THE FIRST HIGHER TECHNICAL UNIVERSITY IN RUSSIA

MINISTRY OF EDUCATION AND SCIENCE OF THE RUSSIAN FEDERATION
Federal State Budgetary Educational Institution of Higher Education
"Saint-Petersburg Mining University"

IOM3 PD APPROVED

IOM3 The Institute of Materials, Minerals and Mining

Approved by
Vice-Rector for Educational Activity
Prof. V.A. SHPENST

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Professional training program

«Energy saving and energy efficiency at the gas production and gas distribution facilities»

SPECIALITIES:
140400 – *«Power and electrical engineering»;*
140100 – *«Heat engineering»;*
131000 –*«Petroleum engineering».*

Attendance: full-time

Course developers: **Associated professor, PhD in Eng. sc. U. Jukovskiy**

Professor, D.Sc. in Engineering, B.Abramovich

St.PETERSBURG
2017

Energy saving and energy efficiency at the gas production and gas distribution facilities

1.General provision

Purpose: The purpose of this course is to train the energy services experts in theoretical knowledge and practical skills in the field of design, selection, installation and use of modern, including explosion proof electrical equipments, as well as the formation of skills and competences of listeners in the field of energy efficiency and energy saving.

1.1. Competencies to be formed:

Target groups	Description of competence
Staff members: office of the chief power engineer; electrical engineering and mechanics; section foremen and services; experts of dispatching department; maintenance and test engineers of electric equipment, electrical and mounting services engineers and experts.	1. To provide equipment modernization for the efficiency upgrading in view of modern science and technology development.
	2. To ensure compliance of the existing equipment to the requirements of the guidance documents in the security field.
	3. To provide required viability of automation facilities and systems, monitoring, diagnostics and control when changing external factors that reduce the efficiency of their operations and planning for continuous improvement of the automation systems quality.
	4. To develop and to validate schemas of electric power systems and their components.
	5. To carry out an economic appraisal of energy and resource conservation in the enterprise
	6. To participate in the development plans of organizational and technical measures aimed at the rational use and saving of energy resources.
	7. To ensure rational expenditure of energy resources.
	8. To use of domestic and foreign experience in energy and resource conservation in the industry
	9. To be able to solve conflicts and provide innovation, to know the features of human resource management in terms of innovation

1.2. Requirement for academic performance:

To master real-life experience:

- in the selection of modern energotechnological equipment;
- in the assessment of energy efficiency use of heat, electricity and waste energy;
- in the use of energy saving solutions;
- in the development of action plan directed on saving energy resources.

1.3. Get skills:

- in the field of compliance with the requirements of current electrical operated guidance documents;
- in the field of rational use of energy resources;
- in the calculations of standards of heat loss, power calculations and fuel rate;
- in the account of power resources;
- in the field of personnel management.

1.4. Get knowledge of:

- the methods of energy conservation;
- the kinds of waste energy and their use;
- the economic aspects of energy conservation and utilization of waste energy resources;
- the basics of energy audit;

- the operation and maintenance;
- current trends in the development of energy in the world and Russia;
- modern science-based technology allows reduce power consumption.

1.5.Course description:

Type of training	Total hours
The total volume of the program (teaching load)	**72**
Classroom training	50
laboratory and practical classes	20
Test	2
Individual work, including hours to prepare for the final control	12

1.6.Course structure:

№	Module title	Total hours	Including		Competences to be formed (according to the list of paragraph 1.1)
			Lectures	laboratory and practical classes	
1	Module 1. General information and legal requirements	4	4	-	1,3,5,6
2	Module 2. Methods of energy saving and energy efficiency assessment	4	4	-	1,3,4,5
3	Module 3. Normalization and energy consumption records	8	4	4	2,3,4,6
4	Module 4. Territorial spaced consumers power supply of alternative and renewable energy sources	16	12	4	3,4,5
5	Module 5. Energy saving automation facilities	6	4	2	4,7,8, 9
6	Module 6. Energy management	8	6	2	4,7,8,9
7	Module 7. Energy-saving technologies at the enterprises of gas production and transportation	18	12	6	4,5,7,8
8	Module 8. Power inspections	6	4	2	4,5,6
9	Module 9. Modern power technology equipment	4	2	2	1,2,4,6,8

1.7.The form of final examination - testing.

