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Федеральное государственное бюджетное образовательное учреждение высшего образования
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АНГЛИЙСКИЙ ЯЗЫК

БЕЗОПАСНОСТЬ ТЕХНОЛОГИЧЕСКИХ ПРОЦЕССОВ И ПРОИЗВОДСТВ

Методические указания к практическим занятиям для студентов бакалавриата направления 20.03.01

ENGLISH

INDUSTRIAL SAFETY

САНКТ-ПЕТЕРБУРГ
2019

УДК 811.111 (073)

АНГЛИЙСКИЙ ЯЗЫК. Безопасность технологических процессов и производств: Методические указания к практическим занятиям / Санкт-Петербургский горный университет. Сост.: *Э.А. Навицкайте*, *И.Б. Померанец.* СПб, 2019. 32 с.

Методические указания составлены для использования на практических занятиях по дисциплине «Иностранный язык». Предлагаемый материал направлен на совершенствование навыков просмотрового и изучающего чтения текстов по специальности, их перевода на русский язык, расширение словарного запаса, а также аудирования при просмотре научно-популярных и учебных видеофильмов в рамках профессиональной тематики.

Предназначены для студентов бакалавриата направления подготовки 20.03.01 «Техносферная безопасность».

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Предисловие

Данные методические указания к практическим занятиям по английскому языку предназначены для студентов бакалавриата направления подготовки 20.03.01 «Техносферная безопасность», профиль «Безопасность технологических процессов и производств». Методические указания составлены в соответствии с учебной программой по дисциплине «Иностранный язык» для формирования иноязычной профессиональной компетенции будущих бакалавров.

Целью работы является развитие навыков просмотрового и коммуникативного чтения, а также аудирования на основе аудиовизуального метода.

Методические указания состоят из четырех частей: Life Safety, Industrial Safety, Prevention of Fires and Explosions in Underground Mines, Mine Rescue. Тематика текстов и видеоматериалов затрагивает основные проблемы безопасности горнодобывающей промышленности.

UNIT 1. LIFE SAFETY

TEXT 1.1 Safety-critical system

1 Make up verbs from the following nouns. Translate the words.

1 a failure – to fail
2 a result -
3 an outcome -
4 a death -
5 an injury -
6 a loss -
7 an increase -

2 Using a dictionary, translate the following word combinations. Make up sentences, using the word combinations below.

A safety-critical system, a life-critical system, a safety-related system, a safety-involved system, to perform safety functions, an increase in the safety risk, severe environmental damage, to provide guidance on safety-related systems, to manage risks, safety engineering, probabilistic risk assessment, failure mode and effects analysis, fault tree analysis.

3 With a partner, discuss the questions below. Compare your ideas with other students.

- What will happen if a safety-critical system fails or malfunctions?
- What is the difference between a safety-critical and a safety-related system?

4 Read the text to check your answers.

A safety-critical system or life-critical system is a system whose failure or malfunction may result in one (or more) of the following outcomes:

- death or serious injury to people
- loss or severe damage to equipment/property
- environmental harm

A safety-related system (or sometimes safety-involved system) comprises everything (hardware, software, and human aspects) needed to perform one or more safety functions, in which failure would cause a signifi-

cant increase in the safety risk for the people and/or environment involved. Safety-related systems are those that do not have full responsibility for controlling hazards such as loss of life, severe injury or severe environmental damage. The malfunction of a safety-involved system would only be that hazardous in conjunction with the failure of other systems or human error. Some safety organizations provide guidance on safety-related systems, for example the Health and Safety Executive (HSE) in the United Kingdom.

Risks of this sort are usually managed with the methods and tools of safety engineering. A safety-critical system is designed to lose less than one life per billion hours of operation. Typical design methods include probabilistic risk assessment, a method that combines failure mode and effects analysis (FMEA) with fault tree analysis. Safety-critical systems are increasingly computer-based.

Source:https://en.wikipedia.org/wiki/Safety-critical_system

5 A Health and Safety Quiz

How well are you informed on the issues of OHS (Occupational Health and Safety)? Read the statements below and choose the correct answer.

1. If you have an accident at work because there is not enough supervision, who is responsible?
   a) you
   b) your employer
   c) no one
2. Why should you follow health and safety rules on a production site?
   a) health and safety rules don't really matter
   b) because this is the law
   c) because a lot of people die every year in accidents
3. What does a blue sign showing a face wearing glasses mean?
   a) there is a risk if you do not wear eye protection
   b) eye protection must be worn
   c) you must not wear eye protection

