UNIT II
DRILLING ENGINEERING

In this unit you will:
1. Revise and learn new vocabulary related to drilling operations;
2. Revise grammar (Complex Sentences, Passive Constructions);
3. Read about drilling techniques and types of rigs;
4. Learn to talk about drilling engineering issues.

INTRODUCTION

I. Work in pairs to translate the words and word combinations.
   oil accumulation conditions, разведочная скважина, dry hole, оценочная скважина, oil reservoir, разработка месторождения, off-shore, промышленная добыча нефти, surface equipment, вышка, natural pressure, срок службы скважины, centrifugal pump, забой, oil occurrence, буровая установка, on-shore reserves, каротаж, processing, нефтедобывающий район, petroleum basin, углеводороды, maintenance operations, порода, drill(ing) string, долото, development well, заканчивание скважины
   • Compare your translations with your group-mates.

II. Guess the meaning of the following words and phrases.
   at the start of the industrial revolution; to dominate the industry; the location and geography of a reservoir; traditional drilling methods; perpendicular; well intervention operations; safety training; personnel

III. Match a “false friend” and its meaning.

<table>
<thead>
<tr>
<th>obstruction</th>
<th>сложный</th>
</tr>
</thead>
<tbody>
<tr>
<td>direction</td>
<td>план, схема</td>
</tr>
<tr>
<td>formation</td>
<td>помеха, препятствие</td>
</tr>
<tr>
<td>schematic</td>
<td>рабочая смена буровой бригады</td>
</tr>
<tr>
<td>tour</td>
<td>направление</td>
</tr>
<tr>
<td>data</td>
<td>данные</td>
</tr>
<tr>
<td>complex</td>
<td>пласт</td>
</tr>
<tr>
<td>to operate</td>
<td>работать, функционировать</td>
</tr>
</tbody>
</table>
IV. Practice to pronounce these words.

1. **ch [k]** school, scholar, chrome, mechanic, mechanical, mechanism, chemistry, chemical, character, scheme, schematic, technique, technical, synchronize

2. **c [s]** civilization, centre, central, centrifugal, process, processing, cementing

**WORD FORMATION**

- Form adverbs according to the given patterns and translate them into Russian.

<table>
<thead>
<tr>
<th>English word</th>
<th>Russian word</th>
<th>Russian adverb</th>
</tr>
</thead>
<tbody>
<tr>
<td>safe</td>
<td>безопасный</td>
<td>безопасно</td>
</tr>
<tr>
<td>easy</td>
<td>легкий</td>
<td>легко</td>
</tr>
</tbody>
</table>

usual обычный + ly = usually
wide широкий + ly = ____________
increasing ____________
economical ____________
principal ____________
horizontal ____________
artificial ____________
dangerous ____________
relative ____________
broad ____________
vertical ____________
common ____________
successful ____________
above ____________
commercial ____________
ultimate ____________
initial ____________

**GRAMMAR REVISION**

I. Analyze the complex sentences below, think of conjunctions (for object clauses) and relative pronouns (for relative clauses) that may be used and translate the sentences into Russian.

**We know (that) petroleum industry is divided into upstream and downstream.** – Мы знаем, что нефтегазовая промышленность делится на первичные и вторичные отрасли.

**The refinery (which/that) our company bought was constructed two years ago.** – НПЗ, который купила наша компания, был построен два года назад.

1. I.M. Gubkin proved accumulations of hydrocarbons could be found in the Volga basin.
2. We know wildcat wells are drilled to determine occurrence of oil.
3. We have read Conrad and Marcel Schlumberger are considered the inventors of electric well logging.
4. The surface equipment we use depends on the stage of the oil field development.
5. Our professor has told us derricks are used on both on-shore and off-shore oil rigs.
6. Petroleum products we use are the result of crude oil processing.
7. The downhole pumps the company produces are in great demand in petroleum producing areas.
8. Most of the energy we get from the ocean is oil and natural gas from wells drilled on the ocean floor.
9. We have learned the use of horizontal and directional drilling makes it possible for a single well to produce oil from a much bigger area.
10. Finished petroleum products cost much more than crude oil they are produced from.

II. Translate the sentences into Russian paying attention to Passive Voice constructions.
1. The price for oil is strongly influenced by demand.
2. The lecture in Reservoir Engineering was followed by a seminar.
3. Oil prices are much spoken of.
4. Energy and natural resources issues are dealt with at our ministry.
5. The Gulf of Mexico oil spill is looked upon as a major environmental disaster.
6. These logging data can be fully relied on.
7. BP plc (United Kingdom), Chevron Corporation (United States), ExxonMobil Corporation (United States), Royal Dutch Shell plc (Netherlands and United Kingdom) and Total SA (France) are referred to as supermajors.
8. The discoveries of on-shore oil and gas fields in the West Siberian petroleum basin were followed by off-shore discoveries.
9. Sometimes banknotes are not worth the paper they are printed on.
10. What is polyethene obtained from?

