DESIGN AND RESEARCH
REPUBLICAN UNITARY ENTERPRISE
BELNIPIENERGOPROM



INTO THE FUTURE WITH NEW TECHNOLOGIES



Dear Partners!

I welcome you on behalf of the Design and Research Republican Unitary Enterprise «Belnipienergoprom» – the leading organization in the Republic of Belarus specializing in the design of energy facilities and heating networks. We successfully collaborate with all organizations within the Belarusian energy system, as well as other industries in the Republic of Belarus. Our designs have been used to construct energy facilities in many regions of the Russian Federation. We maintain business contacts and collaborate with manufacturers and suppliers of energy equipment from both the CIS and non-CIS countries. The company has experience in designing and constructing facilities in such countries as Macedonia (Yugoslavia), Nigeria, Iran, China, Angola, Lithuania, the Union of Myanmar, and Estonia. The company's highly qualified specialists, state-of-the-art computer equipment, databases of regulatory and technical documentation, up-to-date design solutions, and modern software enable us to comprehensively address the full range of design issues and ensure the timely and high-quality development of projects of any complexity.

Our use of 3D scanning, BIM modeling, 3D design, and artificial intelligence technologies guarantees the high performance of facilities constructed using our design documentation.

In carrying out its activities, the company guarantees a high technical level in the adopted design solutions and strives to promptly respond to changing conditions and new demands.

The foundation of our success is accountability for results and mutual respect. We value your trust and are open to long-term cooperation!

Viktor Yushkevich,
Director of RUE «Belnipienergoprom»

DESIGN AND RESEARCH
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RUE «Belnipienergoprom» is a leading design organization for energy facilities and heating networks in the Republic of Belarus. Its founder is the Ministry of Energy of the Republic of Belarus, and its parent organization is the State Production Association «Belenergo».

The company's organizational structure includes 29 divisions, including 15 production departments, a testing laboratory for measuring emissions from fuel-burning equipment and ventilation emissions, accredited for compliance with STB ISO/IEC 17025. Over 550 qualified specialists provide design work in 40 specialties.

DIRECTOR OF ENTERPRISE

- Accounting Department
- HR Department
- Legal Department
- Leading Specialist in State Secrets Protection
- Representative Office in the Russian Federation

Deputy Director for Economics and Finance

- Financial and Economic Department
- Control and Records Management Department
- Marketing and Quality Management Department

Deputy Director for Ideological Work and General Issues

- Ideological and Social Work Department
- Documentation Department
- Leading Engineer for Information Security

FIRST DEPUTY DIRECTOR – CHIEF ENGINEER

Deputy Chief Engineer for Electrical Engineering

- Electrical Engineering Department
- Process Automation Department
- Control Systems Department
- Automatic Control and Electrical Systems Department

Deputy Chief Engineer for Thermal and Mechanical Engineering

- Thermal and Mechanical Department
- Heat Supply Layout Department
- Heat Network Department
- Ecology Department

Deputy Chief Engineer for Construction

- Architectural and Construction Department
- Construction Projects Department
- General Plan and Transportation Department
- Hydraulic Engineering and Water Treatment Department

Deputy Chief Engineer for Production and Digitalization

- Chief Project Engineer Department
- Digitalization Department
- Estimate Documentation Department
- Contract Support and Accounting Sector

- Information and Technical Documentation Department
- Production and Technical Department
- Lead Safety and Fire Engineer
- Quality Control Sector

MAIN ACTIVITIES

- Comprehensive design and development of certain sections of design documentation for the construction, reconstruction (modernization), and major repairs of thermal power plants, boiler houses, electrical and heating networks, and other construction projects
- Development of pre-project (pre-investment) documentation
- Development of business plans and financial models for investment projects
- Development of heat supply layouts and their electronic models
- Conducting general and detailed structural surveys of buildings and structures to assess their technical condition, checking their load-bearing capacity, and operational suitability
- Construction supervision
- Development of projects for the use of local fuels and renewable energy resources
- Assessment of the environmental impact of energy sources and industrial enterprises and preparation of environmental passports
- Inventory and development of maximum permissible emissions for pollutants
- Development, installation, and commissioning of automated process control systems for energy sources
- Development and implementation of busbar voltage regulation systems 110–330 kV and auxiliary power plant needs
- Modernization and adjustment of excitation systems for electric generators



QUALITY POLICY

The main goal of RUE «Belnipienergoprom» is to ensure the highest quality of performance of:

- general designer functions;
- pre-design work;
- integrated design and development of particular sections of design and other technical documentation;
- research and development work;
- commissioning;
- inspection work for buildings and structures;
- construction supervision;
- ordering customer functions during construction, reconstruction, restoration, and improvement of construction projects.

QUALITY OBJECTIVES ARE ACHIEVED THROUGH:

- studying the needs and interests of clients, an individual approach to each client based on long-term and mutually beneficial relationships;
- improving design technology and other work based on digitalization and automation of production using BIM technologies and artificial intelligence systems;
- using progressive space-planning, design, and engineering solutions, equipment, and materials in design documentation;
- continuous development of competencies, deepening professional knowledge, and improving the skills of specialists at all levels;
- developing a corporate information and educational environment, managing knowledge obtained from internal and external sources, and implementing best-practice initiatives;
- continuous quality control at all levels and stages of the design process, including supervision of construction projects.

QUALITY MANAGEMENT SYSTEMS

RUE «Belnipienergoprom» holds the following certificates:

- international certificate of conformity of the management system to the requirements of ISO 9001:2015 (TUV, Thuringen, Germany). Certification was conducted in accordance with the TIC procedure and includes regular surveillance audits;
- certificate of conformity of the quality management system to the requirements of STB ISO 9001:2015 of the national conformity assessment system of the Republic of Belarus;
- certificate of conformity of the health and safety management system for professional activities, pre-design work, integrated design and development of individual sections of design documentation, other technical documentation, research and development work, energy audits, commissioning, building and structure inspections, and construction supervision with the requirements of STB ISO 45001-2020.

RUE «Belnipienergoprom» holds four licenses and four certificates of conformity in the Republic of Belarus. It is a member of the self-regulatory organization «Association of Urban Planning and Design» (Russia). The company's archives contain documentation on 1,800 completed projects, as well as information on the design of the projects in the USSR and abroad.







HISTORICAL EXCURSION

1952

The Minsk branch of the State Union Design Institute Promenergoproekt was established on the basis of the design office of the Belenergoproektstroy trust. The branch was tasked with developing thermal power plant designs for the Belarussian SSR, the Lithuanian SSR, and several regions of the RSFSR (Smolensk, Kalinin, Bryansk, Kuibyshev, Saratov, and others). In its initial period, the branch designed low-power, medium-pressure TPPs with turbines ranging from 1.5 to 12 MW. The number of employees was 38.