4. What does a yellow sign with a skull and crossbones mean?
   a) there is a risk of toxic hazard
   b) there is a risk from pirates
   c) there is a risk from motorcyclists
5. If you have an accident at work because of an electrical fault, who is responsible?
   a) you
   b) your employer
   c) no one
6. What does a yellow sign with a fire symbol mean?
   a) there is a risk of fire
   b) you must start a fire
   c) do not start a fire
7. Which colour is the safety sign which tells you that you must NOT do something?
   a) green
   b) yellow
   c) red
8. A red circle with a red diagonal line through it hangs from a piece of equipment. What does it mean?
   a) you must use this piece of equipment
   b) there is a risk if you use this piece of equipment
   c) you must not use this piece of equipment
9. What type of fire extinguisher would be most effective in a flammable gases fire?
   a) water
   b) dry powder
   c) foam
   d) carbon dioxide
10. What colour is identified with water fire extinguishers?
    a) red
    b) blue
    c) black
    d) none
11. What does PPE stand for?
    a) people protection equally
    b) proper protection equipment

c) personal protective equipment
d) pretty poor equipment

12. Which of the following is NOT a factor that influences health and safety?
    a) occupational factors, e.g. work risks
    b) environmental factors, e.g. workplace noise
    c) superstitious factors, e.g. walking under ladders, black cats, etc.
    d) human factors, e.g. error or haste
13. Which of the following is NOT the type of health hazard?
    a) chemical
    b) magical
    c) biological
    d) ergonomic
14. What is the most important reason why accidents should be investigated and recorded?
    a) prevent similar accidents in the future
    b) satisfy the enforcement officer
    c) comply with health and safety law
15. What is the best way to protect an employee working at a noisy machine?
    a) allow the machine to be only used at short periods of time
    b) provide a pair of ear defenders
    c) reduce or eliminate noise from the machine
16. Under the health and safety work act 1974, an employer must:
    a) provide a bright, cheerful place to work
    b) safeguard the safety and health of all employees
    c) give everyone their own copy of the company safety policy
    d) provide personalized hard hats in a variety of colours
17. What is the minimum recommended temperature for office work and none physical activities?
    a) 20 degrees
    b) 16 degrees
    c) 13 degrees
    d) 100 degrees
18. Which of the following is NOT a way in which machines can cause injury?

a) entrapment
b) entanglement
c) impact
d) boredom

19. Which is the best way to prevent injury at work?
    a) send all employees home
    b) provide gloves and hard hats
    c) restrict access to the hazard
    d) remove the hazard or redesign the task
20. What is ergonomics?
    a) interaction between people, equipment, and their environment
    b) a study of production and distribution of goods
    c) a type of food

TEXT 1.2 Safety Engineering

1 With a partner, discuss the questions below. Make a list of possible answers. Compare your ideas with other students.

- What is safety engineering?
- What are the functions of a safety engineer?
- What are the most recent trends in safety engineering?

2 Read the text to check your answers.

Safety engineering is the study of the causes and the prevention of accidental deaths and injuries. The field of safety engineering has not developed as a unified, specific discipline, and its practitioners have operated under a wide variety of position titles, job descriptions, responsibilities, and reporting levels in industry and in the loss-prevention activities of insurance companies.

The general areas that have been identified as the major functions carried out by the professional safety engineer or safety professional are: the identification and appraisal of accident-producing conditions and practices and the evaluation of the severity of the accident problem; the development of accident and loss-control methods, procedures, and programs; the communication of accident and loss-control information to

those directly involved; and the measurement and evaluation of the accident and loss-control systems and the modifications that are required to obtain optimum results.

The most recent trends in safety engineering include increased emphasis on prevention by the anticipation of hazard potentials; changing legal concepts with regard to product liability and negligent design or manufacture, as well as the developing emphasis on consumer protection; and the development of national and international legislation and controls, not only in the areas of transportation safety, product safety, and consumer protection but also in occupational health and environmental control.

Source: https://www.britannica.com/technology/safety-engineering

3 Find words and phrases in the text which match the following definitions:

a) the act of stopping something from happening or of stopping someone from doing something;
b) physical harm or damage to someone's body caused by an accident;
c) a particular area of study;
d) seriousness of the accident;
e) preparation for something happening;
f) not being careful or giving enough attention to people or things that are your responsibility;
g) the protection of buyers of goods and services against low quality or dangerous products and advertisements that deceive people

4 Make a list of responsibilities you will need to do as a safety engineer. Which area interests you most? Explain your choice.

5 Write an essay of 120-150 words on the topic *My future career is a safety engineer*.

6 Watch the video *Flirting with Disaster – The Importance of Safety: Crash Course Engineering #28* **at** *https://www.youtube.com/watch?v=WavEcAsI2AY* **and decide if the following statements are true or false:**

1) Safety in general means minimizing or eliminating the hazards involved with what you are doing.
2) Today the area around Chernobyl is densely populated.
3) There are two main categories of safety precautions: public safety and occupational safety.
4) One step to safety is wearing the right protective equipment.
5) Initial safety analysis is learning about the possible hazards and safety limits.
6) HAZOP stands for hazard and operability study.
7) A safe fail means that if your design fails or shuts down, it does so as safely as possible, rather than leading to a catastrophe.
8) It's always good to have as many alarms as possible.
9) One of the problems with the Chernobyl accident was that the operators disabled the automatic shutdown mechanisms.
10) Safety is less important than other engineering concepts.

