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ИНОСТРАННЫЙ ЯЗЫК

АВТОМАТИЗАЦИЯ ТЕХНОЛОГИЧЕСКИХ ПРОЦЕССОВ И ПРОИЗВОДСТВ В НЕФТЕГАЗОПЕРЕРАБОТКЕ

ENGLISH FOR SPECIFIC PURPOSES AUTOMATION OF TECHNOLOGICAL PROCESSES IN OIL AND GAS PROCESSING INDUSTRY

Методические указания к практическим занятиям для студентов бакалавриата направления 15.03.04

САНКТ-ПЕТЕРБУРГ
2023

УДК 811.111 (073)

ИНОСТРАННЫЙ ЯЗЫК. Автоматизация технологических процессов и производств (ENGLISH FOR SPECIFIC PURPOSES. Automation of technological processes in oil and gas processing industry). Методические указания к практическим занятиям / Санкт-Петербургский горный университет. Сост. *И.С. Рогова, М.А. Троицкая.* СПб, 2023**.** 33 с.

Методические указания предназначены к практическим занятиям студентов направления подготовки 15.03.04 «Автоматизация технологических процессов и производств (Автоматизация технологических процессов и производств в нефтегазопереработке)» и согласованы с программой по иностранному языку для студентов неязыковых вузов. Изучение предложенного материала направлено на развитие навыков иноязычной коммуникативной компетенции в ситуациях профессионально-ориентированного общения.

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ПРЕДИСЛОВИЕ

Данные методические указания по дисциплине "Иностранный язык" разработаны для практических занятий со студентами, обучающихся по направлению подготовки 15.03.04 «Автоматизация технологических процессов и производств (Автоматизация технологических процессов и производств в нефтегазопереработке)».

Предложенные аутентичные материалы и разработанный комплекс упражнений к ним направлены на совершенствование навыков устной и письменной иноязычной речи в ситуациях профессионально-ориентированного общения. Тематика текстов затрагивает проблему автоматизации промышленности, в частности различные виды автоматизации нефтегазоперерабатывающей промышленности. Большая часть заданий нацелена на совершенствование навыков технического перевода и говорения, а также навыков ознакомительного и поискового чтения.

Особое внимание уделяется накоплению активного словарного запаса, который включает наиболее употребительные для специальности термины и слова общетехнического значения.

UNIT I. INDUSTRIAL AUTOMATION

Text 1

Industrial Automation

I. Find the corresponding English word combinations in the text:

промышленная обработка, машинное оборудование, развитие технологий, вмешательство оператора, высокая точность, автоматизация производства, техника автоматического управления, управляющие устройства, система с ручным регулированием, монтажные работы, превосходные характеристики производительности, регулируемые переменные технологического процесса, заданное значение, аппаратные и программные продукты

II. Discuss the following questions with a partner:

1. Do you know the origin of the word «automation»?
2. What is the difference between mechanization and automation?
3. What is industrial automation?
4. What process variables can be sensed by means of industrial automation control?
5. What is the primary function of control systems?

III. Read the text below and check your answers.

Automation means application of machines to tasks once performed by human beings or, increasingly, to tasks that would otherwise be impossible. Automated manufacturing had several steps in its development. Mechanization was the first step necessary in the development of automation. Although the term mechanization is often used to refer to the simple replacement of human labour by machines, automation generally implies the integration of machines into a self-governing system. Automation has revolutionized those areas in which it has been introduced, and there is scarcely an aspect of modern life that has been unaffected by it.

Due to the rapid advances in technology, all industrial processing systems, factories, machinery, test facilities, etc. turned from mechanization to automation. A mechanization system needs human intervention to operate the manual operated machinery. As new and efficient control technologies evolved, computerized automation control is being driven by the need for high accuracy, quality, precision and performance of industrial processes. Automation is a step beyond the

mechanization which makes use of high control capability devices for efficient manufacturing or production processes.

Industrial automation is the use of control devices such as PC/PLCs/PACs etc. to control industrial processes and machinery by removing as much labor intervention as possible, and replacing dangerous assembly operations with automated ones. Industrial automation is closely linked to control engineering.

Automation is a broad term applied to any mechanism that moves by itself or is self dictated. The word 'automation' is derived from ancient Greek words of Auto (means '*self*') and Matos (means '*moving*'). As compared with manual systems, automation systems provide superior performance in terms of precision, power, and speed of operation. In industrial automation control, a wide number of process variables such as temperature, flow, pressure, distance, and liquid levels can be sensed simultaneously. All these variables are acquired, processed and controlled by complex microprocessor systems or PC based data processing controllers.

Control systems are an essential part of an automation system. The various types of closed-loop control techniques ensure the process variables to follow the set points. In addition to this basic function, the automation system employs different other functions such as computing set points for control systems, plant startup or shutdown, monitoring system performance, equipment scheduling, etc. The control systems combined with monitoring adapted to the operating environment in the industry allow for a flexible, efficient and reliable production system.

It is important to understand some of the differences in the senses that these two terms are generally interpreted in technical contexts:

1. Automation systems may include control systems but the reverse is not true. Control systems may be parts of automation systems.

2. The main function of control systems is to ensure that outputs follow the set points. However, automation systems may have much more functionality, such as computing set points for control systems, monitoring system performance, plant startup or shutdown, job and equipment scheduling etc.

The automated system needs special dedicated hardware and software products for implementing control and monitoring systems. In

recent years, the number of such products has been developed from various vendors which providing their specializing software and hardware products.

Industrial automation is the use of computer and machinery aided systems to operate the various industrial operations in a well-controlled manner.