VOCABULARY (TEXT II A)

- Study the word list and translate the example sentences in writing.
1. to appraise v. оценивать
   The Ghana National Petroleum Corporation is to promote petroleum exploration activities and to appraise existing petroleum discoveries.

2. to evolve v. развиваться, претерпевать изменения, видоизменяться
   The small company has evolved into a major chemical producer.

   evolution n. эволюция

3. cable-tool rig установка для ударно-канатного бурения
4. rotary rig установка для вращательного бурения
5. drillship n. буровое судно
6. semi-submersible n. полупогружная буровая платформа
   Semi-submersible vessels have increased stability.

7. jack up rig n. самоподъемная буровая установка
   The cost of semisubmersibles is generally higher than that of a jackup.

8. fixed adj. стационарный; неподвижный, фиксированный; определенный

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1 Plc – public limited liability company (компания с ограниченной ответственностью открытого типа в Великобритании)
2 S.A. – Société Anonyme (акционерное общество с ограниченной ответственностью открытого типа во Франции)
**fixed platform** стационарная морская платформа

syn. **submersible**  
*Fixed off-shore platforms are best suitable for depths up to about 500 m.*

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**workover** n. Подземный ремонт скважины  
*A workover is a service on an oil or gas well, requiring interventions in the wellbore itself to correct a problem with the well.*

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**conventional** adj. стандартный, традиционный, обычный  
*Opp. unconventional*  
*Oil industries and governments across the globe are investing in unconventional oil sources due to the increasing scarcity of conventional oil reserves.*

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**pay zone** продуктивный пласт/горизонт/интервал  
*Pay zone (or pay, or pay sand) is a reservoir or portion of a reservoir that contains economically producible hydrocarbons. The term derives from the fact that it is capable of “paying” an income.*

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**gross pay** общая толщина пласта  
**net pay** эффективная толщина пласта  
*The overall interval in which pay sections occur is the gross pay; the smaller portions of the gross pay that meet local criteria for pay (such as minimum porosity, permeability and hydrocarbon saturation) are net pay.*

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**slant** n. наклон; уклон  
*wc slant drilling* наклонное бурение  
*wc slant hole* наклонная скважина  
*With slant wells, it is important to ensure that the well profile remains straight.*

---

**directional drilling** наклонно-направленное бурение  
*Directional drilling is drilling the wellbore in a planned trajectory.*

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**angle** n. угол  
*An angle measures the amount of turn.*

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**to tap** v. вскрывать пласт  
*There are many oil reserves around the globe that remain untapped, and explorers continue to discover new fields deep beneath the earth's surface.*

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**wellbore** n. ствол скважины  
**to resemble** v. иметь сходство, напоминать  
*Hydrates resemble snowflakes and can clump together (образовывать комки) to form plugs in pipes.*

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**multilateral drilling** многоствольное бурение
19. **operator** *n.* рабочий на промысле; диспетчер; нефтедобывающая фирма; нефтедобывающая компания; нефтяная компания, ответственная за разведку, бурение и добычу на арендованном участке; владелец предприятия, ведущего разработку месторождения; оператор

*In the Oil and Gas industry, operator means the individual, company, trust, or foundation responsible for the exploration, development, and production of an oil or gas well or lease. Generally, it is the oil company by whom the drilling contractor is engaged.*

20. **whatever** *adj.* какой бы ни, любой, независимо от того, какой

21. **bottomhole location** *(BHL)* местонахождение забоя (скважины); определение местонахождения забоя (скважины)

*“Bottom-hole location” means the subsurface point at the greatest measured penetration of a well or a well branch.*

22. **rigging up** монтаж буровой установки

*Rigging up is placing and assembling the various parts of equipment that make up the rig, and preparing the rig for drilling.*

23. **coiled tubing drilling** бурение на гибких трубах

*Coiled tubing drilling is very efficient in specific situations.*

24. **continuous** *adj.* непрерывный, сплошной

*continuous logging while drilling*

25. **producing** *(production)* **well** добывающая скважина

26. **acceptance** *n.* признание, одобрение

*to accept* *v.* принимать, соглашаться, признавать

27. **to plug and abandon** *(a well)* *(P&A)* затампонировать и ликвидировать скважину

*The purpose of P&A is to establish permanent barriers to prevent migration of hydrocarbons to the surface.*

28. **commercially viable** рентабельный

29. **to strengthen** *v.* укреплять, закреплять

*The application of these and similar materials to strengthen the wellbore has proved successful.*

30. **casing** *n.* обсадная колонна

*Casing consists of a series of metal pipes installed into the new well in order to strengthen the walls of the well hole, to prevent fluids and gases from seeping out of the well as it is brought to the surface, and to prevent other fluids or gases from entering the rock formations through which the well was drilled.*

31. **to run** *v.* управлять (инструментом)

*Magnetic sensors must be run within a nonmagnetic environment.*

32. **guidance systems** системы управления
Last summer I worked as a hand at an oilfield in Siberia.

