

I N N O V A T I O N S

The Company's Innovative Development Program was developed in pursuance of the Rosseti's Policy of Innovative Development, Energy-saving and Efficacy Enhancement²⁷. During 2016 we have revised the Company's Innovative Development Program for 2016-2020, covering mid-term implementation blueprint, and set innovation-related KPIs. The goal of the Company's Innovative Development Program for the mid-term and long-term (till 2025) periods is to shift to the new-generation innovative network with game-changing properties related to reliability, efficiency, availability, controllability and customer-centricity.

The key aspects of the Company's innovative development are:

- Transition to 35-110(220) kV digital substations;
- Transition to digital smart grids;
- Transition to end-to-end performance of business processes and automation of control systems;
- Application of the latest technologies and materials;
- HR development and partnerships with educational institutions.

Target economic, technical and social effects:

- Enhanced labor productivity;
- Reduced prime cost, per-unit costs, enhanced efficiency of production processes;
- Improved quality of services;
- Enhanced energy efficiency and ecological production properties;
- Efficiency of investments in innovations;
- Waiver to use obsolete and non-efficient technologies, implementation of breakthrough production technologies and governance practices, transition to principles of best available technologies.

I N N O V A T I V E D E V E L O P M E N T P R O G R E S S

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

We enforce the innovative project related to implementation of digital data exchange solutions in relay protection and automation systems, compliant with MEK 61850, in pilot substations. The project includes activities related to reconstruction of 35/6 kV "AMZ" substation. 2016 expenditures: RUB 64.0 million (target), RUB 13.63 million (actual). Deviation from the target was affected by revised solutions and construction plans.

2. Transition to digital smart grids:

The following activities were completed:

- Full automation of distributive networks of Sosnovsky distribution zone (Chelyabenergo's "Central Electric Grids" production department).

Goal of the project: To create existing network service based on advanced scheme solutions using cutting-edge electric equipment and automation, communications and telematics systems.

Effects to be achieved: enhanced network transmission capacity, enhanced SAIDI/SAIFI reliability indicators, reduced electricity losses and network exploitation costs, optimized performance of operating personnel, build-up of the shared SCADA-based IT control system.

2016 expenditures: RUB 9.0 million (target), RUB 7.63 million (actual). Deviation from the target was influenced by tender-reduced prices.

- Roll-out of 0.4 kV smart metering systems. Upgrade/Build-up of data measuring systems. Automation of data collection from data measuring systems.

Goal of the project: Enhanced operating efficiency to provide all market participants with timely and reliable information on flows of electricity and capacity, required for performance of the electricity retail market.



Effects to be achieved: exclusion of in-house network losses from the total volume of energy purchased to compensate losses; reduction of losses in power line segments, selected for the program (metering accuracy increase and unrecorded consumption decrease); increase of net supply (metering accuracy increase and unrecorded consumption decrease, plus monthly billing based on metered values at the end of the period); reduction of operating costs, incurred to service metering devices (manual collection of meter data, manual entry of meter data into databases, instrumental inspections).



2016 expenditures: RUB 249.20 million (target), RUB 231.15 million (actual). Deviations from the target were impacted by revised CIW terms after tenders, some stages being transferred to 2017.

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

The following activities were completed:

- Implementation of counter-cyberattacks software and hardware.

Goal of the project: Enhanced security of the Company's local network.

2016 expenditures: RUB 20.20 million (target), RUB 43.27 million (actual).

- Implementation of the geographic information system (please, refer to "Development of Telecommunications and IT systems" Section for more details)

By the end of the year we completed designing of the corporate geographic information system. Roll-out and spatial data entry was transferred to 2017. 2016 expenditures: RUB 6.0 million (target), RUB 0.45 million (actual). Deviation from the target was due to contractor's delays.

- Build-up of the PAMS (please, refer to "Network Exploitation" for more details).

2016 expenditures: RUB 19.62 million (target), RUB 111.55 million (actual).

4. Application of the latest technologies and materials:

The following activities were completed:

- Reconstruction of 110 kV power line "Pervouralskaya-SUMZ-3" (application of innovative new-generation wire).

Goal of the project: implementation of a pilot project related to the use of innovative new-generation wires and their production test.

Novelty grade: production of a wire uses innovative technologies improving its properties.

2016 expenditures: RUB 59.0 million (target), RUB 33.94 million (actual). Deviations from the target were impacted by revised CIW terms after tenders, some stages being transferred to 2017.

- Acquisition of UV isolation detection CoroCam 6D.