1974

The Minsk branch of Promenergoproekt was transformed into the Belarusian branch of the All-Union State Research and Design Institute «VNIPIenergoprom». The number of employees exceeded 1,000, of which 160 worked in research departments.

1981

The USSR Council of Ministers Prize was awarded to the developers of the ZIGM CHPP serial design, developed with the participation of the Belarusian branch of VNIPIenergoprom and widely used in the USSR for the construction of CHPPs.

1983

The USSR Council of Ministers Prize was awarded to the team that created unique cogeneration systems in several cities in Russia and Belarus, including Minsk.





2014 – present

RUE «Belnipienergoprom» is part of the State Production Association «Belenergo»

1991

The Belarusian branch of «VNIPIenergoprom» was transformed into the State Belarusian Research and Design Institute «BelVNIPIenergoprom».

1992

The institute was renamed the Belarusian Research and Design Energy Institute «BelNIPIenergoprom».

1996

The Institute was renamed the State Enterprise «Belnipienergoprom».

2000

The State Enterprise «Belnipienergoprom» received its current name – the Design and Research Republican Unitary Enterprise «Belnipienergoprom».





HISTORICAL EXCURSION

1962

1975

During the design and construction of combined heat and power plants (CHPPs) in the Soviet era, the most advanced primary equipment of its time was used, and progressive technical and technological solutions were incorporated. According to the designs of RUE «Belnipienergoprom» the following projects, first in the USSR, were installed at Belarusian CHPPs:

- T-100-130 cogeneration turbine (Minsk CHPP-3, 1962);
- PT-135-130 cogeneration turbine (Mozyr CHPP, 1975);
- BKZ-420 NGM boiler with a steam capacity of 420 t/h (Bobruisk CHPP-2, 1976).

1976

1985

Some of the most significant achievements of the 1980s and early 1990s include the construction and commissioning of the following facilities, designed by RUE «Belnipienergoprom»:

- three 250 MW combined heat and power units at Minsk CHPP-4 (1985, 1987, 1998);
- two 110 MW power units at Astrakhan CHPP-2 (1986, 1987);
- three 180 MW combined heat and power units at Gomel CHPP-2 (1986, 1988, 1995);
- the first 65 MW combined cycle unit in the Republic of Belarus at Orsha CHPP (1998);
- a 330 MW condensing and cogeneration unit at Minsk CHPP-5 (1999).

1986

1987

1988

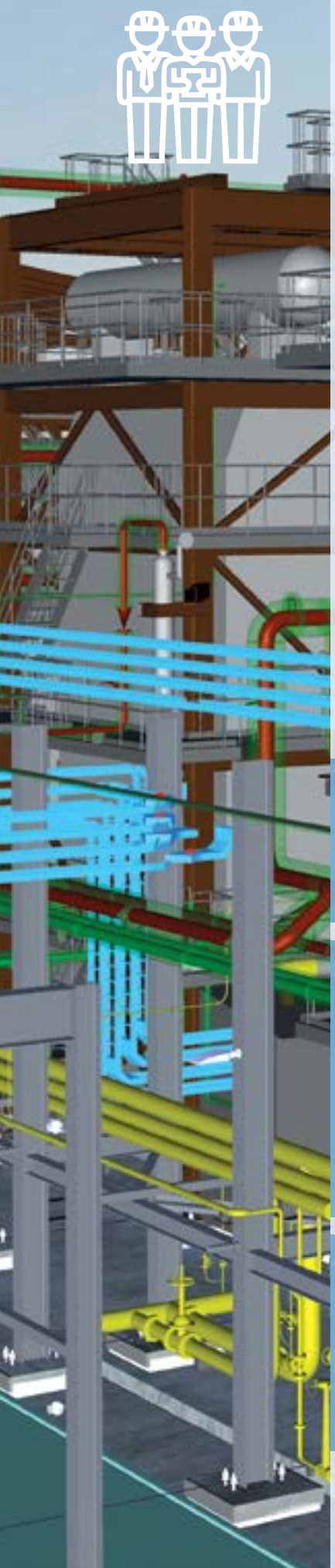
The company's research and development projects have enabled:

- the introduction of nuclear-powered heat supply systems, including the justification and commencement of construction of the Minsk Nuclear Power Plant;
- the development of technical and design solutions for integrating CHPPs into the regulation of nighttime dips in the electrical load schedule of power systems (first implemented at large steam turbine units of Minsk CHPP-4 and Gomel CHPP-2);
- the development, in collaboration with the E.O. Paton Electric Welding Institute (Ukraine), of highly efficient self-compensating pipelines and their use in main heating networks (Minsk, Vitebsk, St. Petersburg, and Kyiv);
- the renewal and development of small-scale district heating energy sources;
- substantiation and establishment of new standards for harmful gaseous emissions related to the energy sector, etc.

1995

1998

1999



HUMAN RESOURCES AND TECHNICAL EQUIPMENT

The priorities of RUE «Belnipienergoprom» include continuous competence development, the adoption of new technologies and equipment as well as staff development.

The company employs over 550 highly qualified specialists. Approximately 85 % of its employees have a higher education. Including two candidates of engineering sciences (PhD), 23 Master's degrees, and 21 Bachelor's degrees. Fifty-two employees have completed retraining programs based on their higher education, and four have received postgraduate education.

Particular attention is paid to young specialists: off-site technical training is regularly organized at Belarusian energy system facilities, and initiatives to encourage youth participation in annual scientific and practical conferences are supported.

Tne company's building is located in the historical center of Minsk. Comfortable working conditions are provided for employees. The company's premises include a catering facility, a gym, a fitness center, a conference hall, and meeting rooms. The company has modern computer hardware and software integrated into a high-performance local area network, as well as engineering copying and duplicating systems.

Primary importance is placed on constantly expanding and maintaining the current collection of regulatory and technical documentation based on reference and information systems, as well as on the digitalization of business processes.