UNIT 2. INDUSTRIAL SAFETY

TEXT 2.1 Industrial Safety System

1 Study the following abbreviations and acronyms related to industrial safety:

PCS (Process Control System) – система управления технологическими процессами
ICSS (Integrated Control and Safety System) – интегрированная система управления и безопасности
SIL (Safety Integrity Level) – класс безопасности эксплуатации оборудования
PSS (Process Safety System or Process Shutdown System) – система обеспечения безопасности технологического процесса / система остановки технологического процесса
SSS (Safety Shutdown System) – система аварийного останова

ESD (Emergency Shutdown) – аварийное отключение
EDP (Emergency Depressurization) – аварийная разгерметизация
OSHA (Occupational Safety and Health Act) – Закон об охране труда и технике безопасности

2 Read the text about industrial safety system.

An industrial safety system is a countermeasure crucial in any hazardous plants such as oil and gas plants and nuclear plants. They are used to protect human, industrial plant, and the environment in case of the process going beyond the allowed control margins.

As the name suggests, these systems are not intended for controlling the process itself but rather protection. Process control is performed by means of process control systems (PCS) and is interlocked by the safety systems so that immediate actions are taken should the process control systems fail.

Process control and safety systems are usually merged under one system, called Integrated Control and Safety System (ICSS). Industrial safety systems typically use dedicated systems that are SIL 2 certified at minimum; whereas control systems can start with SIL 1.

There are two main types of industrial safety systems in process industry:

- Process Safety System or Process Shutdown System, (PSS).
- Safety Shutdown System (SSS): This includes Emergency Shutdown-(ESD) and Emergency Depressurization-(EDP) Systems.

A third system also exists which acts as a barrier and contains the spray out of hot oil & gases from flanges, valves & pipe joints. These systems are popularly known as safety spray shields and flange guards. The use of spray guards is mandated by OSHA.

Source: *https://en.wikipedia.org/wiki/Industrial_safety_system*

3 Answer the questions:

1. Where and under what circumstances is industrial safety system used?

2. Do industrial safety systems control the process itself?

3. Which two systems are combined in the Integrated Control and Safety System?

4. What are the two main types of industrial safety systems in process industry?

4 Find words and phrases in the text which match the following definitions:

a) an action taken against an unwanted action or situation;
b) extremely important or necessary;
c) to combine or join together;
d) an occasion when something stops operating;
e) something used as protection or providing protection.

5 A quiz. Match health and safety signs to their meanings:

1. 

2. 

3. 

4. 

5. 

6. 

7. 

8. 

9. 

10.  11.  12. 

a) biohazard; b) safety helmet must be worn; c) safety footwear must be worn; d) general danger; e) eye protection must be worn; f) ear protection must be worn; g) corrosive material; h) explosive material; i) toxic material; j) flammable material; k) authorized personnel only; l) industrial vehicles.

TEXT 2.2 Occupational Safety and Health Act (United States)

1 Discuss these questions with a partner:

- What do you know about the history of health and safety legislation in Russia and in other countries?
- What is the main goal of health and safety laws?

2 Read the text to learn more on the topic.

The Occupational Safety and Health Act of 1970 is a US labor law governing the federal law of occupational health and safety in the private sector and federal government in the United States. It was enacted by Congress in 1970 and was signed by President Richard Nixon on December 29, 1970. Its main goal is to ensure that employers provide employees with an environment free from recognized hazards, such as exposure to toxic chemicals, excessive noise levels, mechanical dangers, heat or cold stress, or unsanitary conditions. The Act created the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH).

Efforts by the federal government to ensure workplace health and safety were minimal until the passage of OSHA. The American system of mass production encouraged the use of machinery, while the statutory regime did nothing to protect workplace safety. For most employers, it

was cheaper to replace a dead or injured worker than it was to introduce safety measures.

After the Civil War, some improvements were made through the establishment of state railroad and factory commissions, the adoption of new technology (such as the railway air brake), and more widespread availability of life insurance. But the overall impact of these improvements was minimal.

In 1893, Congress passed the Safety Appliance Act, the first federal statute to require safety equipment in the workplace (the law applied only to railroad equipment, however). In 1910, in response to a series of highly publicized and deadly mine explosions and collapses, Congress established the United States Bureau of Mines to conduct research into mine safety (although the Bureau had no authority to regulate mine safety). Backed by trade unions, many states also enacted workers' compensation laws which discouraged employers from permitting unsafe workplaces. These laws, as well as the growing power of labor unions and public anger toward poor workplace safety, led to significant reductions in worker accidents for a time.

