified in item 11.4.
- 11.7 In the innermost casing a cement plug must be placed from the shoe depth of the previous casing and 100 m up.
- 11.8 It must be ensured that no communication from down hole formation to the sea-bed/surface via any casing annulus is possible.
- 11.9 A cement plug, at least 100 m long, shall be placed near the surface.
- 11.10 The total weight of the cement plugs in the well and the weight of the fluid between the plugs shall ensure that as a minimum the system is in balance with any pressure which may develop in the borehole.
- 11.11 When a well is abandoned the original state of the well site shall be re-established. Where reasonable departure from this requirement may be approved by the Danish Energy Agency (approval by other authorities may also be necessary).

When abandoning a well, the condition of the well site shall be verified. Obtained documentation shall be submitted to the Danish Energy Agency.

Guidelines for Drilling – Exploration

12. Daily Reports

From the time when the drilling platform (drilling equipment) arrives at the well site and until the well site is left again, the Danish Energy Agency shall daily, before 11:00 a.m., by telex or other acceptable means, receive reports on operations and results during the last 24 hours. The reports shall at least cover the activities till 06:00 a.m. on the reporting day. The Danish Energy Agency may establish special rules for reporting during weekends and holidays. Technical and geological information contained in the daily reports to the Danish Energy Agency must also be submitted to the Geological Survey of Denmark and Greenland.

The Danish Energy Agency may set up more detailed rules for the presentation of the reports. The reporting must at least contain the following information:

- 12.1 Reporting date.
- 12.2 The number and name of the well.
- 12.3 Drilling platform/drilling rig.
- 12.4 Operator
- 12.5 Total days on the drilling site.
- 12.6 Present operation.
- 12.7 Present well depth.
- 12.8 Progress during the last 24 hours.
- 12.9 Detailed description of operations during the last 24 hours, covering essential results as well as a description of operational problems.

When relevant, at least the following shall be covered:

- a) Significant (down hole) loss or gain in drilling fluid system.
- b) Problems with well stability.
- c) Problems in controlling or monitoring well direction.
- d) Substantial deviation from the anticipated geological conditions.
- e) Substantial deviation from anticipated formation pressures.

Guidelines for Drilling – Exploration

- f) Casing operations, including casing data (diameter, weight and type, as well as setting depth), cementing data (density, volume, expected top) and outline of the cementing operations (circulation rate, pressure development, gain or loss of fluids as well as other indications, if any, of good or bad cementing quality).
 - g) Pressure tests of both equipment and formation.
 - h) Logging, indicating intervals logged and problems, if any.
 - i) Test production, listing principal results from the testing, including the development of fluid and gas production as well as of pressures and temperatures. Furthermore principal data for produced fluids (e.g. densities, gas composition and for produced water information on tracer concentrations, salt content and resistivity) must be given.
 - j) Performed plugging operations, including results from testing of the plugs.
 - k) Performed perforation, stating intervals perforated, perforation density and type.
 - l) Performed hydraulic and chemical treatment of formation, including principal information on the operations carried out.
- 12.10 Principal data for the drilling fluid, including density and temperature in and out of the borehole, viscosity, water loss, pH, oil content, tracer concentration, and other main components.
- 12.11 The gas content of the drilling fluid out of the borehole during drilling, connection and trip, indicating total gas and gas components including at least C1 to C4 and hydrogen sulphide. Furthermore similar information on background gas for circulated drilling fluid must be given.
- 12.12 Bit diameter and type.
- 12.13 Description of drill string assembly.
- 12.14 Latest casing diameter.
- 12.15 Latest casing setting depth.
- 12.16 Test pressure for formation below the casing.
- 12.17 Maximum permissible surface pressure with actual drilling fluid

Guidelines for Drilling – Exploration

- density.
- 12.18 Wave height and direction.
- 12.19 Wind force and direction.
- 12.20 Barometric pressure and air temperature.
- 12.21 Performed directional surveys.
- 12.22 The well inclination and direction, as well as horizontal and vertical position, as calculated from the latest directional survey.
- 12.23 Description of the geological formations penetrated during the reporting period, indicating depth, lithology, colour, grain size, porosity and - when possible - expected geological age, including detailed results from the preliminary core descriptions.
- 12.24 Quantitative as well as qualitative information on hydrocarbon indications.
- 12.25 Drilling speed in the penetrated layers.
- 12.26 Principal results from logs run.
- 12.27 Costs for the last 24 hours.
- 12.28 Accumulated costs.