Design Automation:

- nanoCAD SPDS, AutoCAD, SPDS GraphiCS
- CREDO III
- energyCS, ModelStudioCS, CAD CVK, VideoCAD, ElectriCS Light
- Ecolog

Calculation software:

- Zulu
- Hydrosystem, Hydrosystem-Thermo, START Prof, START-Grunt, dPIPE, ISO-SSU Flowmeter, Izolyatsiya
- Scad Office, FOK PC-2014
- EMTP-RV
- Sankom Auditor, ARS-PS, TermoSOFT
- TAKSATSIYA-AUTO
- Grand-Smeta, RSTC Smeta

BIM modeling environments:

- AVEVA
- Tekla Structures
- Autodesk Revit
- CREDO
- Civil
- NavisWorks

COMPLETED PROJECTS

Under the projects by RUE «Belnipienergoprom», a large number of operating combined heat and power plants (CHPPs) have been modernized in Belarus and other countries. The following projects have been built and commissioned:

88
CHPPs
of varying capacities

267
power boiler units

161
hot water boilers

254
turbo-generator units

~ 1100 км
of dual-pipe main heating networks











IN THE REPUBLIC OF BELARUS

the following projects have been built, reconstructed, and modernized:

29
CHPPs
of varying capacities

9660 MW
total capacity

Gas turbine units (GTU) at peak-reserve power sources:

- **CHPP-5** (300 MW)
- **Beryoza SDPP** (250 MW)
- **Lukoml SDPP** (150 MW)
- **Novopolotsk CHPP** (100 MW)

Hydroelectric power plants (HPPs):

- **Vitebsk HPP** (40 MW)
- **Polotsk HPP** (22 MW)
- **Grodno HPP** (17 MW)
- **Osipovichi HPP** (2.18 MW)
- **Chigirin Mini-HPP** (1.5 MW)
- **Volpa Mini-HPP** (0.5 MW)
- **Zelva HPP** (0.15 MW)

Power facilities using local fuels:

- **Osipovichi Mini-CHPP** 1.2 MW (239 Gcal/h, including 5.4 Gcal/h on wood chips and peat)
- **Bobruisk CHPP-1** 12 MW (60 Gcal/h, including 16.2 Gcal/h on lignin and peat)
- **Mini-CHPP in Vileika** 2.4 MW (114 Gcal/h, including 13.5 Gcal/h on wood chips)
- **Pinsk CHPP** 22 MW (91 Gcal/h, including 5.4 Gcal/h on wood chips and peat)
- **Zhodino CHPP** 54 MW (344 Gcal/h, including 32.4 Gcal/h on wood chips)
- **Mini-CHPP in Baran** 3.25 MW (39.7 Gcal/h)
- **Luninets CHPP** 4 MW (62.4 Gcal/h)
- **Boiler house in Pravdinsky** 0.5 MW (21.6 Gcal/h)
- **Boiler house of Lyaskovichi woodworking complex** 4.1 Gcal/h

COMPLETED PROJECTS

IN THE RUSSIAN FEDERATION

the following projects were built, reconstructed, and modernized

43
CHPPs of various capacities and boiler house

6800 MW
Total capacity





- **Aleksin CHPP** 136.1 MW, 157 Gcal/h
- **Astrakhan SDPP** 121 MW, 244 Gcal/h
- **Astrakhan CHPP-2** 380 MW, 910 Gcal/h
- **Balakovo CHPP-4** 370 MW, 1,052 Gcal/h
- **Bezymyanskaya CHPP in Samara** 48.7 MW, 1,103.7 Gcal/h
- **Volzhskaya CHPP-1** 497 MW, 1,947 Gcal/h
- **Volzhskaya CHPP-2** 240 MW, 945 Gcal/h
- **Guryev CHPP** 414 MW, 695 Gcal/h
- **Gusev CHPP** 15.5 MW, 118 Gcal/h
- **Dankov CHPP** 9 MW, 148 Gcal/h
- **Dorogobuzh CHPP** 90 MW, 242.2 Gcal/h
- **Elets CHPP AOOT** 5 MW 148 Gcal/h
- **Kazan CHPP-1** 426 MW, 542 Gcal/h
- **Kaliningrad SDPP-1** 247 Gcal/h
- **Kaliningrad SDPP-2** 20.8 MW, 111 Gcal/h
- **Kaliningrad CHPP-2** 900 MW, 680 Gcal/h
- **Klintsy CHPP** 23.25 MW, 113.8 Gcal/h
- **Kursk CHPP-1** 125 MW, 904 Gcal/h
- **Michurinskaya CHPP** 36 MW, 80 Gcal/h
- **Pervomayskaya CHPP** 360 MW, 928 Gcal/h
- **Penza CHPP-1** 310 MW, 805 Gcal/h
- **Penza CHPP-2** 16 MW, 335.5 Gcal/h
- **Samara SDPP** 24 MW, 2691.4 Gcal/h
- **Samara SDPP** 440 MW, 2054 Gcal/h
- **Saratov SDPP** 23 MW, 292 Gcal/h
- **Saratov CHPP-1** 100 Gcal/h
- **Saratov CHPP-2** 109 MW, 363.5 Gcal/h
- **Saratov CHPP-5** 445 MW, 1,239 Gcal/h
- **Smolensk CHPP-2** 275 MW, 774 Gcal/h
- **Syzran CHPP** 372.4 MW, 765 Gcal/h
- **Tambov CHPP** 235 MW, 947 Gcal/h
- **Tver CHPP-3** 170 MW, 694 Gcal/h
- **Tver CHPP-4** 88 MW, 620 Gcal/h
- **Engels CHPP-3** 80 MW, 364 Gcal/h
- **CCGT-115 unit boiler house of the Kursk CHPP in the North-West Region** 116.9 MW, 710 Gcal/h
- **CCGT-CHPP «Centralnaya» in Astrakhan** 235 MW, 131.8 Gcal/h
- **CCGT Plant at Stavrolen LLC in Budyonnovsk** 153 MW, 115.2 Gcal/h
- **Huadian-Teninskaya CHPP in Yaroslavl** (450 MW CCP) 463.9 MW, 295.7 Gcal/h
- **Voronezh CHPP-1** (225 MW CCP unit) 378.3 MW (1,389.3 Gcal/h)
- **Chelyabinsk SDPP** 757.5 MW, 725 Gcal/h (chemical water treatment)
- **Ryazan SDPP** 3,024 MW, 212.5 Gcal/h (unit No. 2) 300 MW
- **Novomoskovskaya SDPP** 219.7 MW, 302.4 Gcal/h (boiler house 116.4 MW)
- **Irkutsk Polymer Plant** (boiler house No. 1) 97.2 Gcal/h



IN OTHER COUNTRIES

16

CHPPs of various capacities

- **Vilnius CHPP-1** (expansion)
- **Vilnius CHPP-2**
- **Vilnius CHPP-3**
- **Jonava CHPP**
- **CHPP of Ionava nitrogen fertilizer plant**
- **Klaipeda CHPP**
- **Petrashunayskaya State District Power Plant**
- **Mini-CHPP in Panevezys** and **12 km of main heating networks** (Lithuania)
- **Skopje Oil Refinery CHPP** (Yugoslavia)
- **Kohtla-Järve CHPP** (Estonia)
- **Ajaokutas Steam Blower Station at Steel Plant CHPP** (Nigeria)
- **Thermal Power unit of Metallurgical Works** (Union of Myanmar)
- **power plants** in China, Iran, Bangladesh and Libya