1.8. Documents confirming professional development of students - standard certificate of professional development.

1.9.Course program:

Section title	The content of the training material, laboratory work	Number of

	and practical classes, individual work of listeners.	hours
Module 1: General information and legal requirements		
Topic 1. General information. Normative documents.	Basic terms and concepts of energy saving. Direction of development standards and methods of the Russian Federation energy saving. Current normative legislation and regulations of the Government of the Russian Federation for energy efficiency. The basic principles of energy conservation policy in Russia and other countries. Principles of manufacturing.	2
Topic 2. Energy strategy	Energy strategy of the Russian Federation. State program of the Russian Federation "Energy efficiency and energy development." Global energy problems. Energy challenges of the XXI century. Analysis of production volumes, consumption of primary natural energy resources. Forecast trends in the development of the resource base. Future direction of energy technologies.	2
Total		*4*
Module 2: Methods of energy saving and energy efficiency assessment		
Topic 1. Methods and criteria for performance evaluating energy efficiency	Thermodynamic performance evaluation of energy efficiency and particular their use in power and heat technologies. Technical (natural) merits for the assessment of energy efficiency. Economic indicators to assess energy efficiency	2
Topic 2. Power balance of consumers fuel and energy resources	Types of power balances. Balance of consumption and use of energy at industrial enterprises. Analysis of the use of natural gas, electricity, heat, LPG, liquid and solid fuels. Balance of consumption and use of energy at the production of hydrocarbon resources. The power balance of the building.	2
Total		*4*
Module 3: Normalization and energy consumption records		
Topic 1. The authorization procedure of energy and fuel reserves standards of Minenergo of Russia.	The authorization procedure of standards of electricity, heat, water and fuel supplies consumption. Design procedure of: - tariffs for heat and electricity, norms of electric power losses during transmission through the electric grid; - norms of heat losses during transmission over heat networks; - norms of specific fuel consumption for electricity and heat from thermal power plants and boilers. Tariff regulation.	4
Topic 2. Energy resources accounting.	Metering of heat energy consumption. Classification. Installation and use. Metered electricity consumption. Classification. Installation and use. Intelligent energy	4

	accounting.	
Total		***8***
Module 4. Territorial spaced consumers power supply of alternative and renewable energy sources		
Topic 1. General issues of alternative and renewable energy sources	The role and place of renewable electricity. Alternative energy technologies. Development of renewable energy in Russia and in the world. Directions of state support in the field of renewable energy. State regulatory framework.	2
Topic 2. Secondary Energy Resources and their utilization.	Types of SER. Use of SER. The possibility of using SER. Exchanger equipment for recycling of high- and medium-SER. Recycling of waste heat gas turbines. The use of low-grade heat by applying heat pump systems. Energy savings during SER recycling. Economic aspects of the use of SER. Techno-economic justification of energy saving measures	4
Topic 3. Solar energy.	The concept of the solar energy. Gross, technical and economic capacity of solar energy. The value of insolation in Russia. Types of converting solar energy into other forms of energy. Characteristics and types of photocells. Selection of the battery and the inverter. Calculation of economic benefit from the use of solar power. Calculating the cost of solar power electricity.	2
Topic 4. Wind power	Wind power in Russia. Devices of various types of wind power plants. Energy characteristics of wind power plants. The average annual production of electrical energy wind power installation. Scheme of autonomous power supply to consumers from a wind power plant. Scheme realization of autonomous electrical systems with wind turbines. Reliability autonomous electrical systems for wind turbines with a guaranteed power supply to consumers. Technical and economic assessment of use of wind power plants in hybrid power generation systems	2
Topic 4. Current energy sector trend	Solid organic fuel gasification. Biogas power plants. Mini and micro hydroelectric power station. Energy of ocean streams. Wave energy. Stirling engine. Utilization expansion generating units. Actual status and prospects of development of nuclear power. Controlled nuclear fusion. Block and mini boiler.	2
Topic 5. Smart Grid technologies	Purpose of structure. The concept of Smart Grid. DLMS and data transfer channels. Implementing Smart Grid equipment. Methods and tools to ensure electromagnetic and energy compatibility in autonomous power supply systems. ACC energy storage by applying fly, super capacitors, heat storage, compressed air systems. UPS topology to ensure energy efficiency of responsible electrical energy consumers. Captive power plant with economical fuel consumption.	4
Total		***16***
Module 5. Energy saving automation facilities		
Topic 1. General automation	General strategy of automation systems OAO «Gazprom»	2