READING

- Scan Text II A and match each part of the text with a heading.

  Part … conventional vs. unconventional drilling methods
  Part … development of directional drilling
  Part … personnel training
  Part … final stages of drilling a well
  Part … the past and the present of drilling engineering
  Part … coiled tubing technology

- Now, find in Text II A the English equivalents of the following:

<table>
<thead>
<tr>
<th>Russian Phrase</th>
<th>English Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>развитие науки и техники</td>
<td>development of science and technology</td>
</tr>
<tr>
<td>могут быть разделены на две категории</td>
<td>can be divided into two categories</td>
</tr>
<tr>
<td>наземная буровая установка</td>
<td>surface drilling rig</td>
</tr>
<tr>
<td>буровая установка для разведочного бурения</td>
<td>drilling rig for exploratory drilling</td>
</tr>
<tr>
<td>установка/агрегат для подземного ремонта скважины</td>
<td>installation or unit for underground well repair</td>
</tr>
<tr>
<td>выполнить резкий поворот</td>
<td>make a sharp turn</td>
</tr>
<tr>
<td>там, где монтаж вышки над необходимым забоем невозможен</td>
<td>where drilling above the required interval is not possible</td>
</tr>
<tr>
<td>легендарные символы</td>
<td>legendary symbols</td>
</tr>
<tr>
<td>отрезок стальной трубы маленького диаметра</td>
<td>segment of small-diameter steel pipe</td>
</tr>
<tr>
<td>первоначально разработанный</td>
<td>initially developed</td>
</tr>
<tr>
<td>получила широкое признание</td>
<td>gained widespread recognition</td>
</tr>
<tr>
<td>оценка пласта</td>
<td>assessment of formation</td>
</tr>
<tr>
<td>современные самолеты и космические корабли</td>
<td>modern airplanes and space vessels</td>
</tr>
<tr>
<td>обучение технике безопасности</td>
<td>training in safety procedures</td>
</tr>
<tr>
<td>учения по технике безопасности на вертолете</td>
<td>training in safety procedures by helicopter</td>
</tr>
</tbody>
</table>
1. The story of modern oil well drilling began at the start of the industrial revolution. The first modern oil well was drilled in Baku in 1846 to a depth of 69 feet (21 metres). By 1872 the Baku area had so many wells that it became known as the “Black City.” Now wells are drilled for various purposes, e.g. to explore for oil and gas, to appraise an earlier discovery, or to create a development well. Types of rigs have evolved along with the development of science and technology: cable-tool rigs drilled many wells in the past while rotary rigs dominate the industry today. Depending on the location and geography of a reservoir a variety of rotary drilling rigs may be used. Rigs may be broadly divided into two categories: rigs that work on land (land rigs) and rigs that work offshore (drillships, semi-submersible rigs, jack up rigs, fixed platforms, etc.). According to the type of operations performed rigs can be classified into exploration rigs, workover rigs, etc.

2. As for drilling techniques, they vary from field to field. Conventional wells are drilled vertically from the surface straight down to the pay zone. This is the traditional and still common type of drilling. Other types of drilling techniques, like horizontal drilling, slant drilling, etc. fall into the category of directional drilling methods. Horizontal drilling uses technologies that allow making a sharp turn and drilling horizontally along a thin pay zone. Slant drilling is performed at an angle from perpendicular (commonly 30° to 45°), which minimizes surface environmental damage. For example, oil reserves under a lake can be tapped by a slant hole drilled from onshore.

3. It should be noted that directional drilling has developed from slant and horizontal drilling to drilling that can change direction and depth several times in one wellbore. A schematic of such wellbores (often several from the same drill site) resembles the roots of a plant. This technique is known as multilateral drilling, and it allows operators to branch out3 from the main well to tap reserves at different depths. This drastically increases production from a well and reduces the number of wells drilled on the surface. Whatever directional drilling technique is used, it can be done for many reasons, e.g. when the bottomhole location (BHL) is under an obstruction such as a building or lake where rigging up over the required BHL is not possible, or when it is necessary to drill several wells from a fixed place, such as an offshore platform or an onshore drilling island to different bottomhole locations.

4. Today, drilling or workover rigs, iconic symbols of the oil field, are not always required for drilling, completions or maintenance operations. Increasingly, the coiled tubing technology is used for many well intervention operations and certain drilling applications. Coiled tubing refers to a continuous length of small-diameter steel pipe and related surface equipment as well as associated drilling, completion and workover techniques. Being initially developed for working on producing wells, coiled tubing oil field technology has more recently gained wider acceptance among operators for a wide variety of workover and drilling applications and for its ability to reduce costs.

