

INNOVATIONS

The Board of Directors has adopted the OAO IDGC of Urals' Innovation Development Program²⁶. The 2022-2026 mid-term implementation plan was revised and approved as a part of the 2021 Innovation Development Program progress report²⁷.

The following key directions of innovation-driven development were set to enhance efficiency of the program planning and implementation:

1. In terms of technological innovations:

- State-of-the-art technologies and solutions – activities related to the usage of new materials, isolations, equipment in primary business processes (current limiters, controlled devices, new-type wires with improved electrical conductivity and durability, new-type isolators, power electronics, etc.);
- Digitization of management and technological processes – transition from analogue to digital principles of control over relay protection and emergency automation, automated process control systems, metering and telecommunications (digital measuring transformers, digital network equipment, shift to digital substations etc.); digitization of production asset management; launch of digital monitoring in the networks and at substations;
- Enhancement of grids flexibility – development of network properties to enhance resilience to network disturbance and automated restoration of normal operations (adaptive relay protection and emergency automation, control systems, logic automation, digital on-line network model).

2. In terms of organizational and marketing innovations:

- Designing new and systemic re-engineering of existing business processes through the lens of end-to-end performance (management of production assets, management systems, front-end services, management of life cycles of the system, lean production practices);
- HR management innovations (implementation of HR management technologies, relevant to this day);
- Shaping innovative environment around the Company (collaboration with innovative companies, scientific and educational institutions dealing with scientific and technical issues by partnership in technological platforms, implementation of cooperation agreements with anchor higher education institutions).

The goal of the Company's Innovation Development Program for the mid-term and long-term (till 2030) periods is to shift to the new-generation innovative network with game-changing properties related to reliability, efficiency, availability, controllability and customer-centricity.

2022 Achievements:

1. Transition to 35-110(220) kV digital substations

The goal of the Digital Substations projects is to create grid facilities with intelligent control and management system by installing state-of-the-art equipment and systems as well as to use IEC 61850 data transfer protocols. Effect from the deployment of the "Digital Substation" technology: reduced exploitation costs due to extended repair intervals, usage of low-maintenance equipment, reduced time for restoration of normal network operation, reduced possibility of incidents and damages of equipment, usage of network fault location and remote switch control system.

The "Digital Substation" technology is planned to be deployed on the following pilot substations:

1) 110 kV "Tekhnologicheskaya" substation (Permenergo)

Innovative technologies implemented: i) digital relay protection and automation devices, supporting digital data exchange; ii) digital (electronic) current and voltage measuring devices (incl. transformers and various detectors, incl. fiber-optic) supporting digital data exchange.

2022 achievements: DSW for a digital decentralized substation, using MMS, GOOSE and Sampled Values protocols, completed. The design stipulated the application of analogue signal converters and electronic CT and VT. In 2022 technical solutions on developed project documentation were approved.

2022 expenses totaled RUB 1.02 million (target), RUB 4.21 million (actual).

2) 110 kV "Novokoltsovskaya" substation (Sverdlovenergo)

Deployment of the project shall:

- enhance observability and manageability of the facility, test solutions using RPA and telematics devices supporting "digital substation" technology in line with IEC 61850;
 - enhance reliability of electricity supply and voltage quality;
 - replace outdated and obsolete equipment;
 - achieve optimal load of the district.
- 110 kV "Novokoltsovskaya" substation has remote management of 10-110 kV equipment:
- 110 kV voltage class by the Sverdlovenergo's grid management center;
 - 10 kV voltage class by the integrated dispatching system of the Central Electric Grid Production Department.

110 kV "Novokoltsovskaya" substation is connected to 110 kV networks by two 110 kV aerial and cable power lines from 110 kV cable line "Yuzhnaya – Sibirskaya II circuit" with branch lines, building up new 110 kV power lines (110 kV "Sibirskaya - Novokoltsovskaya" power line with a branch line to "Lechebnaya" substation, 110 kV "Yuzhnaya - Novokoltsovskaya" power line with a branch line to "Zagorodnaya" substation). 2022 expenses totaled RUB 157.51 million (target) and RUB 176.88 million (actual).

3) 110/35/6 kV "Pyshma" substation (Sverdlovenegero)

Innovative technologies implemented: i) digital relay protection and automation devices, supporting digital data exchange; ii) PMU devices integrated into DSP; iii) systems for control (analysis) of IEC 61850 digital communications protection, etc., using machine learning and neural networks to discover abnormalities, to ensure functional security of remote control of primary grid equipment; iv) automated systems for control of 10-220 kV equipment status after synchronous registration and monitoring of normal and emergency modes parameters; v) smart meters with possible integration into the unified management system, providing remote control and information on network parameters; vi) fieldbus firewalls with functions of control and infiltration of OPC.