Guidelines for Drilling – Exploration

13. Driller's Log

- 13.1 The drilling platform shall have a daily log, corresponding to IADC standard, onboard. The log shall be kept at least in duplicate. One copy shall be filed at the operator's office in Denmark. The other copy shall be retained on the platform until drilling of the concerned well has been finished.
- 13.2 The log shall be filled in after each shift and it shall give relevant description of the work, which has been accomplished, as well as contain a list of names and positions of the persons responsible for the various operations carried out.

Guidelines for Drilling – Exploration

14. Further Reporting, Submission and Storing of Samples

The Danish Energy Agency and/or the Geological Survey of Denmark and Greenland must receive certain samples as well as reports on results from surface and downhole measurements.

- 14.1 While drilling the reporting shall among others include the following:
- a) A "Mud, Pressure and Temperature Log", shall be send to the Danish Energy Agency and the Geological Survey of Denmark and Greenland. The logs must be send to the Danish Energy Agency at the latest together with the open hole logs from the given hole section. The Geological Survey of Denmark and Greenland shall receive the logs continuously, each time a log sheet is completed. Final logs have to be forwarded to the Energy Agency and the Geological Survey when the well has reached final depth.
 - b) "Well Site" geological report, as well as core descriptions, if any, shall be forwarded continuously to the Danish Energy Agency and the Geological Survey of Denmark and Greenland.
 - c) A "Drilling Mud Report", shall be forwarded to the Geological Survey of Denmark and Greenland after termination of drilling operations.
 - d) Ordinary wire line logging: 1 transparent and 1 paper copy for each printed scale (normally at least 1:200 and 1:1000) of all log runs shall be forwarded to the Danish Energy Agency and the Geological Survey of Denmark and Greenland. Logs where the raw data are recorded on magnetic tape must be send to the Geological Survey of Denmark and Greenland in a standard format which can be read by the Survey without difficulties (normally Schlumberger L.I.S. format is used). A table of contents must follow the tape.

Edited magnetic tapes must be send to the Geological Survey of Denmark and Greenland in the same way together with a verification list and a paper log of the tape contents.

The material must be forwarded immediately after preparation.

Furthermore, if called for by the drilling situation, the Danish Energy Agency may also require that "Field Prints" be forwarded without delay.

Guidelines for Drilling – Exploration

- e) Directional surveys: The results from surveys shall be forwarded to the Danish Energy Agency and the Geological Survey of Denmark and Greenland when they are available.
- f) Composite, processed and interpreted logs, including parameter listing, shall together with a processing report and a justification for choice of parameters be submitted to the Danish Energy Agency and the Geological Survey of Denmark and Greenland.
- g) Vertical seismic profile (VSP). One set of standard processed results on paper must be forwarded to the Danish Energy Agency and the Geological Survey of Denmark and Greenland. Furthermore the data must be forwarded to the Geological Survey of Denmark and Greenland on magnetic tape together with a detailed description of the format used and the data contained.

14.2 Samples (cuttings, cores, fluids).

14.2.1 The following geological types and quantities of samples are to be forwarded to the Geological Survey of Denmark and Greenland:

- a) Cuttings. A set of washed and dried samples, taken at the same intervals as samples for the Licensee's own use, shall be forwarded to the Geological Survey of Denmark and Greenland upon termination of drilling operations.
- b) Cuttings. Wet samples, taken at the same intervals as samples for the Licensee's own use, shall be forwarded to the Geological Survey of Denmark and Greenland not later than 2 weeks after they have been taken. From each sample interval above Base Upper Cretaceous the sample size must be at least 1000 g. From sample intervals below Base Upper Cretaceous the sample size shall – whenever possible - be at least 1000 g.
- c) Sample (1 litre) of the drilling fluid from the inlet side taken after each qualitative change of additives and before test production. Further samples must be taken to ensure intervals of not more than 300 metres (drilled depth) between consecutive samples.
- d) Side wall cores. Remaining material shall be stored at the Geological Survey of Denmark and Greenland not later than one year after the well is completed. If samples are prepared for paleo-analysis, one set of paleontologic or palynologic slides (original or extra set) shall be forwarded to the Geological Survey of Denmark and Greenland after the analysis is completed.

Guidelines for Drilling – Exploration

- e) Cores. The material shall be stored at the Geological Survey of Denmark and Greenland not later than one year after completion of the well. This time period may upon request be prolonged by the Danish Energy Agency.