5. Once the formation evaluation is done, the operator must decide if the well should be completed as a producing oil or gas well. If the well does not contain hydrocarbons, or not enough to pay for the completion, the well will be plugged and abandoned (P&A). In case a well is commercially viable, it must be completed to allow for the flow of oil or gas. The completion process involves strengthening of the well walls with casing and installing the appropriate equipment to control the flow of oil or gas from the well.

6. Nowadays drilling has become a specialized and technologically advanced business. The equipment used to drill a well is technically complex (for example, the guidance systems used in directional drilling are as sophisticated as those found on modern jet aircraft or spacecraft), and those who run the equipment must be well trained. Safety training is part of everyday life for all

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3 делать ответвления
hands on a drilling rig. There are safety meetings at the beginning of every tour and before each new part of a job. Outside training, such as helicopter safety training for offshore crews, is also required for drilling personnel.

- Read Text II A again and do COMPREHENSION exercises below.

**COMPREHENSION**

I. **Answer the following questions:**
1. What may be the reasons for drilling?
2. What is the oldest drilling technique?
3. What does the design of the rotary drilling rig depend on?
4. What techniques of well drilling are mentioned in the text?
5. What is the advantage of slant drilling?
6. When are wells completed?
7. What operations does completion involve?
8. When are wells plugged and abandoned?
9. Why is safety training a must for all hands on a drilling rig? How often is it done?
10. How do feet and meters correlate?

II. **Choose A, B or C.**

1. The first modern oil well was drilled in Baku in
   A. 1846.
   B. 1746.
   C. 1946.

2. Today, the most common types of rigs are
   A. rotary rigs.
   B. cable-tool rigs.
   C. both rotary and cable-tool rigs.

3. Conventional wells are drilled by
   A. vertical drilling.
   B. horizontal drilling.
   C. slant drilling.

4. Slant drilling technology
   A. minimizes surface environmental damage.
   B. maximizes surface environmental damage.
   C. has no impact on the environment.

5. Well completion is the
   A. first stage of drilling operations.
   B. intermediate stage of drilling operations.
   C. final stage of drilling operations.

III. **Say whether the statements below are true, false or not mentioned in the text.**

1. Drilling engineers are well paid.
2. Cable-tool drilling is older than rotary drilling.
3. Onshore and offshore rigs do not differ in design.
4. Vertical drilling has developed from slant and horizontal drilling.
5. Slant drilling is considered a conventional drilling method.
6. Directional drilling is the most commonly used drilling method.
7. Coiled tubing technology is not used offshore.
8. If a well is commercially viable, it is to be completed.
9. A well is strengthened with casing at the final stages of drilling.
10. Today, drilling is a much more technologically advanced business than it used to be.
VOCABULARY

I. Find synonyms of the following words in Text II A.
   1. borehole __________________
   2. oil platform __________________
   3. traditional __________________
   4. oil accumulation __________________
   5. plan __________________
   6. to need __________________
   7. section of pipe __________________
   8. to operate equipment __________________
   9. worker __________________
   10. shift __________________

II. Find antonyms of the following words in Text II A.
   1. old __________________
   2. onshore __________________
   3. mobile __________________
   4. vertical __________________
   5. thick __________________
   6. parallel __________________
   7. to maximize __________________
   8. underground __________________
   9. simple __________________
   10. inside __________________

III. Match a word and its meaning.
   1. to evolve a. staying the same; not changing or able to be changed; not able to be moved
   2. conventional b. to look like or be similar to another person or thing
   3. continuous c. normal and ordinary
   4. angle d. a person who does physical work
   5. to resemble e. spreading in a line or over an area without any spaces
6. hand  f. to develop gradually, especially from a simple to a more complicated form
7. to strengthen  g. the people who work for an organization
8. to run  h. to operate; to use something or make it work
9. personnel  i. to become stronger; to make somebody/something stronger
10. fixed  j. the space between two lines or surfaces that join, measured in degrees

IV. Write down the names of angle type.

<table>
<thead>
<tr>
<th>Type of Angle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>an angle that is less than 90°</td>
</tr>
<tr>
<td></td>
<td>an angle that is 90° exactly</td>
</tr>
<tr>
<td></td>
<td>an angle that is greater than 90° but less than 180°</td>
</tr>
<tr>
<td></td>
<td>an angle that is 180° exactly</td>
</tr>
<tr>
<td></td>
<td>an angle that is greater than 180°</td>
</tr>
</tbody>
</table>

V. Fill in the gaps with the words from the box:

<table>
<thead>
<tr>
<th>evolved</th>
<th>whatever</th>
<th>tapped</th>
<th>strengthened</th>
<th>hand</th>
<th>personnel</th>
</tr>
</thead>
</table>

angles continuous conventional run untapped

1. The new director is likely to make major changes in _________.
2. The company has _________ over the years into a multi-million dollar organization.
3. I joined the firm as a factory _________ and gradually worked my way up to the top.
4. The interior _________ of a square are right angles, or angles of 90 degrees.
5. _________ oil and gas refers to petroleum, or crude oil, and raw natural gas extracted from the ground by conventional means and methods.
6. Do you know how to _________ this sort of machinery?
7. Yesterday the pound _________ against the dollar.
8. Western and central China will experience increasing energy development because they hold many _________ and lesser _________ oil and gas fields.
9. She was in _________ employment until the age of sixty-five.
10. The personnel may take _________ action is needed.