Grammar point

Multicomponent word combinations in English should be translated starting with the main word which is usually the final component, e.g.– *process control* ***system*** *–* ***система*** *управления технологическим процессом.*

IV. Translate into Russian the following word combinations:

industrial processing systems, manual operated machinery, computerized automation control, PC based data processing controllers, closed-loop control techniques, industrial automation systems, process plant automation

V. Answer the questions:

1. Why does an automated system achieve superior performance compared to a manual one? Can you give an example where this happens?
2. Can all manufacturing processes be automated?
3. Can you give an example of an automated system, which contains a control system as a part of it?

VI. Search the Internet and find definitions of the terms: industry, automation, technology, mechanization and control system

VII. Search the Internet and find information on the topic "History of Automation" to prepare a presentation. Tell your group mates about the main steps in its development. You will be allotted 5-7 minutes.

VIII. Watch the video on YouTube about the history of automation and answer the questions:

1. When did the history of automation begin?
2. What accelerated the development of industrial automation at the beginning of the 19^{th} century?
3. When and where was the first continuous production line designed and put into practice?

4. What technological advances influenced the development of automation in the late forties?
5. How can manufacturing operations be classified?
6. What are the benefits of industrial automation?

Text II
Types of Automation Systems

I. Match the following 15 English word combinations with their Russian equivalents:

1.	manufacturing process	A	объём партии
2.	high volume production	B	гибкая автоматизация
3.	dedicated equipment	C	станок с ЧПУ*
4.	high production	D	производственный процесс
5.	machining transfer line	E	станок
6.	batch quantity	F	автоматизация средствами ЧПУ*
7.	programmable automation	G	специализированное оборудование
8.	Industrial robots	H	технологические инструкции
9.	flexible automation	I	высокая производительность
10.	numerical-control machine tool	J	предприятие мелкосерийного производства
11.	production machine	K	массовое производство
12.	processing instructions	L	обработка цифровой информации
13.	job shop	M	автоматическая станочная линия
14.	computer-aided design	N	автоматизированное конструирование
15.	digital information processing	O	промышленные роботы

** ЧПУ - числовое программное управление*

One of the most important application areas for automation technology is manufacturing. Automation systems can be categorized based on the flexibility and level of integration in manufacturing process operations. Various automation systems can be classified as follows.

Fixed Automation: It is used in high volume production with dedicated equipment, which has a fixed set of operation and designed to be efficient for this set. This form of automation is characterized by high initial investment and high production rates. It is therefore suitable for products that are made in large volumes. Examples of fixed automation include machining transfer lines found in the automotive industry, automatic assembly machines, distillation process, conveyors, paint shops, etc.

Programmable Automation: Programmable automation is a form of automation for producing products in batches. The products are made in batch quantities ranging from several dozen to several thousand units at a time. For each new batch, the production equipment must be reprogrammed and changed over to accommodate the new product style. Investment on programmable equipment is less, as production process is not changed frequently. A numerical-controlmachine toolis a good example of programmable automation. The program is coded in computer memory for each different product style, and the machine tool is controlled by the computer program. Industrial robots are another example.

Flexible Automation: In flexible automation, the variety of products is sufficiently limited so that the changeover of the equipment can be done very quickly and automatically. The reprogramming of the equipment in flexible automation is done off-line. Human operators give high-level commands in the form of codes entered into computer identifying product and its location in the sequence and the lower level changes are done automatically. Each production machine receives settings/instructions from computer. These automatically loads/unloads required tools and carries out their processing instructions. After processing, products are automatically transferred to next machine. It is typically used in job shops and batch processes where product varieties are high and job volumes are medium to low. Such systems typically use multipurpose CNC machines, automated guided vehicles (AGV) etc.

Integrated Automation: It denotes complete automation of a manufacturing plant, with all processes functioning under computer control and under coordination through digital information processing. It includes technologies such as computer-aided design and manufacturing, computer-aided process planning, computer numerical control machine

tools, flexible machining systems, automated storage and retrieval systems, automated material handling systems such as robots and automated cranes and conveyors, computerized scheduling and production control. In other words, it symbolizes full integration of process and management operations using information and communication technologies. Typical examples of such technologies are seen in advanced process automation systems and computer integrated manufacturing (CIM).

II. Complete the sentences:

1. The following types of automation in production can be distinguished:….
2. …..is a process using mechanized machinery to perform fixed and repetitive operations in order to produce a high volume of similar parts.
3. Programmable automation is typically used in ….
4. The disadvantage with programmable automation is the time required to …..
5. A numerical-control machine tool and industrial robots are examples of … .
6. The reprogramming of the equipment in flexible automation is performed ….
7. Integrated automation comprises technologies such as…..

III. What kind of automation would you recommend for manufacturing: automobiles, textile , cement, pharmaceuticals, toys

IV. Discuss with your partner what industries use automation technologies and give examples.

V. Translation challenge

Many industries are highly automated or use automation technology in some part of their operation. In communications and especially in the telephone industry dialing and transmission are all done automatically. Railways are also controlled by automatic signaling devices, which have sensors that detect carriages passing a particular point. In this way the movement and location of trains can be monitored.

Not all industries require the same degree of automation. Sales, agriculture, and some service industries are difficult to automate, though agriculture industry may become more mechanized, especially in the pro-

cessing and packaging of foods. The automation technology in manufacturing and assembly is widely used in car and other consumer product industries. Nevertheless, each industry has its own concept of automation that answers its particular production needs.