Industrial production increased significantly in the United States during World War II, and industrial accidents soared. Winning the war took precedence over safety, and most labor unions were more concerned with maintaining wages in the face of severe inflation than with workplace health and safety. After the war ended, however, workplace accident rates remained high and began to rise. In the two years preceding OSHA's enactment, 14,000 workers died each year from workplace hazards, and another 2 million were disabled or harmed. Additionally, the "chemical revolution" introduced a vast array of new chemical compounds to the manufacturing environment. The health effects of these chemicals were poorly understood, and workers received few protections against prolonged or high levels of exposure. While a few states, such as California and New York, had enacted workplace safety as well as workplace health legislation, most states had not changed their workplace protection laws since the turn of the century.

Source:
https://en.wikipedia.org/wiki/Occupational_Safety_and_Health_Act_(United_States)

2 Answer the questions below:

1. When was the Occupational Safety and Health Act adopted?
2. Who signed the Act?
3. What is the main goal of the Act?
4. Why were so many employers against the Act?
5. What other measures were taken by the Government to increase workers' safety?
6. Why did industrial accidents increase significantly during World War II?
7. What changes did the "chemical revolution" bring?

3 Match the words and phrases to their Russian equivalents. Study the vocabulary related to OSHA.

1. compliance	a.вести учет, регистрировать
2. to comply with	b.профессиональные травмы и заболевания
3. to keep/maintain records	c.обеспечение выполнения/контроль за исполнением
4. to revise standards	d.уровень смертности
5. occupational injuries and illnesses	e.соответствовать
6. work-related deaths/ workplace fatalities	f.соответствие
7. enforcement	g.Свод федеральных законов
8. mortality rate	h.смертельные случаи на производстве
9. applicable	i.пересматривать стандарты
10. Code of Federal Regulations	j.взыскания

11. citations	k.обращение в суд
12. penalties	l.применимый
13. advance notice	m.нарушение
14. legal action	n.предписания
15. imminent danger	o.якобы
16. complaints and referrals	p.предварительное уведомление
17. compliance officer	q.нападать или угрожать физическим насилием
18. allegedly	r.оповещение об опасности
19. violation	s.штрафовать
20. to fine	t.защита органов дыхания
21. to falsify records	u.жалобы и обращения
22. to assault	v.искажать данные
23. hazard communication	w.непосредственная опасность
24. respiratory protection	x.блокировка
25. lockout/tagout	y.передающиеся с кровью патогенные микроорганизмы
26. bloodborne pathogens	z.должностное лицо, обеспечивающее выполнение требований

4 Watch the video "Introduction to OSHA" at *https://www.youtube.com/watch?v=H6wRRWi6i0c* and answer the questions:

1. What was the purpose of Occupational Health and Safety Act of 1970?
2. Who had decided occupational health and safety issues before OSHA was adopted?
3. Why was Occupational Safety and Health Administration created?
4. What were the purposes of the Act?
5. What are the three basic strategies used by OSHA?
6. How many people die each year from workplace injuries in the private sector?
7. Which groups of people are not covered by OSHA?
8. How are OSHA standards enforced?
9. What happens after OSHA's inspection?
10. What can be done to avoid receiving citations and penalties?

5 Write a summary of the facts you have learned about OSHA (100-150 words).

UNIT 3. PREVENTION OF FIRES AND EXPLOSIONS IN UNDERGROUND MINES

TEXT 3.1 Fire Prevention in Mines

1 With a partner, discuss what measures should be taken to prevent fires and explosions in mines.

2 Read the text to check your answers.

Safety for fires and explosions in underground mines is based on the general principles of preventing fire and explosion. Normally, this involves using common-sense fire safety techniques, such as preventing smoking, as well as providing fire protection measures to prevent fires from growing, such as portable extinguishers or early fire detection systems.

Fire and explosion prevention practices in mines generally fall into three categories: limiting ignition sources, limiting fuel sources and limiting fuel and ignition source contact.

Limiting ignition sources is perhaps the most basic way of preventing a fire or explosion. Ignition sources that are not essential to the mining process should be banned altogether. For example, smoking and any open fires, especially in underground coal mines, should be prohibited. All automated and mechanized equipment that may be subject to unwanted buildup of heat, such as conveyors, should have thermal cutouts on electric motors. Explosives present an obvious hazard, but they could also be an ignition source for suspended dust of hazardous gas and should be used in strict conformance with special blasting regulations.

Eliminating electrical ignition sources is essential for preventing explosions. Electrical equipment operating where methane, sulphide dust or other fire hazards may be present should be designed, constructed, tested and installed so that its operation will not cause a mine fire or explosion. Limiting fuel sources starts with good housekeeping to prevent unsafe accumulations of trash, oily rags, coal dust and other combustible materials.