VI. Circle the word or word combination in bold that fits best.

1. A producing well / An exploratory well is a well drilled in a proven producing area.
for the production of oil or gas.

2. An appraisal well / An injection well is an exploratory well drilled to establish the extent and size of a petroleum deposit that has already been discovered by a wildcat well.

3. Cable-tool / Rotary drilling was the first method used to drill a bore hole.

4. Pay zone / Drill site refers to the rock in which oil and gas are found in exploitable quantities.

5. Rotary rigs / Cable-tool rigs drill the vast majority of wells today, including all medium and deep wells.

6. Jack-Up Rigs / Semisubmersibles are offshore rigs with retractable steel legs that can be placed on the ocean floor and raise the rig above the water line.

7. Vertical drilling / Horizontal drilling is a conventional type of drilling.

8. Horizontal drilling / Vertical drilling starts with a vertical well that turns horizontal within the reservoir rock.

9. If the well is commercially viable, it is completed / plugged and abandoned.

10. The purpose of safety training / guidance systems is to provide the knowledge necessary to perform job safely.

VII. The verb “run” in its meaning “to operate equipment” can be translated differently into Russian, for example:

- to run tools to the bottom – опускать инструмент на забой
- to run casing to the surface – обсаджать до устья
- to run a gas engine – включать газовый двигатель
- to run barefoot – эксплуатировать скважину с необсаженным продуктивным горизонтом
- to run dry – бурить всухую
- to run up the engine – опробовать двигатель (на режимах работы)

- Translate the sentences containing the verb “run” into Russian.

1. Casing is run into the well and officially landed when the weight of the casing string is transferred to the casing hangers, which are located at the top of the well and use slips or threads to suspend the casing in the well.

2. Tripping pipe (or “Making a round trip” or simply “Making a trip”) is the physical act of pulling the drill string out of the wellbore and then running it back in.

3. After the logging is completed at total depth, the crew will run the drill string back into the well and then proceed to lay it down before installing the final set of casing (the “production casing”).

4. There are many types of wireline logs and they can be categorized either by their function or by the technology that they use. “Open hole logs” are run before the oil or gas well is lined with pipe or cased. “Cased hole logs” are run after the well is lined with casing or production pipe.

5. Completion, in petroleum production, is the process of making a well ready for production (or injection). This principally involves preparing the bottom of the hole to the required specifications, running in the production tubing and its associated down hole tools as well as perforating and stimulating as required. Sometimes, the process of running in and cementing the casing is also included.

6. In cased hole completions, once the completion string is in place, the final stage is to make a connection between the wellbore and the formation. This is done by running perforation guns to blast holes in the casing or liner to make a connection.

7. A standpipe is a pipe run vertically up the derrick about 10 to 12 metres.

8. After observing a machine or piece of equipment that is lockout for maintenance
operations the personnel must not attempt to run the machine or piece of equipment.

9. An engine is to be run up after certain types of maintenance procedures are performed on an aircraft.

10. Various onshore and offshore facilities are run by the oil and gas industry today.

TEXT II B

- Translate the text into Russian and do the exercises below. Use the link to look up the new words http://www.multitran.ru.

Today, almost all oil and gas wells are known to be drilled using rotary drilling. In rotary drilling, the rotating equipment turns the drill bit. This equipment consists of the swivel, the kelly, the rotary table, the drill pipe, the drill collar, and the bit. The swivel is attached to the bottom of the traveling block and permits the drill string to rotate. The kelly is a square or hexagonal shaped section of pipe that is attached to the swivel and fits in a matching slot in the rotary table. As the rotary table turns the kelly is also turned. The movement of the kelly rotates the drill string and the drill bit. The drill pipe is round steel tubes about 30 feet long with a diameter of from 4 to 5 inches. The drill collar is used to add weight on the bit. The drill pipe has threaded connections on each end that allow the pipe to be joined together to form longer sections as the hole gets deeper. The drill bit is used to create the hole. The drill bit sizes vary from six inches to three feet in diameter. The most common drill bits are roller cone bits and diamond bits. Roller cone bits have three cones containing rows of teeth. The cones rotate on bearings and turn as the drill bit rotates. The teeth cut and crush the rock to create the hole. Diamond bits have a single fixed head that contains many small diamonds. As the bit turns the diamonds cut the rock. Different drill bits are used depending on the type of rock that is encountered. During drilling, the circulating system pumps drilling mud or fluids into the well bore to cool the drill bit, remove rock chips, and control subsurface fluids. Typically, mud is circulated down through the hollow drill pipe. The mud exits the pipe through holes or nozzles in the drill bit, and returns to the surface through the space between the drill pipe and the well bore wall.