When the cores are stored in Denmark the Licensee, the Geological Survey and the Danish Energy Agency may freely inspect the material and may - after consulting the Danish Energy Agency - take samples for further analysis.

The core material shall from it is taken till it is stored at the Geology Survey be stored in such a way that representatives from the supervising authority at the Licensee's expense have unimpeded access to inspect the material in so far as it is reasonable and to take samples for additional analysis.

Cores shall be used to obtain information concerning the specific layers penetrated and in the long-term establishment of general information on the Danish subsoil. It is therefore important that core material be kept as intact as possible. Samples should be sawed or drilled out. The Danish Energy Agency can at any time require special procedures to be followed in connection with handling of and sample taking from cores.

Unless another procedure is agreed with the Danish Energy Agency the following shall be followed:

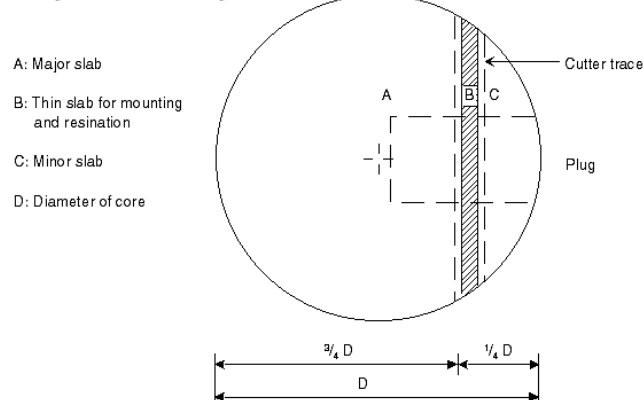
- Core chips: To avoid unnecessary damage of the core material only essential chips should be taken. Chips, which are not immediately needed, shall be taken by sawing or drilling (e.g. reference samples). If it is necessary to take chips at the well site (e.g. for quick paleontological dating) this shall be done with care and the chips shall whenever possible be taken where the core already is broken.
- Drilling of plugs: A 1" diameter horizontal plug shall be taken for each, 0.3 m of core. At the same depth a supplementary plug (normally 1½") may be taken for special core analysis. Furthermore a 1" diameter vertical plug may be taken for each 1.5 m core.

Additional plugging requires accept from the Danish Energy Agency. The Danish Energy Agency may when justified require additional plugging to be done by the Licensee.

- Slabbing of cores: For each 1 m core a 15 cm long, undisturbed section shall be wax-sealed and stored. For the remaining core material eccentric slabbing - as shown below - shall be performed.

Guidelines for Drilling – Exploration

Longitudinal slabbing of core



Further work can be carried out after the programme for the work has been discussed with the Danish Energy Agency.

All core material (i.e. the wax-sealed sections, part A, B and C together with plugs) shall be stored at the Geological Survey of Denmark and Greenland as soon as practicable and at the latest 1 year after completion of the well. Part B shall be glued in a tray or a section of plywood by the Licensee.

Permission must be obtained from the Danish Energy Agency if cores are to be stored in Denmark outside the Geological Survey Central Core Storage Facilities.

- f) Samples of formation fluid from each test produced interval. If possible, 2 litres of all produced liquids. When samples of separator gas are taken for PVT-analyses, a corresponding sample shall be taken and forwarded to the Geological Survey of Denmark and Greenland. Whenever possible, the fluid samples shall be sent to the Geological Survey of Denmark and Greenland in containers which can be retained by the Survey. If the containers shall be returned the Licensee and the Geological Survey of Denmark and Greenland must agree on the time from which rental may be charged to the Survey. The Licensee must furthermore cover all transport costs.

14.2.2 Marking. All samples collected by the Licensee shall bear a label stating name of the well and depth (depth interval) from which the sample is taken. The label must be made in a way that ensures permanent sample identification.

14.2.3 Packing. The samples must be packed so that the possibility of long-term identification and storage is ensured. Fluid samples from formation and production tests f) and c) and samples of drilling mud shall be packed so that quality and quantity are not affected during transportation.