issues	development. Domestic and foreign experience of implementation, development of automation systems. Cost-effectiveness analysis of implementation of automation systems and production industry. The main theoretical issues of integration of automation systems in industrial plants.	
Topic 2. Realization of automation systems	Classification, features design and implementation of DCS, MES and ERP-systems. Creation of intelligent accounting systems of resource consumption, energy saving management, measuring the quality of electric energy, vision, geographic information systems, and others. The organization of data communication in automation systems. Foreign experience in developing, designing, implementing, operating systems automation objects. System software and systems optimization. Information system for monitoring energy efficiency indicators.	4
Total		***6***
Module 6. Energy management		
Topic 1. Energy management	Energy management. Implementation of the system of energy resources management based on ISO 50001. Optimization of energy consumption. Requirements for the energy management system. Design stages of the development of an energy management system. Operation of the established standards rules.	2
Topic 2. Design of energy saving programs	The effect of the introduction of the energy management system. Organization of motivation of energy conservation and energy efficiency. General provisions of investment project development. Development stage of energy-efficient design. Energy service agreements. Economic efficiency of investment projects. Business planning. Financial and economic features of the development of a feasibility study of energy efficiency measures.	4
Topic 3. Psychological aspects of innovation in the field of energy saving	Psychological aspects of innovation in the industry. Innovative conflicts. Special aspects of personnel management under the conditions of innovation.	2
Total		***8***
Module 7. Energy-saving technologies at the enterprises of gas production and transportation		

Topic 1. Modern energy-saving technology in the power sector.	Power factor correction. Power quality. Power quality parameters of electromagnetic processes in systems with semiconductor converters. Problems of the higher-order harmonic in power systems and methods for their suppression. Improving the quality of electrical energy in power systems with active and hybrid filters. Zonal concept of development the rational electromagnetic environment in the workplace. Economic damage from violations of electromagnetic compatibility. Voltage regulation and power factor in distribution networks of gas production and transportation enterprises. Voltage limitation. Intelligent energy-saving lighting systems. Treatment and reclaiming processing of waste oil. Rational use of energy in buildings. The adoption of organizational and technical solutions to ensure rational use of energy.	8
Topic 2. Energy saving by means of electric drive	The main trends in the development of modern electric drive. Basic systems of settable frequency electric drive. Examples of energy saving electric tools in a variety of devices. Equipments dispatching in thermal power plants by means of the electric drive. Saving energy by limiting the duration of idling conditions. Energy saving potential by means of the electric world market for energy-saving devices.	4
Topic 3. Energy saving in gas production and distribution	Energy efficiency upgrading of basic and auxiliary production. Exposures the negative reduction on the environment. Reducing the unit cost of natural gas for its own needs. Mode optimization on the gas fields. Energy savings in drilling. Energy efficiency of gas transport. Reducing heat loss in the pipeline transportation of hydrocarbons.	6
Total		***18***
Module 8. Power inspections		
Topic 1. Organization of energy audits	Types of energy audits. Legal framework of energy audits. Methods for energy audits. Normative and methodological materials used in completing the energy performance certificate.	2
Topic 2. Survey energy audits	Stages of the audit. Energy audit tool. Technical tools used in the energy survey. Analysis of the existing instrument base used in the energy survey. Tests and measurements in electrical installations	4
Total		***6***
Module 9. Modern power technology equipment		
Topic 1. Electrical grid equipments	SSIW, AERO-wire, cables with fiber-optic lines, compact insulating structure, lightning protection. Reclosers and boosters. Grounding neutral mode in networks of 6-35 kV	2
Topic 2. Equipment of	Liquid dielectric transformers, dry type transformers.	2

switchgear and substations.	Reliability of switchgear, comparative characteristics of circuit breakers. Current distributor with cast insulation. New types of instrument transformers	
Total		*4*
Final test		**2**
Total		**72**