When available, less hazardous substitutes should be used for certain combustible materials such as hydraulic fluids, conveyor belting, hydraulic hoses and ventilation tubing. The highly toxic products of combustion that may result from the burning of certain materials often necessitates less hazardous materials. As an example, polyurethane foam had previously been widely used in underground mines for ventilation seals, but more recently has been banned in many countries.

For underground coal mine explosions, coal dust and methane are typically the primary fuels involved. Methane may also be present in non-coal mines and is most commonly handled by dilution with ventilation air and exhaustion from the mine. For coal dust, every attempt is made to minimize the generation of dust in the mining processes, but the tiny amount needed for a coal dust explosion is almost unavoidable. A layer of dust on the floor that is only 0.012 mm thick will cause an explosion if suspended in air. Thus, rock dusting using an inert material such as pulverized limestone, dolomite or gypsum (rock dust) will help to prevent coal dust explosions.

Limiting fuel and ignition source contact depends upon preventing contact between the ignition source and the fuel source. For example, when welding and cutting operations cannot be performed in fire-safe enclosures, it is important that areas be wet down and nearby combustibles covered with fire resistant materials or relocated. Fire extinguishers should be readily available and a fire watch posted for as long as necessary to guard against smouldering fires.

Areas with a high loading of combustible materials, such as timber storage areas, explosives magazines, flammable and combustible liquid storage areas and shops, should be designed to minimize possible ignition sources. Mobile equipment should have hydraulic fluid, fuel and lubricant lines re-routed away from hot surfaces, electrical equipment and other possible ignition sources.

Abridged and adapted from: http://www.iloencyclopaedia.org/part-xi-36283/mining-and-quarrying/123-74-mining-and-quarrying/fires-and-explosions-in-mines

3 Match the words and phrases to their Russian equivalents. Study the vocabulary related to fire prevention:

1.portable extinguisher	a.источники возгорания
2. early fire detection system	b.накопление тепла
3. ignition sources	c.предохранительное устройство от перегрева
4. fuel	d.горючие материалы
5. buildup of heat	e.система раннего обнаружения пожара
6. thermal cutout	f.тлеющий огонь
7. combustible materials/combustibles	g.топливо
8. smouldering fire	h.склад взрывчатых веществ
9. explosives magazines	i.огнеопасная и взрывоопасная жидкость
10. flammable and combustible liquid	j.переносной огнетушитель

4 Make up nouns from the following verbs. Translate the words.

1 to explode – an explosion
2 to prevent -
3 to protect -
4 to detect -
5 to ignite -
6 to contact -
7 to ban -
8 to subject -
9 to eliminate -
10 to install -

TEXT 3.2 Fire Detection and Warning Systems

1 What do you know about fire detection and warning systems? Read the text to find out.

The elapsed time between the onset of a fire and its detection is critical since fires may grow rapidly in size and intensity. The most rapid and reliable indication of fire is through advanced fire detection and warning systems using sensitive heat, flame, smoke and gas analysers.

The detection of gas or smoke is the most cost-effective approach to providing fire detection coverage over a large area or throughout the entire mine. Thermal fire detection systems are commonly installed for unattended equipment, such as over conveyor belts. Faster-acting fire detection devices are considered appropriate for certain high-hazard areas, such as flammable and combustible liquids storage areas, refuelling areas and shops. Optical flame detectors that sense either ultraviolet or infrared radiation emitted by a fire are often used in these areas.

All miners should be warned once a fire has been detected. Telephones and messengers are sometimes used, but miners are often remote from telephones and they are often widely scattered. In coal mines, the most common means of fire warning are shutdown of electric power and subsequent notification by telephone and messengers. This is not an option for non-coal mines, where so little equipment is powered electrically. Stench warning is a common method of emergency communication in non-coal underground mines. Special wireless radio frequency communi-

cation systems have also been used successfully in both coal and non-coal mines.

The primary concern during an underground fire is the safety of underground personnel. Early fire detection and warning permit the initiation of an emergency plan in the mine. Such a plan assures that the necessary activities, such as evacuation and fire-fighting will occur. To assure smooth implementation of the emergency plan, miners should be provided with comprehensive training and periodic retraining in emergency procedures. Fire drills, complete with the activation of the mine warning system, should be performed frequently to reinforce the training and to identify weaknesses in the emergency plan.

Abridged and adapted from: http://www.iloencyclopaedia.org/part-xi-36283/mining-and-quarrying/123-74-mining-and-quarrying/fires-and-explosions-in-mines

2 Find words and phrases in the text which match the following definitions:

a) the moment at which something unpleasant begins;

b) able to record small changes (about equipment);

c) providing good value for the amount paid;

d) not being watched or taken care of;

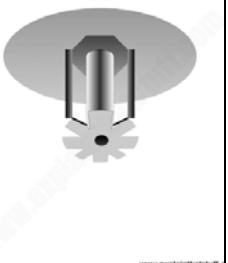
e) to be informed about a possible danger or problem;

f) a strong, unpleasant smell;

g) a situation in which people practise what they must do in order to leave a building safely if there is a fire.

h)

3 Match the following pictures of fire-suppression equipment to their names:

1. 	2. 	3. 
4. 	5. 	

a.foam generator; b.rock dust; c.sprinkler systems; d.water hoseline; e.portable hand extinguisher.