I. Choose the most suitable heading.

- Diamond bits.
- Rotary drilling method.
- Types of bits.

II. Find the English equivalents of the following terms in Text II B.

<table>
<thead>
<tr>
<th>русское слово</th>
<th>английское слово</th>
</tr>
</thead>
<tbody>
<tr>
<td>бурильная труба</td>
<td>drill pipe</td>
</tr>
<tr>
<td>насадки</td>
<td>drill bit</td>
</tr>
<tr>
<td>буровой раствор</td>
<td>drilling mud</td>
</tr>
<tr>
<td>ведущая труба, квадрат</td>
<td>kelly</td>
</tr>
<tr>
<td>вертлюг</td>
<td>swivel</td>
</tr>
<tr>
<td>талевый блок</td>
<td>traveling block</td>
</tr>
<tr>
<td>резьбовое соединение</td>
<td>threaded connection</td>
</tr>
<tr>
<td>роторный стол; ротор буровой</td>
<td>rotary table</td>
</tr>
</tbody>
</table>
III. Finish the sentences.

The rotating equipment consists of ...
The swivel is attached to … and permits...
The kelly is …
The drill pipe is …
The drill collar is used to …
The drill bit is used to …
The most common drill bits are …
Roller cone bits have …
The cones rotate on …
Diamond bits have …
The drilling mud is pumped into the wellbore to …
The mud exits the pipe through …

VOCABULARY AND TRANSLATION BANK

I. Fill in the gaps with the words from the box.

Offshore Drilling Rig Today

As offshore drilling moves into greater water depths and more _________ environments, all costs increase rapidly. It also leads to the increase in size of petroleum _________ required to justify the drilling. In some cases, oil companies must consider a reserve _________ at 100 million barrels (16 million cubic metres) of oil marginal; that is, if they estimate that they can _________ only 100 million barrels from a reservoir, then that reservoir will not be _________ due to the high costs of drilling, producing, and transporting the oil to shore. Commercial reserves begin at 300 million barrels (48 million _________ metres) of expected production for some fields. However, exploring for offshore oil and gas is _________ as improvements in drilling and production techniques help _________ costs and increase the chances of success. The type of rig used in offshore drilling depends largely _________ whether the company is drilling for exploration or for development. Development wells are the wells drilled in a reservoir that _________ has found. Oil companies almost always use mobile rigs in exploratory drilling, and often use fixed platforms with production and well maintenance _________ for development drilling.
II. Translate the texts below into Russian in writing and give them headings.

- On large rigs, the owners replace the conventional swivel with a powered swivel called a top drive. The top drive hangs from the travelling block and has its own heavy-duty motor. The motor turns a threaded drive shaft that connects directly to the top of the drill stem to turn it. Rigs with top drives do not need a kelly, kelly bushing, or master bushing. They do retain the rotary table, but only as a place for the crew to hold the drill stem in place with the slips.

- The main advantage of a power swivel over the conventional kelly and rotary table system lies in the area of pipe handling and drilling efficiency. With the conventional system, joints of pipe must be added to the drill stem one at a time as the hole deepens. With a power swivel, the pipe can be added three joints at a time. Adding three-joint stands of pipe saves time in making connections. Also, manufacturers have recently developed a portable top drive that an operator of a smaller rig can rent to drill a difficult section of the hole or to drill horizontally.

- The casing is fabricated in sections, or joints, that are usually about 40 feet long and screwed together to form longer lengths of casing, called casing strings. The small space between the casing and the untreated sides of the well is filled with cement to permanently set the casing in place. After running the casing and before the cementing the well, a used drill bit is inserted into the well via a drillstring, and drilling fluid is then circulated for a certain amount of time to remove any remaining cuttings from the well. Casing strings are supported by casing hangers that are set in the wellhead, which later will be topped with the Christmas tree. The wellhead usually is installed on top of the first casing string after it has been cemented in place.