2022 achievements: DSW ended, principal technical solutions developed. 2022 expenses totaled RUB 0.0 million (target) and RUB 18.48 million (actual).

4) 110 kV "Alapaevsk" substation (Sverdlovenegero)

Deployment of the project shall:

- enhance observability and manageability of the facility, test solutions using RPA and telematics devices supporting "digital substation" technology in line with IEC 61850;
- enhance reliability of electricity supply and voltage quality;
- replace outdated and obsolete equipment;
- achieve optimal load of the district.

2022 achievements: DSW ended, principal technical solutions developed. 2022 expenses totaled RUB 0.0 million (target) and RUB 10.76 million (actual).

2. Transition to digital smart grids with distributed intelligent automation and control system

2022 achievements:

Deployment of projects on the creation of distributed network automation and location of damaged sections, enhancement of observability and automation of network management in Permenergo, Chelyabenergo and Sverdlovenegero

2022 Chelyabenergo's expenses totaled RUB 3.79 million (target) and RUB 3.79 million (actual), 2022 Sverdlovenegero's expenses totaled RUB 8.74 million (target) and RUB 0.0 million (actual), 2022 Permenergo's expenses totaled RUB 17.0 million (target) and RUB 0.95 million (actual). The odds between actual and target values is due to long procurement and equipment attestation processes, failures to discharge contractual liabilities by a contractor (claim stage in process).

- Deployment of projects on the roll-out and development of smart metering (0.4-110 kV) in Permenergo, Chelyabenergo and Sverdlovenegero. The goal of the project is to create a customer-centered automated metering system with smart metering functions (remote reading of metering parameters, incl. billing and load limitation/disconnection; remote collection of consumption data; multi-tariff function; monitoring of meter status; data exchange).

Innovative technologies implemented:

- Smart metering system is based on the usage of smart meters united into one system of automated control and recording. To get the system working, a new-generation meter is mounted on a power line tower. The meter transfers consumption metrics to the dispatcher and customer's display. Two-way GSM/GPRS communications enable to monitor the system in real time, control electricity supply and rapidly detect losses and attempted electricity thefts. Alongside with the installation of the automated metering system, cable entrance points are reconstructed: old-generation wires are replaced with self-supporting insulated wires, which provides higher quality of energy supply and reduces unauthorized connections to zero. Implementation of state-of-the-art automated systems of control and recording of electricity consumption makes it possible to arrange remote metering on any facilities and perform remote switching off/on;
- Customer services and CRM (management of electricity supply and demand).

Effects from implementation:

- reliable metering at points of delivery at responsibility boundaries of multi-family and single-family houses;
- reliable metering at points of delivery for consumers connected to networks with peak losses and consumption;
- location of electricity loss centers through upgraded metering systems on 6(10)/0.4 kV substations making it possible to prepare balances of main substations with problematic feeders;
- minimization of expenses on metering automation (per metering point).

2022 achievements:

- exclusion of in-house losses (in multi-family houses) from electricity purchased to compensate losses;
- reduction of losses on selected network sections (by enhanced accuracy of metering and reduced unmetered consumption);
- growth of net supply (same as previous, plus monthly billing using metered values as of the end of each calculation period);
- reduction of operating expenses related to meter maintenance (manual data collection, manual data input, instrumental inspections).

2022 Permenergo's expenses: RUB 44.98 million (target) and RUB 45.64 million (actual), 2022 Chelyabenergo's expenses: RUB 36.06 million (target) and RUB 107.85 million (actual); 2022 Sverdlovenegero's expenses: RUB 0.77 million (target) and RUB 0.77 million (actual).

3. Transition to end-to-end performance of business processes and automation of control systems

2022 achievements:

1) Build-up of the Production Assets Management System (PAMS)

Goals of the project:

- build-up of the system for regular centralized management of core production assets in line with the Company's strategic goals;
- enhancement of the quality of planning for repair, maintenance, upgrade and reconstruction programs;
- provision of Company's management with a tool to generate objective data on production assets' health and exploitation costs;
- creation of a mechanism for provision of maximum possible reliability level within set funding.

Innovative technologies implemented: electronic catalogues and databases of standard technical solutions.