4 Watch the video about Pennsylvania's 50-year-old coal fire at https://www.youtube.com/watch?v=v6F0TuV3JMg and answer the following questions:

1. Why did the town of Centralia become abandoned?
2. How big is the coal seam burning under the town?
3. When did the fire start and under what circumstances?
4. How many coal fires are burning now in the US?

5. How do coal fires usually start?
6. How fast do coal fires move?
7. Why are coal fires almost impossible to extinguish?
8. What attempts were taken to extinguish the coal fire in Centralia?
9. For how many more years is the Centralia fire estimated to continue?

UNIT 4. MINE RESCUE

TEXT 4.1 Mine Rescue

1 With a partner, discuss the following questions:

1) **Who can become a mine rescuer?**
2) **What equipment do they use?**
3) **What personal qualities do you need to become a mine rescuer?**

2 Read the text for more information:

Mine rescue is the specialised job of rescuing miners and others who have become trapped or injured in underground mines because of mining accidents, roof falls or floods and disasters such as explosions caused by firedamp.

Mining laws in developed countries require trained, equipped mine rescue personnel to be available at all mining operations at surface and underground mining operations. Mine rescue teams must know the procedures used to rescue miners trapped by various hazards, including fire, explosions, cave-ins, toxic gas, smoke inhalation, and water entering the mine. Most mine rescue teams are composed of miners who know the mine and are familiar with the mine machinery they may encounter during the rescue, the layout of workings and geological conditions and working practices. Local and state governments may have teams on call ready to respond to mine accidents.

The first mines rescuers were the colliery managers and volunteer colleagues of the victims of the explosions, roof-falls and other accidents underground. They looked for signs of life, rescued the injured, sealed off underground fires so it would be possible to reopen the pit, and recovered bodies while working in dangerous conditions sometimes at great cost to themselves. Apart from safety lamps to detect gases, they had no special equipment. Most deaths in coal mines were caused by the poisonous gases caused by explosions. Survivors of explosions were rare and most apparatus taken underground was used to fight fires or recover bodies. Early breathing apparatus derived from under-sea diving was developed and a crude nose and mouthpiece and breathing tubes was tried in France before 1800. Gas masks of various types were tried in the early-19th century: some had chemical filters, others goat skin reservoirs or metal canisters, but none eliminated carbon dioxide rendering them of limited use. Theodore Schwann, a German professor working in Belgium, designed breathing apparatus based on the regenerative process in 1854 and it was exhibited in Paris in the 1870s but may never have been used.

Henry Fleuss developed Schwann's apparatus into a form of self-contained breathing apparatus in the 1880s and it was used after an explosion at Seaham Colliery in 1881. The apparatus was further developed by Siebe Gorman into the Proto rebreather. In 1908 the Proto apparatus was chosen in a trial of equipment from several manufacturers to select the most efficient apparatus for use underground at Howe Bridge Mines Rescue Station and became the standard in rescue stations set up after the Coal Mines Act of 1911. An early use of the breathing apparatus was in the aftermath of an explosion at the Maypole Colliery in Abram in August 1908. Six trained rescuers at Howe Bridge trained men at individual collieries in the use of the equipment and at the time of the Pretoria Pit Disaster in 1910 several hundred trained men participated in the operation.

Mine rescue teams are trained in first aid, the use of a variety of tools, and the operation of self-contained breathing apparatus (SCBA) to work in passages filled with mine gases such as firedamp, afterdamp, chokedamp, and sometimes shallow submersion.

Abridged and adapted from: https://en.wikipedia.org/wiki/Mine_rescue.

3 Match the words and phrases to their Russian equivalents.

1.trapped	a.наводнение
2.roof fall	b.бедствие
3.flood	c.рудничный газ; метановоздушная смесь
4.disaster	d.заблокированный, замурованный
5.firedamp	e.обрушение кровли
6.cave-in	f.каменноугольная шахта
7. colliery	g.герметизировать, изолировать
8.seal off	h.вывал породы в выработку; обрушение; завал
9.breathing apparatus	i.газовая смесь, образующаяся после взрыва рудничного газа
10.afterdamp	j.мертвый газ, т.е. перенасыщенный CO2
11.chokedamp	k.дыхательный аппарат

4 Do the following statements agree with the information in the text? Write *TRUE*, *FALSE* or *NOT GIVEN*.

1. You do not need a special training to become a mine rescuer.
2. Most mine rescue teams consist of miners who are familiar with the mine and machinery used there.
3. Mine rescue is often performed by volunteers.
4. The first mine rescuers helped the injured, sealed off underground fires and recovered the bodies of the dead.
5. The first mine rescuers did not have any special equipment.