Guidelines for Drilling – Exploration

- 14.3 Reports on analyses of samples from the borehole. Copies of descriptions and reports shall be forwarded to the Danish Energy Agency and the Geological Survey of Denmark and Greenland, including, among others, the following information:
- a) Reports on stratigraphic, sedimentologic and paleontologic analyses.
 - b) Core descriptions.
 - c) Colour photos of all cores shall be submitted. Each photo shall show well name, core number, depth, and scale as well as top and bottom data. Furthermore, a copy of all other photos from the handling of core material (e.g. taking of plugs) must be forwarded.
 - d) Conventional core analyses.
 - e) Special core analyses.
 - f) Petrophysical measurements of core material.
 - g) Qualitative and quantitative water analysis if formation water is produced.
 - h) PVT report indicating qualitative and quantitative composition of fluid samples from any test productions.
 - i) Reports on source rock analyses.
- 14.4 Reports on test production.
- 14.4.1 Reports containing pressure and temperature profiles in the well and at the surface as well as separator conditions, choke size, operational sequence, production rates and cumulative production.
- 14.4.2 For all test productions a summarising and concluding report shall be prepared. The report must be forwarded to the Danish Energy Agency and the Geological Survey of Denmark and Greenland not later than 4 months after the termination of the well. The report shall as a minimum comprise the following information:
- a) Information on the individual test productions, including perforating pattern and interval, description of any stimulations, or other operations performed to stabilise or increase production.
 - b) A listing of measured data used for analysing the test production.

Guidelines for Drilling – Exploration

- c) A listing of non-measured parameters used in the analysis of the test production and a documented explanation for the choice of parameters.
 - d) A listing of calculated values from the test production, including among others permeability, extrapolated pressure, radius of investigation, and flow efficiency.
 - e) All type curves and plots used for analysing the test productions indicating match point.
 - f) A detailed discussion of the achieved results and interpretations hereof.
- 14.5 Final reporting: At the latest 6 months after the completion of a well the following reports shall be forwarded:
- 14.5.1 Summarising technical/geological report (copy each for the Danish Energy Agency and the Geological Survey of Denmark and Greenland) at least containing:
- a) Listing of the well's principal data, name, position in geographical and Universal Transverse Mercator (UTM) co-ordinates, drilling rig, water depth/ground level, reference level, operator, contractor, dates of the included operations, total time spent, and total depth of the well indicating geological age at TD.
 - b) Summary of the progress of drilling operation, stating technical problems, if any, and discussion hereof.
 - c) Summary of geological information obtained during the drilling operation.
 - d) Listing of installed casings and results of cementing.
 - e) Detailed description including layout drawing of the well status when completing the operation.
 - f) Composit log with main information from the well stating at least core- and test intervals, position of casings, cement and plugs together with lithology and selected logs.
- 14.5.2 One set of summary accounts for economy and for time split into main operations shall be forwarded to the Danish Energy Agency.
- 14.5.3 A discussion of the results obtained, time spent, and economy related to expectations to be forwarded in one copy to the Danish Energy Agency.

Guidelines for Drilling – Exploration

15. Sampling and Measurements

- 15.1 When drilling is in progress, the Licensee shall take cuttings of all lithologies from all geological formations penetrated. The sampling shall commence immediately after return of the drilling fluid is established. The interval between the samples shall not exceed 10 m. However, when drilling in formations which may contain hydrocarbons, the intervals shall not exceed 3 m.
- 15.2 When preparing the drilling programme and during drilling operations, the Licensee should aim at obtaining sidewall cores from intervals where it is relevant, e.g. for dating of geological horizons, determination of lithology or evaluation of the potential reservoir or source rock. The Licensee shall carry out relevant analyses based on the sidewall cores taken.
- 15.3 The Licensee - with due consideration of safety aspects - shall aim at obtaining core information from all potentially significant hydrocarbon bearing reservoirs. Sufficient coring shall be done to ensure satisfactory information for the evaluation of the reservoir and the necessary analyses shall be performed.
- 15.4 When preparing the drilling programme and during drilling operations the Licensee shall see that sufficient logs are run in the well to obtain satisfactory geologic, geophysical, hydrocarbon and stratigraphic information from the layers penetrated.
- 15.5 When essential for the evaluation of the hydrocarbon potential or whenever measurement of the formation pressure in another way might give valuable information the Licensee shall attempt to carry out pressure measurements and take fluid samples from relevant penetrated horizons.
- 15.6 Penetrated formations with potentially important hydrocarbon shows must - if possible - be test produced. Test production shall be carried out in such a way that as much relevant information as feasible is obtained concerning fluids produced, production capacity of the formation and possibly the size of the reservoir. When relevant for the evaluation of the hydrocarbon content and/or production mechanism, test production shall be carried out from water bearing zones, which may have connection to the hydrocarbon bearing formations.