(873 characters)

VI. Watch the following video on YouTube and write down the subtitles to it: *https://www.youtube.com/watch?v=tw-79FiRYKA*

VII. Give a two-minute talk about industrial automation and its types.

Text III
Industrial Automation Equipment

I. Match the two halves of the table to get definitions:

1.	Automation	A	a device that is used to record that something is present or that there are changes in something:
2.	Equipment	B	a device used to operate or control a machine
3.	Sensor	C	part of a machine or system that moves something or makes something work
4.	Actuator	D	the use of machines and computers that can operate without needing human control
5.	Controller	E	the machinery, tools, etc. that you need to do a job

II. Pay attention to the following words from the text and place them into the table below:

System, element, function, control, figure, structure, sensor, process, temperature, form, signal, techniques, controller, relay, motor, instrument, microprocessor, computer, nature, parameter, operator, information, major, status, result

International words	***„False friends“***

III. Answer the questions:

1. Do you know any industrial automation equipment? Give some examples.
2. What are the functions of industrial automation equipment?

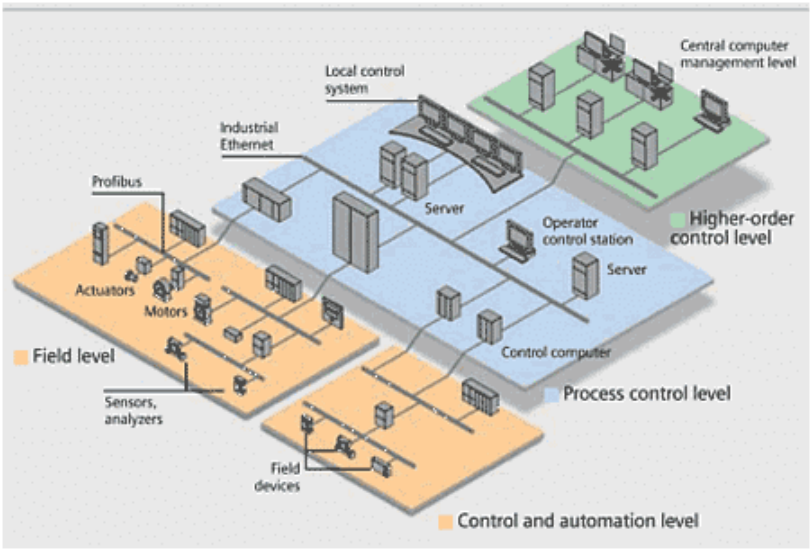

Figure 1

Industrial automation (IA) is an integrated, flexible and low-cost system platform that consists of various equipment and elements which perform a wide variety of functions like sensing, control, supervision and monitoring related to industrial processes. Figure 1 shows the structure of industrial automation which describes the various functional elements of IA.

Sensing and Actuating Elements

The sensors or sensing elements convert the physical process variables such as flow, pressure, temperature, etc. into electrical or pneumatic form. Various sensors include thermocouples, resistor temperature detectors (RTDs), strain gauges, etc. The signals from these sensors are used for processing, analyzing, and making decisions in order to produce the control output. The various control techniques are implemented to produce the required output by comparing the current sensed process variable with set values. Finally, the controllers produce

the computed outputs and are applied as electrical or pneumatic signal inputs to the actuating elements. Actuators convert the electrical or pneumatic signals to the physical process variables. Some of the actuators include control valves, relays, motors, etc.

Control System Elements

These are the microprocessor-based electronic controllers or simply industrial computers that accept the signals from various sensors as well as command signals from supervisory systems or from human operators. The controller processes the sensing values and supervisory values and depends on the control structure, it produce the control output to various actuating devices.

A modern type of control device used in automation systems is the Programmable Logic Controller (PLC). PLCs come with dedicated software so that these are capable of being programmed to perform corresponding control operations. PLCs have rugged CPU, digital I/O, analog I/O and communication modules such that they can operate at industry environment conditions to control the various process parameters.

Human Machine Interface or operator interface is a graphical interface for the operators which displays the process information such as process variable status, logging results to the database, generating alarm signals, etc. SCADA is one of the graphical user interfaces which remotely controls the industrial operations. Also, Distributed Control Systems (DCS) provide their own HMI for the graphical display of various industrial parameters.

Supervisory Control Elements

Supervisory control performs higher level control over the automatic controllers which further controls the smaller subsystems. The major elements of this level are process station PCs, and Human Machine Interfaces. These process station PCs are responsible for functions like set point computations, performance monitoring, diagnostics, startup, shutdown, and other emergency operations.

Human Machine Interface or operator interface is a graphical interface for the operators which displays the process information such as process variable status, logging results to the database, generating alarm

signals, etc. SCADA is one of the graphical user interfaces which remotely controls the industrial operations.

IV. Complete the sentences with the words from the box:

sensors	PLC	set values	SCADA	process variables	actuators

1. _____is one of the graphical user interfaces which remotely controls the industrial operations. **2.** The sensors convert the physical _____ into electrical or pneumatic form. **3.** Various _____ include thermocouples, resistor temperature detectors (RTDs), strain gauges, etc. **4**. All control techniques are focused on comparing the current sensed process variables with _____ . **5.** There are different types of _____ that comprise control valves, relays, motors, etc. **6.** A modern type of control device that come with dedicated software is _____.

V. Make up 5 yes-no questions and 5 questions with a question word to the text.

Grammar point

An abbreviation is a shortened form of a word or group of words. Abbreviations are often used in tables, footnotes, lists, catalogs, orders and bills, drawings, drafts, figures, captions to illustrations, etc.