DESIGNING OF THE BELARUSIAN NUCLEAR POWER PLANT

As part of the Belarusian NPP project, RUE «Belnipienergoprom» carried out site selection, investment justification, and environmental impact assessment work, and developed design and estimate documentation for the construction of a complex of buildings and structures (production facilities), including:

- an administrative and amenity complex;
- a complex of production buildings and premises, including amenity spaces for employees;
- a concrete mixing plant with a capacity of 180 m³/h;
- a point for unloading aggregates from railway cars and amenity spaces;
- a warehouse complex for the types of stored products;
- general contractor warehouse facilities (heated and unheated warehouses, storage areas for materials and structures);
- general contractor workshops, as well as a complex of buildings and structures for the types of work performed;
- common-site facilities (transformer substation, boiler house, entry control point).

The designed fire station of the Belarusian NPP includes a depot, a storage unit, and a protective structure. The depot includes space for 12 fire and rescue vehicles, process equipment, fire-fighting equipment, and emergency rescue equipment, communication and warning systems, information technology (IT) equipment, furniture, and inventory.

The Belarusian NPP's backup boiler house includes four steam boilers with a capacity of 40 t/h, each operating on natural gas (steam parameters: 9 bar, 175 °C, with diesel as backup fuel). The boiler house is equipped with three system water heaters with heating capacities of 50, 25, and 10 MW. The boiler house is fully automated.



DESIGNING OF A RADIOACTIVE WASTE DISPOSAL FACILITY

RUE «Belnipienergoprom» has been appointed the general designer for the development of pre-design (pre-investment) and design documentation for the construction of radioactive waste (RW) disposal facilities. The construction of the national RW disposal facility (RWDF) is aimed at the safe, final isolation of RW from the environment through defense-in-depth protection.

In 2023 and 2024, Belnipienergoprom, with the assistance of RUE «BelRAO», together with leading specialized scientific organizations, conducted research and survey work to select preferred RWDF sites that meet national nuclear and radiation safety requirements. Since 2025, pre-project (pre-investment) documentation has been developed and environmental impact assessments have been conducted at the selected sites.

To maximize the use of modern radioactive waste disposal technologies, JSC «TVEL», a specialized organization of the Rosatom State Corporation with significant experience in constructing such facilities, has been engaged to develop the technological concept and assess long-term safety. The State Scientific Institution «JIPNR-Sosny» is assessing the completeness and adequacy of the completed surveys.

The next stage will be the development of design documentation for the selected waste disposal facility construction site, including all necessary expert reviews and approvals. This work will be carried out by RUE «Belnipienergoprom», with the participation of leading design and scientific organizations in Belarus.









INTEGRATION OF THE BELARUSIAN NUCLEAR POWER PLANT INTO THE POWER SYSTEM

As part of the integration of the Belarusian NPP into the power grid the following facilities under the projects of RUE «Belnipienergoprom» were installed:

electric hot water boilers:

- Gomel CHPP-2 – 2×40 MW;
- Minsk CHPP-2 – 2×20 MW;
- Minsk CHPP-3 – 2×50 MW;
- Minsk CHPP-4 – 4×40 MW;
- Grodno CHPP-2 – 2×30 MW;
- Mogilev CHPP-2 – 2×20 MW;
- Bobruisk CHPP-2 – 2×15 MW;

electric hot water boilers with heat accumulation systems (heat storage tanks):

- Lukoml SDPP – 2 x 40 MW, 4.500 m³ heat storage tank;
- Beryoza SDPP – 1 x 30 MW, 3.500 m³ heat storage tank;
- Mini-CHPP «Severnaya» in Grodno – 1 x 30 MW, 3.000 m³ heat storage tank;
- Soligorsk Mini-CHPP – 2 x 20 MW, 1.500 m³ heat storage tank;
- Molodechno Mini-CHPP – 1 x 40 MW, 5.000 m³ heat storage tank;
- Lida CHPP – 1 x 10 MW, 1.600 m³ heat storage tank;
- Boiler house in Kostyukovichi – 1 x 10 MW, 1000 m³ capacity;

peaking backup units with SGT-800 gas turbines:

- CHPP-5 – 6×50 MW;
- Beryoza SDPP – 5×50 MW;
- Lukoml SDPP – 3×50 MW;
- Novopolotsk CHPP – 2×50 MW.







DESIGNING OF POWER SUPPLY SYSTEMS

RUE «Belnipienergoprom» provides a full range of design services for the construction or reconstruction of energy facilities: combined heat and power plants, boiler houses, and heating networks. Integrated design involves developing all sections (sets) of documentation at all stages of the design process, including supporting calculations, cost estimates, and environmental impact assessments. This documentation is also coordinated with authorized bodies and organizations, and undergoes state review.

For its customers, the company acts not only as a design organization but also as a competence center, developing investment justifications, business plans for investment projects, digital models, and providing construction supervision. The company's employees have competencies in 40 engineering and technical areas necessary for the integrated design of any energy facility.





BIM DESIGNING

When designing energy source facilities and heating networks, RUE «Belnipienergoprom» uses innovative technologies to create comprehensive BIM models of facilities.

A model is a specific type of database that contains all graphical, geometric, and alphanumeric parameters and codes related to a project or building. All innovations and changes are integrated into this model.

The BIM process ensures project transparency, improves communication with clients, contractors, and other project participants, and organizes teamwork at a higher level with change tracking, reducing the number of change requests from construction teams, lowering costs, and saving time.

To ensure effective internal collaboration and coordination, a common data environment has been created a repository accessible by specialists from production departments. This allows for real-time collaboration with models from different disciplines, quick and efficient changes to design solutions, and tracking of results across all interconnected models. Graphical changes automatically modify the BIM model database by linking, adding, and configuring information in the form of properties and attributes to the model's component parts.

Navisworks software enables collaborative management of model data from different disciplines, working in a single model based on these data, coordinating actions and approvals, automatically detecting design errors and clashes, virtually examining the facility, and simulating the construction process to identify potential clashes.

The BIM model allows monitoring the condition of the facility during its operational phase, including monitoring the condition of structures, engineering systems, and equipment in the event of technical upgrades, remodeling, major repairs, and reconstruction.

3D SCANNING

One of the work areas at RUE «Belnipienergoprom» is surface laser 3D scanning, which is inextricably linked to BIM technologies.