6. Most deaths in coal mines were caused by flooding.
7. The first gas masks were not very effective as they did not eliminate carbon dioxide.
8. Several thousand trained men participated in Pretoria Pit Disaster rescue operation in 1910.
9. Mine rescue teams are trained in first aid, the use of various equipment and the operation of SCBA.

5 Would you like to work as a mine rescuer? Think of the advantages and drawbacks of the job and summarize your ideas. Discuss them with a partner and then write an essay of 100-150 words.

TEXT 4.2 Chilean Mine Rescue

1 With a partner, share the information about mine disasters and rescue operations.

2 Read the text about the 2010 Chilean mining accident.

The 2010 Copiapó mining accident, also known then as the "Chilean mining accident", began on Thursday, 5 August 2010 with a cave-in at the San José copper–gold mine, located in the Atacama Desert 45 kilometers north of the regional capital of Copiapó, in northern Chile. Thirty-three men, trapped 700 meters underground and 5 kilometers from the mine's entrance via spiraling underground ramps, were rescued after 69 days.

After the state-owned mining company, Codelco, took over rescue efforts from the mine's owners, exploratory boreholes were drilled, and seventeen days after the accident a note was found taped to a drill bit pulled back to the surface: "Estamos bien en el refugio, los 33" ("We are well in the shelter, the 33 of us").

Three separate drilling rig teams, nearly every Chilean government ministry, the United States' NASA space agency, and a dozen corporations from around the world cooperated completing the rescue. On 13 October 2010 the men were winched to the surface one at a time, in a specially built capsule, as an estimated 1 billion people worldwide watched. With few exceptions all were in good medical condition with no long-term physical effects anticipated. Private donations covered one-third of the US$20 million cost of the rescue, with the rest coming from the mine owners and the government.

Previous geological instability at the old mine and a long record of safety violations for the mine's owners, San Esteban Mining Company, had resulted in a series of fines and accidents, including eight deaths, during the dozen years leading up to this accident. Following three years of work, lawsuits and investigations into the collapse concluded in August 2013 with no charges filed.

Source: https://en.wikipedia.org/wiki/2010_Copiap%C3%B3_mining_accident

3 Using a dictionary, translate the following word combinations. Make up sentences, using the word combinations below.

Spiraling underground ramps, to take over rescue efforts, exploratory bore-holes, a drill bit, a drilling rig team, to complete the rescue, to be winched to the surface.

4 Answer the questions on the text:

1. How did the Copiapó mining accident start?
2. How many men were trapped underground?
3. Where were the men trapped?
4. How many days did the trapped men stay underground?
5. When and how did the rescuers obtain the information from the trapped miners?
6. Who took part in the rescue operation?
7. How were the miners brought to the surface?
8. Who paid for the rescue operation?

5 Watch the video Chilean Mine Rescue Timeline at https://www.youtube.com/watch?v=WIJ0BjlMwpA&t=95s and decide if the following statements are TRUE or FALSE:

1. After the collapse, the miners took shelter in a refuge chamber.
2. The size of the refuge chamber equals to a three-room flat.
3. During the rescue operation, the trapped miners received food, medicine and water through a drilled hole.

4. The only challenge for the rescuers was to keep the miners healthy.
5. The target area for the drill is called the workshop.
6. The miners were rescued two at a time.

TEXT 4.3 Meghalaya Mining Accident

1 Discuss with a partner: which mining accidents and rescue operations have been in the news recently?

2 Read about the latest mining accident which happened in the Indian state of Meghalaya in December 2018.

The Meghalaya mining accident happened on 13 December 2018, when 15 miners were trapped in a mine in Ksan, in the Indian state of Meghalaya. While five miners managed to escape, rescue efforts for the remaining 15 have continued till 30 January 2019. The miners are trapped inside the coal mine at a depth of around 370 feet (112 meters) in Jaintia Hills district. The tunnel the miners were in flooded with water after they cut into an adjacent mine which was full of water from the nearby Lytein river.

Service personnel from the National Disaster Response Force (NDRF) and the State Disaster Response Force began operations shortly after the miners were trapped. After a request for assistance from the district administration, teams from Coal India, Kirloskar Brothers, the Indian Air Force and the Indian Navy joined the operation to rescue the miners.

In 2014, Meghalaya's yearly coal production was around 6 million tonnes. In 2014, the National Green Tribunal (NGT), a government body that handles environmental issues in India, issued an order banning mining in Meghalaya, specifically banning mining through the 'rat-hole' technique.