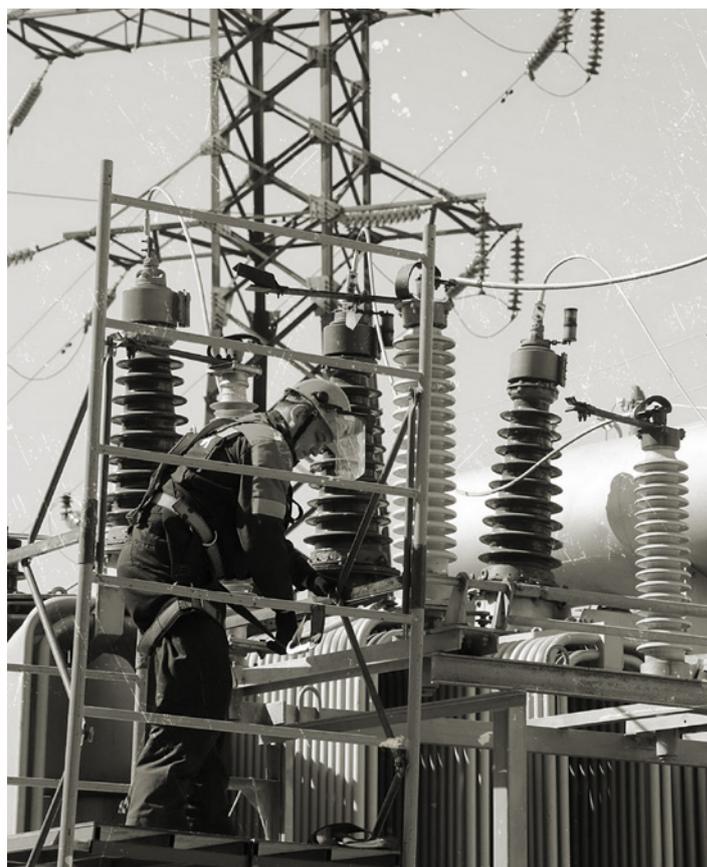
Goal of the project: acquisition of the hardware to be used for UV isolation test.

2016 expenditures on acquisition of CoroCam 6D devices: RUB 0.0 million (target), RUB 4.56 million (actual).

5. HR development and partnership with educational institutions:

The following activities were completed:

- 223 students are sponsored by the Company.
- 36 workers underwent advanced training.
- 3 workers underwent occupational retraining.



The projects under the Company's Innovative Development Program are funded as a part of investing and operating activities. Financial support of innovative projects implemented as a part of investing activities came from internal resources (profit allocated as investments; depreciation and amortization; other internal resources) and borrowed funds (loans, borrowings, budgetary funding, other borrowed funds). Expenses incurred to implement innovative projects as a part of operating activities are recognized as components of the prime cost.

| Aspects of the innovative development | Target, RUB million net of VAT | Actual, RUB million net of VAT |
|--|--------------------------------|--------------------------------|
| Transition to 35-110(220) kV digital substations | 64.00 | 13.63 |
| Transition to digital smart grids | 258.20 | 238.78 |
| Transition to end-to-end performance of business processes and automation of control systems | 45.81 | 155.59 |
| Application of the latest technologies and materials | 59.00 | 38.49 |
| Development of the system used for generation and implementation of innovative products and technologies | 9.11 | 9.11 |
| HR development and partnership with educational institutions | 9.22 | 10.39 |
| TOTAL | 445.34 | 465.99 |

Total expenses of 2016 spent on the Program amounted to RUB 465.99 million (target – RUB 445.34 million, completion – 104.6%).

During 2016 we completed the following researches:

1. "Study case to investigate, in terms of climatic zones and soil constitution, the speed of new growth of forest forming species, typical for the Perm, Sverdlovsk and Chelyabinsk regions in areas pierced by active power lines, with regional corridor-clearing-cycle maps drawn and recommendations provided". Contractor: Zashchitnye Sooruzheniya "Dor-proyekt" (OOO). Research duration: 02 March 2015 – 31 March 2016.

Summary of the research:

The following corridor-clearing cycles are recommended for planning of the Company's corridor clearing activities: 5 and 6 year-cycles (to be applied in the Perm and Sverdlovsk regions); 5, 6 and 7 year-cycles (to be applied in the Chelyabinsk region). The most economically relevant methods used for corridor clearing are mechanical methods: disc mowers and dozers, wood scrap being incinerated during fire safe periods or processed by mulchers. Manual corridor clearing should be minimized and used only in vehicle-inaccessible places.

2. "Development of methods and mathware to calculate energy distribution modes and localization of non-technical energy losses. A pilot project for IDGC of Urals (OAO)". Contractor: Urals Federal University named after B.N. Yeltsyn. Research duration: 21 July 2015 – 30 November 2016.



Summary of the research:

- During the research a new scientific approach towards implementation of the energy distribution mathware with a view to localize inaccurate measurements and non-technical losses of Sverdlovennergo's power lines was put to an evaluation test. It was impossible to implement all potentialities of the energy distribution mathware in all production departments due to metering equipment deficiency of the networks and lack of a shared depot to store even monthly-cycle measurement data. "Balance4" software solution was implemented in the "Central Electric Grids" and "Nizhnyi Tagil Electric Grids" production departments.
- Since 87% of Sverdlovennergo's net supply is transmitted through 110 kV power lines (with 80% being metered by devices, almost uncontrollable by Sverdlovennergo), the Company should focus on developing the electric power fiscal metering system and own metering systems to be mounted on high-voltage networks to enforce control of non-technical losses and accuracy of measurement.
- Calculation of energy distribution (at month or hour intervals) showed that 110 kV networks had significant non-technical losses caused by metering inaccuracy. To enhance efficiency of energy balance build-up, calculation of technical losses and localization of non-technical losses, it is advisable to integrate data collected from the electric power fiscal metering systems of consumers and grid operators, mounted in 6-110 kV networks, with own information systems to control accuracy at hour intervals.
- Expansion of the company into commercial metering and isolation of metering devices from consumers should be the core objective in this aspect. Installation of commercial metering facilities before 110 kV substations of consumers and facilities of grid operators is deemed efficient. Priority of such installation should be defined by values of non-technical losses, occurring in points to be potentially equipped with meters, obtained from energy distribution calculations.
- Implementation of "Balance4" software solution in Sverdlovennergo's production departments should be continued with due regard to automated processing of hourly measurements from the electric power fiscal metering systems.