The process is carried out using a Faro Focus S150 Plus laser scanner. The result is individual scans in the form of so-called point clouds collections of multiple measurements on a real object. Each point has three coordinates (X, Y, Z) in the device's local coordinate system, allowing the external surface of the object to be represented in three dimensions. The point density in an individual scan depends on the distance to the object and the scanning time and can reach tens of thousands of points per square meter of surface. Combining («stitching») individual scans into a single point cloud enable the construction of a highly accurate 3D model of the object.

Modern terrestrial laser scanners perform measurements at high speed (up to 2 million measurements per second) and density, resulting in photorealistic 3D models. For reconstruction and modernization projects in the energy sector involving large numbers of pipelines and cables (turbine and boiler rooms, pump stations, etc.), 3D scanning ensures the reliability of the data used in subsequent design. Point clouds are compatible with Revit, Tekla, and Aveva software packages, which are used at Belnipienergoprom for BIM design.

Since acquiring the 3D scanner, specialists from the Belnipienergoprom architectural and construction department have been scanning virtually all surveyed energy system facilities in Belarus and Russia. The production department specialists have mastered the use of point clouds. The laser scanner used is included in the state register of BelGIM as a measuring instrument used in legal metrology and is approved for measurements and the use of the results.

APPLICATION OF COMBINED-CYCLE AND GAS PISTON TECHNOLOGIES IN POWER FACILITY DESIGN



RUE «Belnipienergoprom» has successfully mastered the design of power sources using combined-cycle and gas piston technologies.

Waste-heat recovery schemes for combined-cycle power plants (CCPPs) are used in new construction. When renovating existing power plants, gas turbine superstructures are sometimes added to existing steam turbine units and steam boilers. In this case, combustion products from the gas turbine are discharged into the boiler being refurbished. This scheme has been implemented at three K-160 units of the Beryoza SDPP, as well as at the Kazan, and Bezymyanskaya CHPPs.

A promising approach to the renovation of existing medium- and high-pressure CHPPs is the installation of gas turbines with waste-heat recovery steam generators operating on a common steam header. This solution allows for a significant increase in electricity generation using thermal energy with relatively low capital costs.



IN THE REPUBLIC OF BELARUS

the following projects have been implemented:

- **Orsha CHPP**: 66 MW combined-cycle gas turbine
- **Mozyr Oil Refinery**: 16 MW gas turbine
- **Mini-CHPP «Grodno-Severnaya»**: 6 MW gas turbine with CHP unit
- **Lida CHPP**: 25 MW gas turbine (superstructure)
- **Minsk CHPP-3**: 230 MW combined-cycle gas turbine
- **Minsk CHPP-2**: two 25 MW combined-cycle units
- **CHPP-5**: 399 MW combined-cycle unit
- **Grodno CHPP-2**: 121.6 MW gas turbine with a recovery boiler
- **Beryoza SDPP**: reconstruction of combined-cycle units No. 4, No. 3 and No. 5, as well as the construction of the unit No. 7 of the 427 MW
- **Lukoml SDPP**: a 426 MW combined-cycle unit
- **Gomel CHPP-1**: creation of a 35 MW combined-cycle gas turbine unit consisting of a 26 MW gas turbine unit, a steam turbine 5.3 MW and a recovery boiler with a nominal steam capacity of 40 t/h
- Zhlobin Mini-**CHPP**: 3×9 MW gas piston engines

ПРОЕКТНОЕ НАУЧНО-ИССЛЕДОВАТЕЛЬСКОЕ
РЕСПУБЛИКАНСКОЕ УНИТАРНОЕ ПРЕДПРИЯТИЕ
БЕЛНИПИЭНЕРГОПРОМ

COMPLETED PROJECTS

12
combined-cycle gas turbines

2580 MW
total capacity











USE OF COMBINED-CYCLE AND GAS PISTON TECHNOLOGIES IN POWER FACILITY DESIGN

IN THE RUSSIAN FEDERATION

the following projects have been implemented:



- **Bezymyanskaya CHPP (Samara)**:
  a 25 MW cogeneration gas turbine unit based on an NK-37 engine with a recovery boiler
- **Dorogobuzh CHPP (Verkhnedneprovsky, Smolensk Region)**:
  two 6 MW cogeneration gas turbine units with a recovery boiler
- **Kazan CHPP-1**:
  two 25 MW gas turbine units based on an NK-37 engine with a recovery boiler
- **Kursk CHPP of the North-West District**:
  a 115 MW combined-cycle gas turbine unit consisting of two LM6000 PD Sprint gas turbines 45.55 MW and a 25 MW steam turbine



- **Boiler House «Centralnaya» (Astrakhan)**:
  combined-cycle power plant consisting of two combined-cycle units with an electrical capacity of 115 and 120 MW and a total thermal capacity of 130 Gcal/h, comprising four LM6000 PF DF Sprint gas turbines, four KTG-44/4.6-435-13/0.5-210 steam turbines, and two T-17/23-4.5-0.18 steam turbines
- **Stavrolen LLC CHP Plant (Budyonnovsk):**
  135 MW combined-cycle unit consisting of two 58.9 MW Tren60 gas turbines, two KU turbines, and a 18 MW T-18-4.2/0.25 steam turbine
- **Huadyan-Teninskaya CHPP (Yaroslavl)**:
  450 MW combined cycle unit consisting of two gas turbines, two PR-225/44-7.60/0.89-510/217 heat recovery units, and an LN-150-7.60/0.84 steam turbine unit
- **Voronezh CHPP-1**:
  223 MW (130 Gcal/h) combined cycle unit consisting of four 45 MW LM6000 gas turbines, four heat recovery units, and two T-25/34-3.4/0.12 steam turbines

FACILITIES ON LOCAL FUELS

RUE «Belnipienergoprom» designs power facilities that burn local fuels – wood, lignin, peat, peat briquettes and fuel pellets. The projects include the use of equipment of Belarusian, Russian, and European manufacturers.

The following facilities were reconstructed according to the company's projects:

- the boiler house of the House of Environmental Education and the Administration of the Pripyatsky National Park, with the installation of three hot water boilers – two 1.5 MW each and one 0.5 MW, burning pellets;
- the boiler house of the Lyaskovichi Wood Processing Plant, with the installation of three 1.6 MW hot water boilers burning wood chips.

RUE «Belnipienergoprom» also developed design documentation for the reconstruction of three facilities of SPA «Belenergo» with the installation of pellet boilers, including:

- two 10 MW hot water boilers (total capacity of 17.2 Gcal/h) at the Baranovichi CHPP;
- an E-20-1.4-250 steam boiler (steam parameters 1.4 MPa, 250 °C) with a steam capacity of 20 t/h at the Shabany boiler house;
- a similar boiler with a steam capacity of 12 t/h at the start-up and backup boiler house of Minsk CHPP-5.