There are a lot of miscellaneous abbreviations in English. An acronym is formed from the initial letters of the words in a name or a phrase and is usually written in capital letters. Some acronyms are read as words. *For example: NATO ['neitou]; UNESCO [yu:'neskou].* ***The majority of acronyms are read letter by letter.*** *For example: BBC ['bi:'bi:'si:]; DNA ['di:'en'ei]; IBM ['ai'bi:'em].*

Some acronyms have become ordinary words written in small letters. *For example, the word "radar" was formed from "radio detecting and ranging", the word "scuba" was formed from "self-contained underwater breathing apparatus".*

Plural ending "s" may be added directly to some acronyms, usually to those acronyms that do not have internal periods: *four URLs; two PCs; three TVs; many CDs.*

VI. Find acronyms in texts 1-3 and explain their meanings.

Text IV
Advantages of Industrial Automation

When you skim a reading passage, you read it quickly to learn about its content and organization. You don't read every word. Instead, your eyes move very quickly over the selection, trying to find general information.

I. Skim the text and match the advantages of industrial automation with their description in the corresponding part of the text:

№	Advantages
	Reduced Labor or Production Cost
	Improved Product Quality
	Improved Safety
	Reduced Routine Manual Tasks
	Increased Labor Productivity
	Assist Remote Monitoring

Manufacturers face many challenges in today's globally competitive business landscape. Some of these challenges include harsh manufacturing environments, increasingly complex supply chains, meeting the latest energy efficient standards, and competing with companies with very small marginal costs.

Many of these reasons drive manufacturers towards industrial automation. The advantages to industrial automation include:

1. _____Automation increases the production rate by producing greater output for a given labor input. It is not possible for human workers to work for long hours without losing accuracy. On the other hand, without compromising on accuracy, automated control systems able to work for long hours. Hence increased productivity and efficiency per hour of labor input.

2. _____ One of the chief benefits of the automation is that the reduction of fraction defect rate. With the manual operation of manufacturing process, there may be a compromise on quality specifications of the product. But the automation system performs operations with greater conformity and uniformity to the quality specifications. By using the automation sys-

tems, industrial processes are controlled and monitored at all stages in order to produce a qualitative end product.

3. _____ The automated systems help the industries to save a great deal in the long term by substituting automated machinery in place of human labor so that unit production cost is reduced. Automation equipment running smoothly or uniformly 24 × 7 not only increases the productivity, but also consequently results in an excellent return on investment by saving salaries, workforce costs, pensions and costs with employees. The automated system also reduces the labor shortage by substituting automated operations in place of labor.

4. _____ In many industrial applications, process variables like temperature, liquid level, pressure, etc. are to be periodically monitored as a routine task to maintain their set levels. Thus an automation system creates the automatic working condition by employing closed-loop control systems.

5._____ By implementing an automated system, work is made safer by transferring the worker from an active participation location in the process to the supervising role. The automated machines are able to work in hazardous environments and other extreme environments. Also, these systems make use of industrial robots in place of human workers, especially in life-threatening conditions (chemical and high-temperature conditions). Thus an industrial automation system prevents the accidents and injuries to the workers.

6. _____ Most of the industrial operations have to be controlled remotely for convenient and long distance monitor and control of process variables. For such cases, automated systems provide a communication link between the process area and supervising (monitor and control) area, thereby allowing operators to control and monitor the industrial processes from a remote location. The best example of this remote control is the automated electric power grid control.

IV.Go to the following sites, study the information and complete the table with the advantages and disadvantages of automation:

1) https://www.britannica.com/technology/automation/Advantages-and-disadvantages-of-automation

2) https://qz.com/1261214/how-exactly-tesla-shot-itself-in-the-foot-by-trying-to-hyper-automate-its-factory/

3) ***https://www.nsenergybusiness.com/FEATURES/OIL-AND-GAS-AUTOMATION/***

Pros	Cons

V. Discussion.

Make your comments on the following words of Elon Musk "The optimal level of automation remains a complex balancing act of design, productivity, quality, and human and machine skills***"***

What do you think the optimal level of automation should be in the production process?

UNIT 2. AUTOMATION IN OIL AND GAS INDUSTRY

Text 1

I. Scan through the text and think of a suitable heading for it.

II. Write down the key words in the text.

III. Answer the questions:

1. What up-to-date technologies and innovations are particularly demanded in the oil and gas industry?
2. What does automation in oil and gas industry include?
3. How can automated equipment improve operational safety in oil and gas industry?

IV. Pay special attention to the translation sentences with the words in bold.

The oil and gas industry is one of the largest in the world. It is also one of the most innovative, and there are many ways in which it is embracing new technologies and innovations to increase productivity. One of the most important ways that the industry is changing is through the adoption of automation and digitization. Here are some of the ways in which the oil and gas industry is developing, which could have important implications over the coming years.

There is considerable demand for automation in industry, and this is true of the oil and gas industry as well. This includes equipment control, simulator-training, machine guidance systems and more. One of the

big developments over coming years **is expected to be** the growth of cloud-based services.

Another area that will play a large role is the increase of automated equipment that is controlled remotely. Remote monitoring and control of equipment have obvious safety benefits in the industry. When processes such as drilling and blasting **can be controlled** remotely, this will allow personnel to stay away from the dangerous environments that they may otherwise have to work in. Instead, they can control the machinery from a control room, and this will provide them with full control without putting themselves at risk.

The whole focus of the Internet of Things (IoT) is that machinery will contain sensors that gather data, and they will then be able to share this data. This will lead to greater accuracy and smaller losses. Sensors **will be used** to gather data, and this data will be shared across the operation so the machinery will run with greater efficiency, helping to reduce problems. Laboratory information management systems (LIMS) play a key role in this because they are used to combine data and improve productivity and quality control.