Effects from implementation:

- build-up of the system for planning and recording of production programs execution (repair program, maintenance program, upgrade and reconstruction program and other programs included into the exploitation decree), compliant with uniform requirements set by external regulatory documents and Company's bylaws;
- integration of the system covering financial and management accounting, control of logistics, transport and human resources;
- integration of the system with external systems to arrange data exchange, required for planning of production programs, integration with Rosseti's GIS systems, business analysis systems of the Company;
- establishment of the KPI system related to production asset management on all levels that help evaluate and compare production departments, branches in terms of processes, technical and economic properties for further solutions.

The project started in 2016, its deployment goes stage by stage. Activities from the 2022-2024 PAMS Development action plan are completed in full in 2022, with the modules put into commercial operation. Further development of the PAMS is suspended until 2025 (when import software will be replaced by domestic software, with further migration of existing automated processes of repairs and maintenance management).

2) Creation and deployment of the GIS Ural geoinformation system

Goals of the project:

- enhancement of management efficiency by creating an integrated geo-oriented cross-functional area for interaction among structural units with straight reporting line to the Chief Operating Officer;
- creation of a unified center for visualization of information on grid infrastructure (100% of grid facilities).

Activities to deploy and launch the system in commercial operation in 2022 were completed in full. 2022 expenses totaled RUB 14.95 million (target) and RUB 14.95 million (actual).

3) Development of the integrated decision support system (unified platform for IS integration)

Effects from implementation:

- Reduction of labor costs on maintenance of homogeneous data in various information systems, enhancement of data quality by centralization of maintenance.
- Enhancement of efficiency of cross-system coupling among information systems used by the Company and PAO Rosseti by centralization of data exchange processes, provision of guaranteed delivery of information among the systems, enhancement of information security in data exchange, roll-out of centralized monitoring of data exchange among the systems.
- Reduction of expenses on deployment of new systems or replacement of existing systems into the intersystem interaction due to loose coupling of the information systems and possible reuse of integration services.
- Reduction of expenses on maintenance and monitoring of data exchange between the Company and PAO Rosseti by rolling out a unified communication channels.

2022 expenses: RUB 27.24 million (target) and RUB 26.98 million (actual).

The odds are due to revised specifications on the project.

4) Development of the management system on advanced professional education in OAO IDGC of Urals

Effects from implementation:

- Reduction of labor costs on preparation of reports and planning by 2024 through integration with the Company's information systems and operations within integrated space;
- Possibility to obtain income from license sales (access to functional modules of the system) to outsiders;
- Reduction of expenses by cost-cutting on 1S-software usage.

The project ended in 2022, key achievements of the projects are:

- Software deployed on the Company's servers.
- Documentation ensuring commercial operation of the system developed and approved.
- Users and administrators of the system were trained.
- Software put into commercial operation.

2022 expenses: RUB 32.59 million (target) and RUB 32.66 million (actual).

5) Deployment of automated electronic document flow system (SEDO)

2022 achievements:

- System design;
- System development and fine-tuning;
- Preparation to pilot operation, trial operations.

2022 expenses: RUB 13.69 million (target) and RUB 4.46 million (actual). The odds are due to changes in calendar schedule as a result of prolonged pilot operation stage. Completion was rescheduled for 2023.

4. Application of the latest technologies and materials

1) Project “Use of innovative wires for 110 kV aerial power lines”

Goals of the project: implementation of a pilot project related to use of innovative wires for aerial power lines. We plan to use innovative wires on the following facilities:

- Reconstruction of 110 kV “Gornaya - Metanol” (circuit II), “Kizelovskaya GRES-3 - Gornaya” (circuit I) power lines (Stage 1) (10.534 km);
- Reconstruction of 110 kV “Gornaya - Metanol” (circuit I), “Kizelovskaya GRES-3 - Gornaya” (circuit II) power lines (Stage 2) (9.873 km);
- Reconstruction of 110 kV “Kizelovskaya GRES-3 - Gornaya” (circuits I,II and branch lines) (Stage 3) (3.9 km).

Effects from implementation:

- reduction of incidents, unscheduled repairs and repeated tension;
- extension of power line faultless lifetime;
- enhancement of reliability of electricity supply.

2022 achievements: innovative wires purchased, CAW and commissioning completed (Senilek wire), the project completed.

2022 expenses: RUB 16.93 million (target) and RUB 17.63 million (actual).