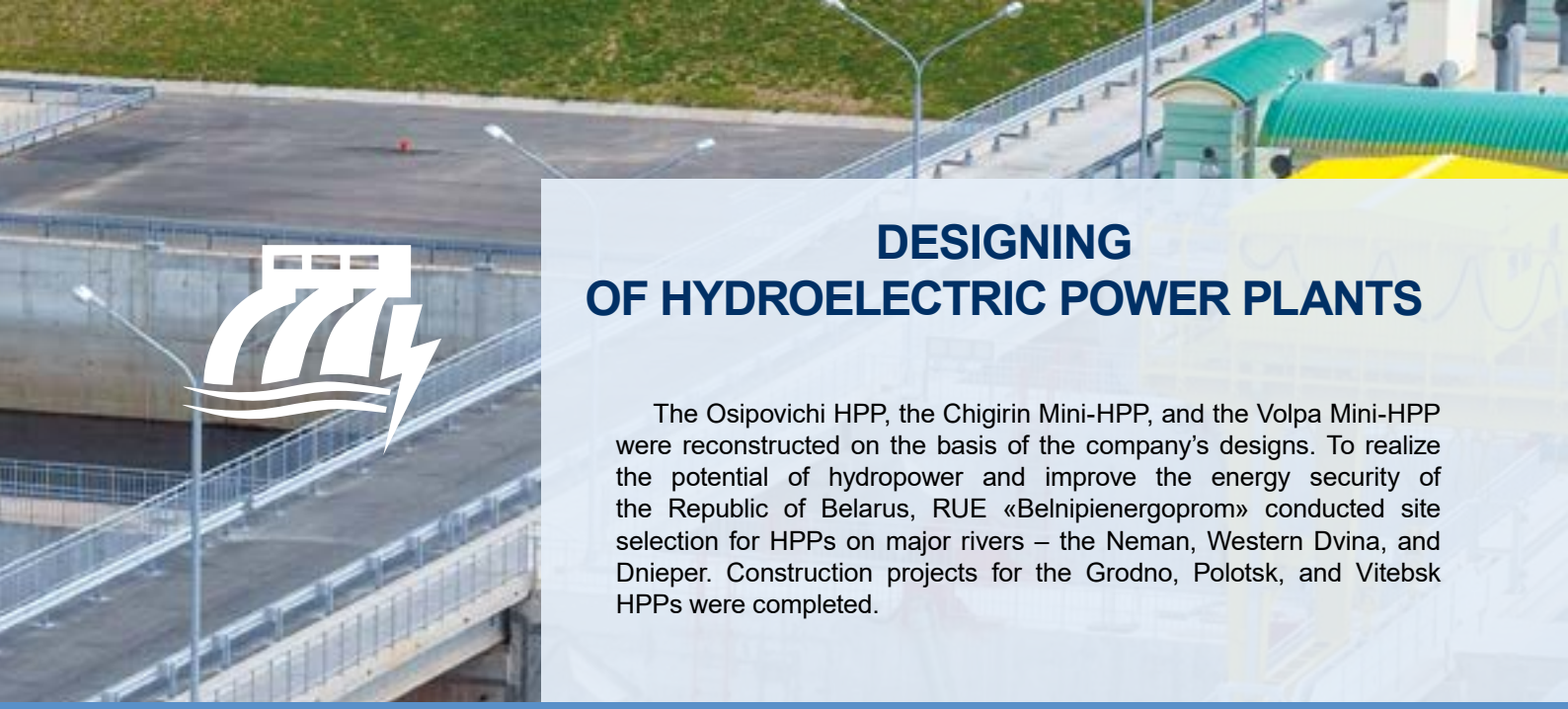




COMPLETED PROJECTS

- **Osipovichi Mini-CHPP (1.2 MW):**
  KE-10-2.4-300 OGMV × 2; fuel – wood, peat; combustion method – in a Shershnev furnace
- **Bobruisk CHPP-1 (30 t/h):**
  KE-30 INEKO × 1; fuel – lignin, peat; combustion method – in a fluidized bed
- **Belorusskaya SDPP (1.2 MW):**
  KE-20-24 × 1; fuel – wood; combustion method – in a fluidized bed
- **Mini-CHPP in Vileika (2.4 MW):**
  KE-25-2.4-350 × 1; fuel – wood; combustion method – in a fluidized bed
- **Pinsk CHPP (4.0 MW):**
  E-10-3.9-440T × 2; fuel – wood; combustion method – in a Shershnev furnace
- **Zhodino CHPP (60 t/h):**
  E-60-9.5-510 INEKO × 1; fuel – peat briquettes, wood; combustion method – in a fluidized bed
- **Belorusskaya SDPP (30 t/h):**
  E-30-3.9-440DF × 1; fuel – wood; combustion method – in a fluidized bed
- **Mini-CHPP in Baran (3.25 MW):**
  the thermal oil boiler 14.79 Gcal/h manufactured by Polytechnik Luft und Fereuerunqstechnik Gmbh (Austria); fuel – milled peat, wood chips; combustion method – ORC module
- **Mini-CHPP in Luninets (4.0 MW):**
  E-20-3.9-440DF × 2; fuel – wood, milled peat; combustion method – in a fluidized bed
- **Boiler house in Pravdinsky (10 t/h):**
  DKVR-10-10/14 × 4; fuel – milled peat; combustion method – in a Shershnev furnace
- **Boiler house of the House of Environmental Education and the administration of the GPU NP «Pripyatsky» (3.5 MW):**
  SN-150 KOMKONT × 2 and SN-50 KOMKONT × 1; fuel – pellets; combustion method – on an inclined grate
- **Boiler house of DPK «Lyaskovichi» (4.8 MW):**
  SN-160 KOMKONT × 3; fuel – wood chips; combustion method – on an inclined grate





DESIGNING OF HYDROELECTRIC POWER PLANTS

The Osipovichi HPP, the Chigirin Mini-HPP, and the Volpa Mini-HPP were reconstructed on the basis of the company's designs. To realize the potential of hydropower and improve the energy security of the Republic of Belarus, RUE «Belnipienergoprom» conducted site selection for HPPs on major rivers – the Neman, Western Dvina, and Dnieper. Construction projects for the Grodno, Polotsk, and Vitebsk HPPs were completed.