Self-driving vehicles **are** also **expected to improve** automation as well. Many modern vehicles already include autonomous elements, and the technology is getting better. Self-driving cars **have been tested** in countries around the world, and there could be 10 million on the road within a few years. It is only a matter of time before the technology makes a big impact on the manufacturing industry and the oil and gas industry **is likely to** see significant benefits.

V. Translate from Russian into English:

1.До автоматизации управления технологическим процессом требовалось много инженеров и людей для управления химическим процессом на нефтеперерабатывающем заводе. **2.** Они измеряли параметры процесса вручную с помощью различных приборов и контролировали химический процесс вручную, открывая и закрывая клапаны и различные исполнительные устройства. **3**.Эта ручная система была неэффективной, и присутствовала вероятность ошибки. **4**.Но при автоматизации управления технологическим процессом на НПЗ каждый процесс контролируется различными датчиками и управляется специализированными контроллерами, такими как АСУТП или

ПЛК. **5.** Можно сделать вывод, что автоматизация процессов нефтепереработки позволила повысить эффективность производства и безопасность труда.

VI. Video „How automation is being used in exciting ways in oil and gas industry".

https://www.youtube.com/watch?v=UcIi30c955U

In this episode of the Futurum Tech Webcast, Interview Series, Shelly Kramer hosts a roundtable discussion on how automation is being used in exciting ways in the Oil & Gas industry. Her guests, experts in the professional area, discussed some of the challenges the industry faces and shared their experiences on some of the areas where they have implemented automation technologies. They also considered the future prospects of automation.

Watch the video and make your notes on:

1. The challenges the industry faces
2. The ways automation is used in oil and gas industry
3. The future of automation in oil and gas industry

Text 2
Process Control Automation in Oil & Gas (Downstream)

I. Find the corresponding English word combinations in the text :

неочищенная нефть, сжиженный нефтяной газ, смазочные масла, регулирующий клапан, нефтегазопереработка, химический завод, единица давления, расход жидкости (скорость потока), вязкость жидкости, точность измерения, скорость флюида, удельная плотность, массовый расход жидкости, замер уровня, опасная зона, косвенное измерение, различные проводники, зависеть от температуры, металлические окислы, автоматизация управления технологическим процессом, система управления производственным процессом, нефтеперерабатывающий завод, ректификационная колонна

II. Complete the sentences:

1. Liquid petroleum gas, diesel, kerosene oil, petrol, heavy gas oil, gasoline, naptha, lubricating oil are …
2. Various sensors, transmitters, controllers, control valves are …
3. Pressure, level, flow, temperature and density are…
4. Bar and psi are…
5. Pressure transmitter, load cell, fibre optic pressure sensor are….

6. Orifice plate, venturi-tube, turbine flow meters, electromagnetic flowmeters, ultrasonic flowmeters are…
7. Thermocouple and thermistor are …

III. Complete the chart and translate the words:

Verb	Noun
to achieve	
to refine	
	production
	regulator
to require	
	pressure
	development
to apply	
to measure	
	operation
to recommend	
	conductor
	calculation

IV. Read the text and answer the questions:

1. What process variables are necessary to regulate in oil and gas processing industry?
2. What chemical processes take place in oil and gas downstream sector?
3. What equipment do automated control systems include in oil and gas processing industry?
4. Why is pressure the most critical process variable in the oil and gas industry?
5. What sensors can be used to measure pressure in oil and gas downstream?
6. What factors affect the measurement of oil and gas flow?
7. What methods are used in oil and gas level measurement?
8. What is the most widely used temperature sensor in oil and gas downstream? Describe the principle of its operation.

In the oil and gas industry, it is crucial to regulate process variables to achieve the task of process automation. In oil and gas sector, especially downstream, different chemical processes take place to refine crude oil and to produce liquid petroleum gas (LPG), diesel, kerosene oil, pet-

rol, heavy gas oil, gasoline, naptha, lubricating oil, residual and different carbon components from crude oil.

There are specific chemical processes for converting crude oil into these products, which require proper technology-based control systems. These control systems consist of different sensors, transmitters, controllers, control valves and different final control elements to regulate process variables within the desired range to carry out the operation successfully. In oil and gas downstream, the critical process variables which are very important to control include pressure, level, flow, temperature, density.

The **pressure** is the most critical process variable in the oil and gas industry. If we know the pressure of a specific process, we can find other process variables easily through it.

Pressure can be described as "Force acting per unit area", it is represented as P = F / A. In this expression P = Pressure, F = Force, A = Area.

The pressure is measured in psi (Pounds per square inch) in British units, and it is measured as Pa (Pascal) in Metric system units. The System International (SI) unit of Pressure is Pascal or N/m2, but in oil and gas industry, we use bar or psi.

There are three types of pressure:

1. The difference between a fluid's pressure and absolute zero of pressure is known as Absolute Pressure; it can also be referred to as vacuum pressure. Zero reference point of absolute pressure scale shows the full vacuum.
2. Gauge Pressure can be defined as the difference between atmospheric pressure, gauge pressure and fluid's pressure changes with the change of atmospheric pressure.
3. Differential pressure is used to express the difference between two absolute pressure values.