But despite the ban, in subsequent orders following petitions by coal mine owners, the National Green Tribunal and the Supreme Court of India continued to allow transportation of coal dug prior to the enactment of the order on 17 April 2014. On 4 December 2018 the Supreme Court again issued an order that the transportation of coal mined prior to the ban was extended to January 31, 2019. However NGT as well as anti-mining activists have pointed

out that illegal mining of fresh coal still continues. In November 2018, two activists were attacked for gathering evidence of illegal coal mining in the area.

Rescue operations started on 13 December. Over 100 service personnel from the National Disaster Response Force (NDRF) and State Disaster Response Force were deployed to rescue the miners. 1,200,000 litres have been pumped out of the mine but this has not helped as rain during the rescue operations and water from the river continues to flood the mine. Divers have also been sent into the mine, but have only been able to reach a depth of 40 feet. Sonar systems as well as cameras have failed to detect the miners.

The local administration had made a request for pumps and other assistance from state owned Coal India on 20 December 2018. But the communication was received by Coal India only on 26 December. On 28 December the Indian Air Force joined in the operations on 28 December 2018, airifting pumps to the site. Teams from Coal India and Kirloskar Brothers are also providing expertise. On 29 December, a 15-member diving team from the Indian Navy also joined in the operation.

Media reports appeared on 27 December that the miners may be dead on the basis of a statement by a diver of the NDRF, which mentioned the presence of a "foul smell" coming from the mine. The NDRF shortly after clarified that this did not mean the miners were dead, and the foul smell could be coming due to other reasons, such as "stagnated water".

After a petition was filed in the Supreme Court of India, the solicitor general, Tushar Mehta, informed the court that the rescue efforts were additionally difficult because there were no blueprints for the 355-feet mine where the miners are trapped. Water flowing into the mine from the nearby river was also making the operation more difficult.

The Chief Minister of Meghalaya, Conrad Sangma, has called for regulation of mining in the state, admitting that illegal mining happens in the state. Meghalaya Police arrested the owner of the coal mine on 15 December 2018. Congress leader Rahul Gandhi criticised the Narendra Modi government over the issue.

After a petition was filed in the Supreme Court of India related to the rescue effort. The Supreme Court said on 3 January 2019: "We're not satisfied with rescue operations. No matter whether they are all dead, some alive, few dead or all alive, they should be taken out. We pray to God they are alive."

Source: https://en.wikipedia.org/wiki/2018_Meghalaya_mining_accident

3 Answer the questions on the text:

1. When did the Meghalaya mining accident happen?
2. How many miners were trapped underground?
3. Why was the tunnel the miners were in flooded with water?
4. Which rescue teams joined the operation to save the miners?
5. Why was mining in Meghalaya banned in 2014?
6. How many people were deployed to rescue the miners?
7. Why didn't pumping water out of the mine help to rescue the miners?
8. Were divers able to reach the miners and help them?
9. What did the Media reports issued 27 December claim?
10. What additional difficulties did the rescue operations encounter?
11. Why was the owner of the mine arrested?

4 Imagine that a mining accident has recently happened in your country. Make up a news story covering the rescue operations.

Internet Links

1. *https://en.wikipedia.org/wiki/Safety-critical_system*
2. *https://www.britannica.com/technology/safety-engineering*
3. *https://en.wikipedia.org/wiki/Industrial_safety_system*
4. *https://en.wikipedia.org/wiki/Occupational_Safety_and_Health_Act_(United_States)*
5. *http://www.iloencyclopaedia.org/part-xi-36283/mining-and-quarrying/123-74-mining-and-quarrying/fires-and-explosions-in-mines*
6. *https://en.wikipedia.org/wiki/Mine_rescue*.
7. *https://en.wikipedia.org/wiki/2010_Copiap%C3%B3_mining_accident*
8. *https://en.wikipedia.org/wiki/2018_Meghalaya_mining_accident*

Video Links

9. *https://www.youtube.com/watch?v=WavEcAsI2AY*
10. *https://www.youtube.com/watch?v=H6wRRWi6i0c*
11. *https://www.youtube.com/watch?v=v6F0TuV3JMg*
12. *https://www.youtube.com/watch?v=WIJ0BjlMwpA&t=95s*

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Методические указания к практическим занятиям для студентов бакалавриата направления 20.03.01

ENGLISH

INDUSTRIAL SAFETY

Сост.: *Э.А. Навицкайте, И.Б. Померанец*

Печатается с оригинал-макета, подготовленного кафедрой иностранных языков

Ответственный за выпуск *И.Б. Померанец*

Лицензия ИД № 06517 от 09.01.2002

Подписано к печати 25.03.2019. Формат 60×84/16.
Усл. печ. л. 1,9. Усл.кр.-отт. 1,9. Уч.-изд.л. 1,5. Тираж 75 экз. Заказ 258. С 97.

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