Grodno HPP

5 electric generators
Electric capacity: 17 MW
Annual output: 85 million kWh



Polotsk HPP

5 shaft hydroelectric units 4.75 MW each
Electric capacity: 22 MW
Annual output: 111 million kWh



Vitebsk HPP

4 capsule hydroelectric units 10.3 MW each
Electric capacity: 40 MW
Annual output: 138 million kWh







USE OF TURBOEXPANDER UNITS

One of the areas of the company's activity is the design of power facilities utilizing the potential energy of compressed gas. Using the pressure drop of natural gas, previously lost in pressure-reducing units, to generate electricity in turboexpander units, improves the efficiency of the energy source. Based on the company's designs, turboexpander units were installed at Gomel CHPP-2, Lukoml SDPP, and Minsk CHPP-4.









Gomel CHPP-2 / Turboexpander unit 4 MW



Lukoml SDPP / Turboexpander unit generators 5 MW and 2.5 MW



Minsk CHPP-4 / Two turboexpander units, 2.5 MW each

OPTIMIZATION OF HEAT SUPPLY LAYOUTS FOR CITIES AND INDUSTRIAL CLUSTERS

Since its inception, the company has developed heat supply layouts for all cities in the Republic of Belarus with populations over 20,000, as well as for several cities in the Russian Federation (Saratov, Astrakhan, Samara, Novosibirsk, Sochi, Kaliningrad, Kursk, Nefteyugansk, Penza, Saratov, Smolensk, Tver, etc.).

Currently, RUE «Belnipienergoprom» carries out electronic modeling of heat supply systems using the ZULUTHERMO GIS. Over the past five years, approximately 10 electronic models of heat and steam supply systems for industrial purposes have been developed and implemented.



The main goals and objectives of the systems are:

- graphical representation of heat supply system facilities referenced to a topographic baseline;
- certification of all heat supply system facilities;
- engineering calculations;
- optimization of heat supply temperature schedules;
- modeling of all types of switching operations carried out in heating networks;
- solving dispatching tasks to localize emergency situations;
- monitoring coolant parameters at control points, the state of thermal insulation, etc.

The Electronic Models of Network Circuits (EMNCs) of thermal power plants, developed by RUE «Belnipienergoprom», are designed for mathematical modeling of the normal and abnormal operating modes of thermal power plant heat-generating equipment and the loading of station network water pipelines.

The main goals and objectives of EMNCs are:

- determining the actual available power of the station in network water;
- determining the hydraulic losses of the station network;
- optimizing operating modes and the composition of pumping equipment;
- determining the speed parameters of station pipelines and identifying bottlenecks;
- determining the thermal-hydraulic parameters at each node;
- compiling the heat balance of heat-generating equipment in all operating modes;
- hydraulic calculations for the station's auxiliary consumers and their adjustments;
- monitoring of operating modes (if SCADA/APCS connection is possible);
- calculations taking into account the projected increase in thermal loads.

DESIGNING OF HEATING NETWORKS

RUE «Belnipienergoprom» provides comprehensive design services for main and distribution heating networks, developing projects for the construction of new networks, reconstruction, and modernization of existing networks designed to transport thermal energy from existing and planned energy sources to consumers.

The company were used to construct the Minsk heat supply system, including CHPP-4, CHPP-3, CHPP-2, five peak boiler houses, and over 65 km of transit pipelines with diameters ranging from 800 to 1400 mm. Between 2015 and 2026, the Heating Networks Department of the RUE «Belnipienergoprom» designed more than 220 km of heating networks with pipeline diameters ranging from 200 to 1400 mm in Minsk, Gomel, Grodno, Mogilev, Vitebsk, Brest, Molodechno, Zhodino, Borisov, Mozyr, Svetlogorsk, Lida, Bobruisk, Osipovichi, Pinsk, and other cities of the Republic of Belarus.

During the design process, the optimal installation method (usually underground trenchless, sometimes aboveground) is selected, as well as the pipeline type and construction method, taking into account all technical requirements, the specific location of the designed facilities in the urban environment, the presence of existing and planned utility infrastructure (including bridges and water barriers), conservation zones, zones for the protection of tangible immovable historical and cultural values, and other factors.

During the development of design documentation, the total estimated cost of the construction project is determined, the project is coordinated with all interested organizations, and conclusions from the necessary state expert assessments (state construction expert review, environmental expert review, if necessary), as well as from regulatory authorities, are obtained.

The company’s specialists perform full supervision of facilities constructed according to design documentation developed by RUE «Belnipienergoprom».





PROCESS AUTOMATION

RUE «Belnipienergoprom» has developed over 250 software and hardware projects and implemented over 100 systems of varying complexity, accomplished using modern software and hardware from various manufacturers.

The automation targets include virtually all primary and auxiliary equipment at power facilities: boilers, turbines, electrical and gas distribution equipment, including large process units and entire power facilities – combined heat and power plants, heating networks, boiler houses, and pump stations. Examples include unit No. 5, a 230 MW unit at the Beryoza SDPP, and the CHPP at the Dobrush Paper Mill «Geroy Truda», where full-scale automated process control systems have been implemented.

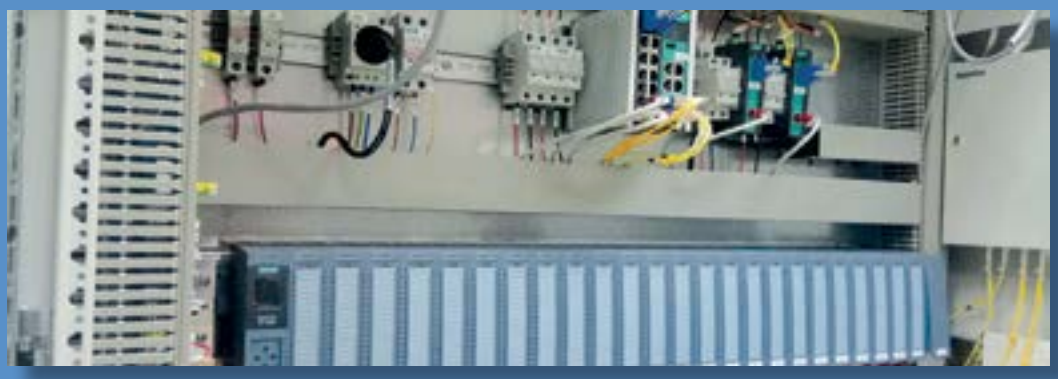
Work on the creation and commissioning of the automated process control system was completed at the generating and grid facilities of all regional power companies:

- **RUE «Brestenergo»**: Beryoza SDPP, Baranovichi and Brest Heating Networks;
- **RUE «Vitebskenergo»**: Lukoml SDPP, Belorusskaya SDPP, Vitebsk, Novopolotsk, Orsha, and Polotsk CHPPs, Vitebsk Heating Networks, and Orsha, Glubokoye, and Vitebsk Electrical Networks;
- **RUE «Gomelenergo»**: Svetlogorsk, Mozyr, and Zhlobin CHPPs, Gomel CHPP-2 and CHPP-1, Gomel Heating Networks;
- **RUE «Grodnoenergo»**: Grodno CHPP-2, Grodno Heating Networks;
- **RUE «Minskenergo»**: Minsk CHPP-3, CHPP-4, CHPP-5, Zhodino CHPP, Minsk Heating Networks;
- **RUE «Mogilevenergo»**: Mogilev CHPP-2, Bobruisk CHPP-2, Mogilev and Bobruisk Heating Networks.