2) Project “Use of new-type PPE for works on facilities under voltage (0-1 kV)”

Goals of the project: Provision technical teams with PPE for works on repair and maintenance of power lines (isolated and non-isolated wire), switchgear and networks with voltage class of 0-1000 V without disconnection from the networks. Innovative technologies implemented: mastering of works under voltage. 2022 achievements: 3 PPE kits (supplier: OOO Volta). In 2023 we plan to purchase 3 PPE kits and finalize the project. 2022 expenses: RUB 1.77 million (target) and RUB 1.77 million (actual).

5. Development of innovative development management systems and shaping of innovative infrastructure

2022 Achievements:

1) Supervisory control of the Company’s management system in terms of its compliance with ISO 9001, ISO 14001, ISO 50001, ISO 45001 and certification of IMS in terms of its compliance with GOST R 56273.1-2014/CEN/TS 16555-1:2013.

Goal of the project: provision of integration of the management system elements into the holistic system meeting requirements of international standards, improvement of innovative development management systems and enhancement of efficiency of the Company’s business processes.

2022 achievements: supervisory audit in OAO IDGC of Urals, incl. Sverdlovenergo, Permenergo and Chelyabenergo, production departments and distribution zones. Compliance of the Company’s integrated management system with ISO 9001, ISO 14001, ISO 50001, ISO 45001 confirmed, compliance of the Company’s IMS with GOST R 56273.1-2014/CEN/TS 16555-1:2013 certified. 2022 expenses: RUB 0.44 million (target) and RUB 0.33 million (actual).

The odds were due to outcomes of procurement procedures.

2) Application of the knowledge management system in process model of technological and innovative development management.

The Company’s knowledge data base is designed for searching, accumulating, storing, distributing and using knowledge by employees and for the activities of professional communities.

2022 achievements: business processes analyzed, concept and target model of the knowledge management system, incl. its integration into the Company’s business processes, developed. Documentation on the creation of the system (technical specifications, project plan, contents of database) prepared. The system was launched using the Company’s capacities, primary content provision and trial testing completed. 2022 expenses: RUB 8.43 million (target) and RUB 8.43 million (actual).

Target and actual expenses in 2022, RUB million, net of VAT

Type of expenses	Expense target value	Expense actual value
Transition to digital substations	158.53	210.33
Transition to digital smart grids with distributed intelligent automation and control system	111.34	159.01
Transition to end-to-end performance of business processes and automation of control systems	133.11	123.07
Application of the latest technologies and materials	18.70	19.40
Development of innovative development management systems and shaping of innovative infrastructure	8.87	8.76
Total	430.55	520.57

There were 3 research and development works during 2022:

1) Research project "Development of an automated system for handling of keys to electric equipment and control of access to facilities, integrated with the PAMS, with application of electronic keys and signature" (completed, project time: 16.08.2021-30.11.2022).

Price: RUB 24.8 million, net of VAT (RUB 29.7 million, incl. VAT). Funds from DP sources.

The contract is executed.

Achievements:

- lay-out for installation of the system at 14 facilities of the Sverdlovsk distribution zone prepared;
- installation of the system at the facilities;
- information system MR R&M finalized;
- TPP prepared, validation tests completed.

2) Research project "Development of a technology and creation of a unit for renovation of filthy line insulation of an aerial power line with further automated diagnostics of isolation breakdown characteristics" (due to contractor's failure to discharge contractual liabilities, we initiated legal proceedings to denounce the contract).

12M 2022 achievements:

- Execution: target/actual – RUB 18.35 million /RUB 0 million, net of VAT;
- Funding: target/actual – RUB 3.132 million /RUB 0 million, net of VAT.

3) Stage 1 of Research project "Expansion of a CIM profile in terms of connection and perspective development of the networks". Price: RUB 15 million, net of VAT (RUB 18 million, incl. VAT). Funding: other own funds.

Stage 1 achievements: analysis of:

- a specialized software in terms of the adequacy of a CIM GOST R 58651 profile to describe information on grid facilities, consumers and grid equipment, transmitted among information systems under processes related to connection and perspective development of the networks;
- regulatory and technical documentation regulating processes of connection and perspective development of the networks in terms of the adequacy of a CIM GOST R 58651 profile to describe information on grid facilities, consumers and grid equipment, transmitted among information systems under processes related to connection and perspective development of the networks.

Expenses on innovations and R&D, RUB million

Indicator	2020	2021	2022	2022/2021, %
Expenses on innovations	520.71	669.54	520.57	77.75%
R&D expenses	22.69	31.51	20.08	63.73%

521 RUB million
expenses on innovations
in 2022