In oil and gas downstream, we use these sensors for the measurement of pressure:

1. Bourdon tube sensing element
2. Bellow Sensors
3. Diaphragm Sensors
4. Pressure transmitter

5. Load Cell
6. Fibre Optic Pressure Sensor
7. Capacitive Pressure Sensor

Flow is also one of essential process variable of oil and gas downstream. To achieve the goal of automation in an oil refinery, it is necessary to control the flow of pipelines and chemical process plant. There are many instruments for measuring oil and gas flow. The accuracy of flow measurement is different for each instrument and different for each application.

There are factors which affect the flow of fluids through the pipe and also the measurement of oil and gas flow. These include: velocity of fluid, pipe size, friction due to pipe, viscosity of fluid, the specific gravity of the fluid, velocity profiles.

Fluid, with its volume passing through a specific point in a certain amount of time, is called **flow rate** and can be measured in gallons/minute (GPM) or litre per minute. But in the oil and gas industry, we mostly use gallons per minute.

The complete flow is the volume of fluid passing over an extended frame of time and can be calculated in different units such as litres, gallons, cubic feet, etc.

Measuring the volume flow rate and measuring the mass flow rate is used to measure the rate at which the fluid flows through a closed pipe. Mass of substance, which passes through a surface per unit time known as **mass flow rate.** The volume of fluid, which passes through a particular surface per unit time, is known as **volume flow rate.**

In oil and gas downstream, we use these sensors for the measurement of flow:

1. Differential pressure flow meters
2. Orifice Plate
3. Venturi-tube
4. Turbine flow meters
5. Electromagnetic flowmeters
6. Ultrasonic flowmeters
7. Bluff Body flowmeters
8. Positive Displacement flowmeters
9. Flow Transmitter

10. Microprocessor-based volumetric flowmeters
11. Coriolis flowmeters

The level is a critical process variable of oil and gas downstream. The position of an interface between two different or the same mediums such as liquid and gas or between two liquid mediums is known as **level measurement.** We measure level in meter or percentage; sometimes we also measure level in feet. The level is the name of two interfaces. We can also calculate level by calculating density in a few applications.

The high point above a zero point is measured by the **direct method** of level measurement through different methods. The actual level is mainly focused here; it is convenient in various facets such as its high reliability and reasonable price for any industry. These methods are especially suitable for hazardous areas due to its advance safety measurements. Therefore, its usage is highly recommended in oil and gas level measurement. These methods include:

1. Dipstick method
2. Weighted Gauge Tape
3. Sight Glass
4. Floats

Indirect level measurement refers to the measurement of level through some property or parameter of liquid, like pressure, density, conductivity. These methods include

1. Hydrostatic Pressure Method
2. Hydrostatic Differential Pressure Method
3. Dry leg method
4. Wet Leg Method
5. Torque tube Method
6. Conductivity Level Method
7. Level Transmitters

Temperature is also an important process variable of oil and gas downstream. It is crucial to control the temperature of the chemical process to achieve the goal of automation – in oil and gas downstream, all chemical processes are heat dependent. There are different specialized instruments which are used to measure temperature in industry. It includes thermocouple and thermistor. We measure temperature in Kelvin or °C or °F.

Thermocouples are the most widely used temperature sensors in chemical industry & oil and gas downstream; it is a junction or combination of two different conductors or metals that are welded together. A thermocouple produces a small voltage in milli-volts when the temperature of process changes. It transfers heat change into electric volts. Thermocouples are cheap and flexible, but its limitation is its measurement accuracy. Its range is around -250 °C to 2500 °C.

A thermistor is widely used for temperature measurement in oil and gas downstream; it is resistance variable as it has resister, which depends upon temperature. It can be measured from – 90 °C to 130 °C. Thermistor is composed of a mixture of metal oxides such as following: copper, cobalt, iron, manganese, uranium.

Process control automation has vast applications in downstream, from the first pump of the refinery, where we give input as crude oil till the last stage where we get final product depends upon process control system. All stages of oil refinery like distillation column have process control automation systems to regulate process variables like pressure, level, flow, temperature.

V. The video presents information on 6 key terms in oil and gas automation: 1)PLC, 2)RTU, 3) I/P Positioner, 4)Transducer , 5) Solar Panels, 6)AC/DC. Watch the video and get ready to explain their functions.

https://www.youtube.com/watch?v=aYltp_iM6VA

Text 3

SCADA Systems: Improving Efficiency in Oil and Gas Industry

I. Read and translate the following words and word combinations:

to manage production processes, to perform manually, to monitor equipment, supervisory control and data acquisition, hardware and software, input/output devices, in remote locations, human-machine interface, to gather data from sensors, data loggers, to interpret the data, to cover large-scale processes, well designed systems, to range from a handful to hundreds of thousands, to improve operational efficiency, to mitigate downtime.

II. Make up 2 or 3 sentences of your own using the word combinations from the previous exercise.

III. Find in the text a word that has the same or a similar meaning to the following:

to inspect facilities, to collect information, everyday work processes, precise data, on-line, manufacturing enterprises, to include, beyond that, to provide assistance

IV. Read and translate the following text.

Industrial organizations in every industry manage countless production processes and transactions every day. Management teams oversee operations, inspect equipment, gather enormous amounts of data, strive to minimize downtime and ensure that everything runs smoothly and seamlessly. Performing these duties manually is a nearly impossible task.

One of the most powerful tools for monitoring equipment and processing data in real time is **supervisory control and data acquisition (SCADA)** — a control system that makes high-level supervision of critical operations in industries like oil and gas, transportation and manufacturing a much more manageable undertaking.

SCADA is a powerful system of hardware and software designed to help industrial organizations in their day-to-day operations. It gives operators more control over equipment and processes, including controllers, input/output devices, communication equipment and systems as a whole. It typically involves several subsystems that manage assets dispersed in remote locations, often with limited connectivity.