- Horizontal drilling starts with a vertical well that turns horizontal within the reservoir rock in order to expose more open hole to the reservoir. These horizontal “legs” can be over a mile long; the longer the exposure length, the more oil and natural gas is drained and the faster it can flow. Horizontal wells are attractive because they (1) can be used in situations where conventional drilling is impossible or cost effective, (2) reduce surface disturbance by requiring fewer wells to reach the reservoir, and (3) can produce as much as 15 to 20 times as much oil and gas compared to a vertical well.
III. Match a definition and a term.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>a rig supported by attached pontoons</td>
<td>a rig supported by attached pontoons</td>
</tr>
<tr>
<td>the main rotating shaft on a rotary drilling rig that connects to</td>
<td>the main rotating shaft on a rotary drilling rig that connects to and turns the drill string</td>
</tr>
<tr>
<td>the equipment at the surface used to lift and run the drilling</td>
<td>the equipment at the surface used to lift and run the drilling string, provide the rotation and pump fluids down the string</td>
</tr>
<tr>
<td>the fluid, water, oil or gas based, that is used to establish well</td>
<td>the fluid, water, oil or gas based, that is used to establish well control, transport cuttings to the surface, provides fluid loss control, lubricates the string and cool the bottom hole assembly</td>
</tr>
<tr>
<td>the action of placing a hole to a depth and location</td>
<td>the action of placing a hole to a depth and location</td>
</tr>
<tr>
<td>hydrocarbon producing interval</td>
<td>hydrocarbon producing interval</td>
</tr>
<tr>
<td>setting cement and mechanical plugs to seal off pays, potential</td>
<td>setting cement and mechanical plugs to seal off pays, potential leak points, fresh water zones and the surface.</td>
</tr>
<tr>
<td>the control sections above the basic wellhead. It may contain</td>
<td>the control sections above the basic wellhead. It may contain hangers, master valves, annular valves, wing valves, and gauges</td>
</tr>
<tr>
<td>more than one producing wellbore from a single wellbore or mother</td>
<td>more than one producing wellbore from a single wellbore or mother bore</td>
</tr>
<tr>
<td>Christmas tree</td>
<td>Christmas tree</td>
</tr>
<tr>
<td>drilling</td>
<td>drilling</td>
</tr>
<tr>
<td>reservoir</td>
<td>reservoir</td>
</tr>
<tr>
<td>pay zone</td>
<td>pay zone</td>
</tr>
<tr>
<td>multilateral</td>
<td>multilateral</td>
</tr>
<tr>
<td>drilling rig</td>
<td>drilling rig</td>
</tr>
<tr>
<td>kelly</td>
<td>kelly</td>
</tr>
<tr>
<td>semisubmersible</td>
<td>semisubmersible</td>
</tr>
<tr>
<td>casing</td>
<td>casing</td>
</tr>
<tr>
<td>drilling mud</td>
<td>drilling mud</td>
</tr>
<tr>
<td>plug and abandon</td>
<td>plug and abandon</td>
</tr>
</tbody>
</table>

IV. Translate the sentences into English using connectors if or whether for Russian “ли”.

Ex. Дай мне знать, есть ли у тебя мобильная связь. – Let me know if/whether you can get cell phone reception.
1. Нужно понять, следует ли бурить здесь. – We need to understand if we should drill here.
2. Необходимо решить, следует ли заканчивать скважину. – It is necessary to decide whether we should complete the well.
3. Он спросил, сильно ли износились (wear off) долото. – He asked if the bit was worn off significantly.
4. Мы обсудили, уменьшит ли наклонная скважина ущерб для окружающей среды. – We discussed if the inclined well would reduce damage to the surrounding environment.
5. Он не знает, возможен ли монтаж вышки над забоем. – He doesn’t know if it is possible to install a derrick above the hole.
6. Интересно, все ли члены буровой бригады прошли обучение технике безопасности. – It is interesting if all the members of the drilling team were trained in safety techniques.
7. Вы знаете, должны ли мы запустить оборудование? – Do you know if we should start the equipment?
8. Нам не сказали, стоит ли применить этот метод. – They didn’t tell us whether we should use this method.
9. Тип буровой установки зависит от того, будут ли бурить разведочные или эксплуатационные скважины. – The type of drilling rig depends on whether we will drill exploratory or operational wells.
10. Интересно, какие виды долот они собираются использовать. – It is interesting what types of bits they are planning to use.
V. Render the following into English.

a) Цели и назначение буровых скважин различны. Эксплуатационные скважины закладывают на полностью разведанном и подготовленном к разработке месторождении. В категорию эксплуатационных входят не только скважины, но и скважины, позволяющие организовать эффективную разработку месторождения (оценочные, нагнетательные, наблюдательные [observation] скважины). Оценочные скважины предназначены для уточнения режима работы пласта [natural recovery drive] и степени выработки [depletion] участков месторождения, уточнения схемы его разработки. Нагнетательные скважины служат для организации нагнетания в эксплуатационный пласт воды, газа или воздуха в целях поддержания пластового давления. Наблюдательные скважины сооружают для систематического контроля режима разработки месторождения [reservoir drive]. Конструкция эксплуатационной скважины определяется числом рядов труб, спускаемых в скважину и цементируемых в процессе бурения для успешной проводки скважин, а также оборудованием ее забоя. В цикл строительства скважины входят подготовительные работы; монтаж вышки и оборудования; подготовка к бурению; процесс бурения; крепление скважин обсадными трубами и ее тампонаж; вскрытие пласта и испытание на приток нефти и газа [production test].