Currently, the company's services include a full range of work, from the development of an APCS concept to its implementation:

- pre-design work (survey, concept development, technical specifications, investment justification, etc.);
- design work (development of design and working documentation);
- development of upper and lower-level application software for APCS on any controller equipment and SCADA;
- full commissioning of APCS;
- engineering support after system commissioning;
- other services (technical support, consulting services, system life extension, etc.).

Turnkey services can be provided upon customer request.





DESIGNING OF INSTRUMENTATION AND AUTOMATION SYSTEMS

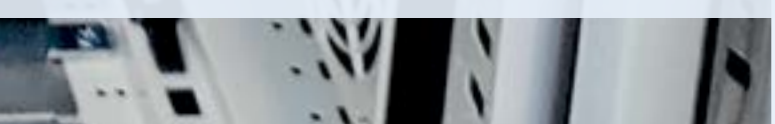
RUE «Belnipienergoprom» designs instrumentation and automation systems for steam and hot water boiler units, steam and gas turbine units, pumping stations, cooling towers, and other facilities in the power, oil refining, and mining industries (drawings of the following brands: ATM, ATX, AVP, ANK, AOV).

The areas of activity in this field include:

- selection of primary instrumentation sensors;
- development of automation schemes and functional diagrams based on the requirements and specifics of the technological process;
- selection of bosses, nozzles, protective sleeves, valves, and stands for installing primary instrumentation sensors, development of pulse lines;
- development of cable routing schemes for instrumentation equipment and electrical fittings;
- development of complete electrical control circuits for electric and pneumatic drives and control cabinets;
- development of panels, consoles, and local boards for process equipment control and installation of secondary instruments;
- comprehensive development of automatic emission control systems at chimneys, connecting instrumentation sensors and electrical fittings to controller cabinets (connection to APCS);
- development of electrical power supply circuits for instrumentation equipment and low-current systems;
- development of automation systems for heating and ventilation equipment and electrical fittings to controller cabinets (connection to APCS);
- development of electrical power supply circuits for instrumentation equipment and low-current systems;
- development of automation systems for heating and ventilation equipment.







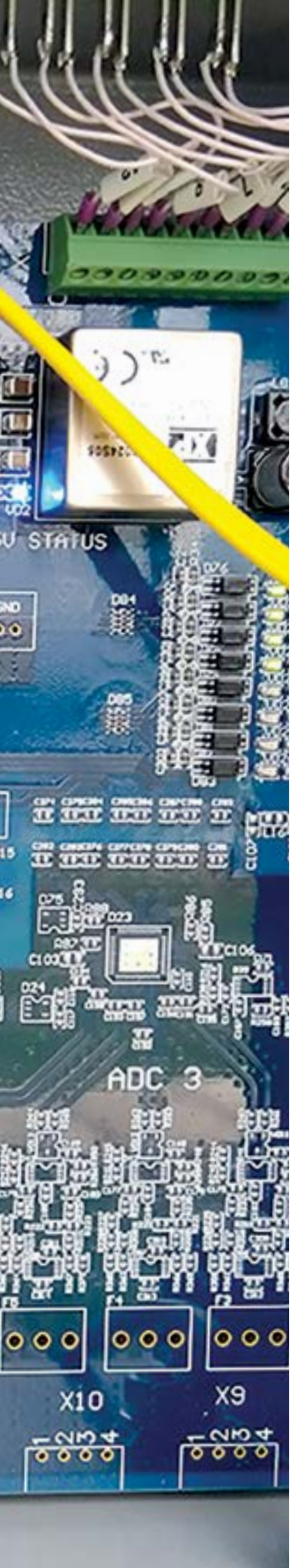


OPERATIONAL AND EMERGENCY CONTROL AUTOMATION SYSTEMS FOR HEAT AND ELECTRIC POWER FACILITIES

The main areas of activity of RUE «Belnipienergoprom» within this field are the design, development, and commissioning of distributed operating and emergency-control automation systems for electric and thermal power facilities.

The company has completed over 100 design and commissioning projects for all power plants and most of the electrical grids of the Belarusian Energy System. During this time, a library of mathematical models of key electrical and thermal power equipment was compiled, a methodology for their verification and validation was developed, and specialized software capable of processing, calculating, and transmitting data in real time was developed. This enables the following tasks to be addressed:

- voltage regulation on high-voltage busbars of 110–330 kV power plants with a maintenance accuracy of 1 % based on group excitation control of parallel-connected generators and the position of the on-load tap changers of autotransformers and controlled shunt reactors;
- voltage regulation on 6 and 10 kV substation busbars using on-load tap changers with the function of maintaining voltage on the busbars of remote consumers and taking into account operating modes and connection characteristics;
- setting up emergency frequency-dividing automation of power units taking into account the composition of generating equipment, consumer categories, and voltage control;
- diagnostics of 330 kV measuring current and voltage transformers under operating voltage (continuous monitoring of current transformers insulation and detection of short circuits in the primary and secondary windings of voltage transformers);
- diagnostics of 6 and 10 kV cable lines and overhead power lines (search for single-phase ground faults with identification of the damaged feeder with a fault current of 1 A and a fault duration of 20 ms or more);
- diagnostics of the operation of a cogeneration pumping station (detection of breaks in the heating network and abnormal closure of shut-off valves, optimization of the loading of parallel-connected pumping units, determination of the efficiency and performance of pumping equipment with an error of no more than 2 %);
- calculations for the selection and analysis of the operation of relay protection and automation devices (at power plants, boiler houses, and substations), emergency automation (at power plants and substations), operational automation (at power plants), auxiliary power mechanisms during power outages, and excitation systems for synchronous generators;
- inspection and feasibility study for the installation of an adjustable electric or hydraulic drive on pumping equipment and mechanisms of the blower group.


U STATUS
ADC 3
X10
X9

220004, Minsk, 5A Romanovskaya Sloboda St.
+375 17 395-22-77 +375 17 375-53-17 (fax)
belnipi@energoprom.by

www.belnipi.by



Editer JSC «Economenergo». Certificate of the SRPMDPP No. 1/354 dated 06.06.2014