SCADA is designed to:

- Control and monitor processes within various parameters
- Gather, process and record real-time data
- Connect employees and equipment through human-machine interface (HMI) software

A SCADA system isn't always the main control system of an operation. Instead, it focuses more on monitoring and parametrization. SCADA systems gather data from sensors, counters, meters, I/O modules, data loggers and other devices. The system processes data and sends the information to the main control system of an organization. Operators then analyze and interpret the data to make better business decisions faster and with more accurate and complete information.

A SCADA system is also different from other industrial control systems in that it covers large-scale processes spanning multiple sites that can be separated by large distances.

Additionally, SCADA can accommodate everything from simple processes to complex configurations. Well designed SCADA systems are scalable, so the number of variables they can process ranges from a handful to hundreds of thousands.

Oil and gas, along with food and beverage, water and wastewater treatment, agriculture, pharmaceutical, telecommunications, power, transportation, recycling, manufacturing and energy all use SCADA systems in some form.

Ultimately, SCADA systems help organizations improve operational efficiency. Actions can be completed more quickly and with greater precision when SCADA systems are in operation. The system connects equipment and people, alerting relevant personnel when a potential problem is detected. This mitigates downtime and keeps operations running as efficiently as possible.

V. Do the following statements agree with the information given in the text? Choose your answer: TRUE, FALSE, NOT GIVEN

1. All industrial enterprises manage numerous production processes daily.
2. Equipment inspection is always performed manually in oil and gas industry.
3. SCADA is a system including hardware and software which was designed to facilitate industrial organizations in their daily activities.
4. The operators cannot use SCADA in remote or hazardous areas.
5. A SCADA system was designed especially for oil and gas industry.
6. A SCADA system recieves, analyzes and interprets the data from sensors, counters, meters and other devices to make business decisions.
7. SCADA can be applied both to simple processes and complex configurations.

Text 4
SCADA Systems in the Oil and Gas Industry

I. Make a plan and give a short summary of the text. Your summary should be about one-third of the original text. Make use of the following clichés:

The text explains/describes/tells us about/deals with the problem of…
It can be divided into… logical parts.
The first part is about …
In the second part the author writes about …
The third part is devoted to…
Attention is concentrated on ….
Finally the author comes to the conclusion that…
In conclusion, I want to say that…
To my mind the text is informative/interesting/ difficult to understand
I've learned a lot of interesting (important, new) facts (information, things) from the text.
So in my opinion it is (not) worth reading.

The oil and gas industry has a very large footprint. Across the three broad sectors - upstream, midstream, and downstream. Accurate, real-time data is key to succeeding in the oil and gas industry. Assets from wellheads to pipelines to holding tanks are often more than two hours away from the nearest maintenance worker. This causes delayed responses, which can allow problems to worsen. Oil and gas SCADA systems help reduce this delay, saving money by improving maintenance results. SCADA systems gather and process data from geographically diverse areas and collect it for presentation at a central station or browser. Engineers need operational data from the field to calibrate equipment, schedule maintenance activities and coordinate with third-party logistics to keep the flow of product moving. Management, meanwhile, uses information analyzed by SCADA systems to calculate production values, generate trends for decision-making and project company profits. SCADA control systems provide a stable and cost-effective solution to the needs of the oil and gas sector.

SCADA systems in the upstream sector. The principal role of a SCADA system in the upstream sector is remote data transmission. It gathers crucial information from oil wells and sends them to headquarters, where the organization can analyze it.

The information that a SCADA system transmits includes insight into the conditions of products and equipment during operations. For instance, the system notifies operators when the oilfield is first breached

and monitors the crude oil as it comes out of the ground at pressures of more than 23,000 PSI.

The SCADA system helps prevent blow-outs, verifies the safety of pumping and watches out for the integrity of the well-bore. The system also aids reservoir engineers in determining quantities of oil and gas, especially during the first few minutes of production.

With reliable data transmission, the team can use accurate, real-time data as the basis of its decisions and respond to critical situations faster. SCADA systems also reduce personnel visits – it controls more operations with less manpower and minimizes hazards for employees.

SCADA systems in the midstream industry. In the midstream industry oil pipelines span thousands of miles, traversing harsh terrain and even underwater conditions. Organizations use SCADA systems to monitor the status of the oil flow throughout its journey from the wellsite to downstream plants. With thousands of miles of pipelines, there are numerous pumping, compression, block valve and delivery stations, each equipped with devices such as flow, pressure and temperature gauges and transmitters. These keep the pressure of the pipeline constant, whatever the weather condition or terrain and keep the extracted products in optimum condition.

Additionally, a SCADA system detects and resolves leaks that may emerge during operations.

SCADA systems in the downstream sector. The downstream oil and gas industry is responsible for receiving and refining crude oil at processing plants, turning them to various products, such as liquefied petroleum gas (LPG), liquefied natural gas (LNG), gasoline and diesel oil, among others.

Refineries often involve 24/7 operations, and organizations need a software system that manages and monitors the plant's performance and output. SCADA systems prepare downstream processes for the inflow of the product. In case of unforeseen circumstances, SCADA systems can detect errors, alert personnel and mitigate damage – in other words, SCADA systems help ensure safe operations.

The term *SCADA system* refers to both hardware and software devices. Hardware gathers and feeds data into computers that run SCADA software. The computers process the data and present it prompt-

ly. The SCADA system records all data and events onto a hard disk. We'll look at the specific parts of a SCADA system's hardware, as well as the various applications of its software tools.