b) Обсадная колонна предназначена для крепления буровых скважин, а также изоляции продуктивных горизонтов при эксплуатации. Обсадные трубы, применяемые при бурении нефтяных и газовых скважин, изготовляются в основном из стали. Применяются обсадные колонны трех видов: кондукторы; промежуточные; эксплуатационные. Промежуточные колонны предназначены для крепления стенок нижних интервалов скважин. Кондукторы и промежуточные колонны обычно цементируются, но могут быть и съемными (например, при бурении некоторых геологоразведочных скважин или глубоких скважин для борьбы с износом спущенных предыдущих промежуточных колонн). Эксплуатационная колонна перекрывает продуктивные горизонты. Через перфорационные отверстия в колонне в скважину поступают нефть и газ, которые перемещаются к устью по колонне насосно-компрессорных труб [tubing]. Обсадные колонны подвергаются воздействию наружного давления жидкости и газа в пластах; воздействию внутреннего давления нефти, газа, а также бурового раствора, собственной массы и усилия натяжения [tension force] колонн, обусловленного влиянием температуры и давления. Длина, диаметры и число обсадных колонн определяются геологическими условиями бурения, уровнем техники и технологии строительства скважин, условиями предупреждения и ликвидации возможных осложнений и аварий и др. Диаметр эксплуатационных колонн и глубина скважины являются основными параметрами для определения диаметра промежуточных колонн. При выборе конструкций колонн учитывается экономичность сооружения и длительность эксплуатации.

c) Бурение скважин – сложный технологический процесс строительства ствола буровых скважин, состоящий из следующих основных операций: углубление скважин посредством разрушения горных пород буровым инструментом; удаление выбуранной породы из скважины; крепление ствола скважины в процессе ее углубления обсадными колоннами; проведение комплекса геологогеофизических работ по исследованию горных пород и выявлению продуктивных горизонтов; спуск на проектную глубину [total depth] и
цементирование последней (эксплуатационной) колонны.

d) Для бурения глубоких скважин используют обычно роторный способ бурения. Это наиболее распространенный способ бурения, составляющий до 80 процентов общего объема буровых работ. При этом способе бурения скважин порода разрушается при помощи вращающегося бура. Ротор, расположенный на поверхности, с помощью колонны бурильных труб передает вращение на бур. Использование долот различного диаметра дает возможность производить бурение внутри обсадных труб. Во избежание обрушения стенок скважины и для перекрытия верхних водоносных горизонтов [water shut-off] в нее опускают обсадную трубу, и дальнейшее бурение производят внутри обсадной трубы долотом меньшего диаметра. Затем в скважину опускают следующую обсадную колонну, затем эксплуатационную колонну, которая будет находиться в водоносном слое. Бурение производится долотами различных размеров, начиная с большего.

SPEAKING

I. Look at the way the rotary drilling process is described. Choose any drilling method mentioned in the text and describe how it works using the words in bold.

First/First of all, the site that contains crude oil is selected. Next/Second, the land for the drilling process is prepared. After the land preparation, the rig must be placed on the site, and holes are dug for this purpose. Later, the oil rig is set up in the holes, and the drilling process is started. The next step/stage is to place the drill bit and the drill collar in the main hole. Then, the kelly and turntable are attached and at this point the actual process can begin. As drilling progresses, new joints to the drilling pipe are attached. Once the preset depth of the process is reached, the drilling bit and the pipe are removed from the hole. After this, the casing pipe sections are placed in the main hole. The process of drilling is continued, and finally the casing pipe is placed in the hole/the final stage is to place the casing pipe in the hole, until the oil is not found. As soon as it is found, the drilling apparatus is removed from the hole.

II. Look at the picture, name the drilling techniques depicted in it and describe them using the words and word combinations from the box.

(un)conventional, horizontal, vertical, to drill, pay zone, well bore, to inject, slant, perpendicular, angle, to minimize, to change direction, to apply, to evolve, commercially viable
III. Choose one of the drilling methods mentioned in the text. Describe the technology and equipment used; mention the advantages and drawbacks of the method, its relevance, ecological problems associated with it.

The following phrases may be useful:
- The method/technique involves/includes/consists of the following operation/steps/processes...
- Firstly, Secondly, Next, Finally
- In my view
- As far as … is concerned
- Also, besides, apart from, on the one hand … on the other hand, moreover, while
- The strong point/advantage/benefit/advanced feature of the method is...
- Among the weak points/disadvantages/drawbacks/problems of the technique I would mention...
- I believe that … is an advantage because ...

IV. Discuss in pairs.
- If you were a drilling engineer, would you like to work onshore or offshore? Why?
- What drilling technique would you use in Arctic conditions?
- What kind of bits would you use in soft/hard rocks?
- What is the most commonly used drilling technology in Russia?
- Which oil producing countries have the most favourable conditions for drilling offshore?