SCADA systems are composed of several subsystems, the most important of which are the remote terminal units (RTUs) and the programmable logic controllers (PLCs).

RTUsact as data concentrators. Connected to sensors on-site equipment, they convert sensor signals to digital data. They employ telemetry hardware, which sends these digital data to the supervisory system. On the other end, RTUs receive digital commands from the supervisory system and transmit them to the end devices.

Programmable Logic Controllers (PLCs) monitor programmed parameters. They could monitor liquid levels, gas meters, voltage, current, pressure, temperature, humidity, viscosity, volumetric flow rate, mass and more. Organizations program PLCs through structured language and elementary logic operations. They usually have more sophisticated control capabilities than RTUs. Sometimes, they are a substitute for RTUs as field devices because they are more economical and versatile. PLCs are best associated with older generations SCADA systems but are quickly being replaced by Industrial PCs.

Industrial PCs (IPCs) are used for process control, data acquisition, and analysis. Unlike PLCs, IPC functions can be updated remotely via cloud-based control systems. This degree of connectivity allows for immediate modification and upgrades to the existing control system. While PLCs were the standard for years, they are not "smart" tech like IPCs that offer advanced features and the ability to update their programming through the cloud.

Telemetry systems connect PLCs and RTUs to the main control center and data warehouses. They are either wired or wireless. Wired telemetry media in SCADA systems include leased telephone lines and WAN circuits. Their wireless counterparts, meanwhile, include satellite, radio and microwaves.

Human-machine interface (HMI) presents processed data to the operators. It usually requests data from data acquisition servers.

Servers are responsible for the acquisition and management of data for a set of parameters. There are different servers for certain tasks.

Some handle alarms, while others file data. Data acquisition servers, for instance, bridge software services with RTUs, PLCs and IPCs via telemetry.

A supervisory system is a computer or group of computers that handle data during operations and sends commands. An extensive communication infrastructure connects this system to RTUs, PLCs and IPCs.

The SCADA system allows operators to change the parameters of various controllers and enable alarm conditions. Here's an example. The SCADA system detects that a certain batch of products has an unusual number of oversights. It notifies the system quickly, and the operator halts production. Another facet of the SCADA system assesses the situation, finds where the error occurred and projects the data. The team then uses this information to apply fixes and resume normal operations.

Such a versatile system is invaluable to the oil and gas industry. From detecting a critical leak in one of the pipelines to remotely opening a release valve if too much pressure builds up on a pipeline, the system can either alert the involved teams or initiate an action based on its programmed commands.

This way, the SCADA system mitigates the damage and minimizes the hazardous conditions that the leak or high-pressure levels could have created. Consequently, it prevents production loss and ensures robust revenues.

As SCADA systems made their first appearance, operators gained more efficient management in the upstream, midstream and downstream sectors. This tool improves operations in various oil and gas facilities – the time, source of controls, way the equipment works and is controlled and more. The system's effectiveness is such that it was able to grow and evolve over little more than half a century.

The **1950s** saw the development of the first computers for industrial use. Huge sectors, such as the major utilities and oil and gas companies, were at the helm of this new technology.

In the **1960s**, industries began using *telemetry*, which is the automatic measurement and wireless transmission of data from remote sources. Sensors from geographically dispersed machinery gather information (such as temperature and pressure) and convert them to specific electrical voltages. A multiplexer then combines these voltages with tim-

ing data into a single data stream. The multiplexer transmits this stream to a remote receiver, which will deconstruct it into its original form (i.e., temperature, pressure and timing data) and display them onto operators.

1970s experts coined the term *SCADA* and started developing its hardware and software — specifically, mainframe computers. These allowed companies to monitor and control automated processes better. These computers, however, were not connected to one another – each SCADA functioned as a single unit. As such, these were known as *monolithic SCADA systems.*

In the **1980s**, local area networking (LAN) technology and PC-based, human-machine interface (HMI) software helped improve SCADA systems further. Soon, people were able to connect their SCADA systems with one another. These were called *distributed SCADA systems.* Many of these systems were owned exclusively by organizations, so they upgraded and reconfigured them freely. The catch of the uneven development, however, is that these systems couldn't communicate with SCADA systems from other organizations.

The **1990s and 2000s** saw organizations launch SCADA systems that were geared toward universal communication. The innovation adopted an open-system architecture, allowing one system to communicate with other SCADA systems from other organizations. On top of that, people could connect more devices to their SCADA network. These were called the *networked SCADA system.*

Later, organizations began using personal computing and IT databases. Modern SCADA systems incorporate IT into traditional SCADA technology, improving the efficiency, security, productivity and reliability of SCADA systems.

II. Watch the video on YouTube about SCADA application in oil and gas industry. Then watch it again but mute and speak yourself on the automation in the oil and gas industy looking at the images on the screen.

https://www.youtube.com/watch?v=iuOqECBtiIw

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ENGLISH FOR SPECIFIC PURPOSES AUTOMATION OF TECHNOLOGICAL PROCESSES IN OIL AND GAS PROCESSING INDUSTRY

Методические указания к практическим занятиям для студентов бакалавриата направления 15.03.04

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Печатается с оригинал-макета, подготовленного кафедрой иностранных языков

Ответственный за выпуск *И.С. Рогова*

Лицензия ИД № 06517 от 09.01.2002

Подписано к печати 08.02.2023. Формат 60×84/16.
Усл. печ. л. 1,9. Усл.кр.-отт. 1,9. Уч.-изд.л. 1,6. Тираж 50 экз. Заказ 92.

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