

7 Basic R&D performed under the Innovation Development Programme

R&D name	Terms	Result	Planned object and effect for result appliance
Research, developmental and technological work (R&D) entitled "Research and development of technology and instrumental and analytical support for X-ray examination of high-voltage switches" (R&D Contract No.10001601000088 dd. 23.06.2016)	<p>Start date of implementation June 28, 2016</p> <p>Planned completion date June 28, 2019</p>	<p>Result at the end of reporting period Radiographic survey of special defective specimen (SDS) was carried out in accordance with the Program for conducting SDS radiographic imaging in laboratory conditions.</p> <p>Comparison of the results of SDS X-ray imaging in laboratory conditions with actually existing defects was performed.</p> <p>Technical requirements for the Programme apparatus complex (PAC) for X-ray examination of high-voltage low-oil switches VMT-110 have been developed.</p> <p>A prototype PAC was developed and a preliminary calculation of economic efficiency was drawn up.</p> <p>A draft instruction manual for the use of prototype PAC was developed, as well as a draft methodology for performing an X-ray examination of high-voltage low-oil switches VMT-110.</p> <p>Expected result</p> <p>Creation of technology and instrumental and analytical support for operational (on-site) monitoring of technical condition of high-voltage low-oil switches VMT-110 without their isolation and opening, namely, the creation of PAC for X-ray examination of switches of the above type</p>	<p>Facility Electrical equipment installed at the facilities of distribution grid complexes of the branches of the IDGC of the South PJSC - Rostovenergo, Volgogradenergo, Astrakhanenergo and Kalmenergo</p> <p>Effect</p> <p>The ability to perform operational (on-site) monitoring of technical condition of high-voltage low-oil switches VMT-110 of type without their isolation and opening, as well as the possibility of detecting defects such as contact surface wear, moving parts curvature, cracks on the internal elements, hidden defects in insulators design, corrosion, the presence of metal shavings, the absence of elements (understaffing), etc.</p> <p>The ability to use technology and instrumental and analytical support for high-voltage gas-insulated, air and oil switches of all voltage classes and later for gas-insulated switchgear (GIS), as well as for other types of electrical equipment and substations of distribution electric grid complexes of the IDGC of South PJSC and other subsidiary and associated companies of Rosseti PJSC, which will allow:</p> <ul style="list-style-type: none"> > control technical condition of the above electrical equipment, as well as identify the presence and degree of danger of the defects without isolation and opening; > optimize the amount of installation work, including the amount of material costs necessary to maintain the above electrical equipment in working condition; > reduce by at least 20% (estimated) of the amount of material costs required for the withdrawal of work, isolation, opening of the above electrical equipment, its repair, subsequent assembly, bus isolation and commissioning

<p>Research and development work (R&D) on the subject "Development of an electromagnetic environment monitoring system at substations with increased thunderstorm activity" (R&D Contract No.2089170/10001701000482 dd. 16.07.2017, concluded with FSBEI of Higher Education National Research University)</p>	<p>Start date of implementation July 16, 2017 Planned completion date December 28, 2018 (actual completion date)</p>	<p>Result at the end of reporting period Prototypes of the system for monitoring the state of electromagnetic environment (EME), including measuring transducers, communication interfaces and power supply units were manufactured.</p> <p>Prototypes of contactless capacitive sensors for surge voltages, magnetic field sensors, communication and measuring modules, digital recorders, and components of a communication node were manufactured.</p> <p>Design documentation for prototypes of EME condition monitoring system was developed, and measurement and switching modules, as well as digital recorders and wireless communication unit were manufactured.</p> <p>Software for a system for monitoring the state of EME, as well as a programme and methods for its preliminary testing were developed.</p> <p>Preliminary tests of monitoring system of EME were conducted.</p> <p>Design documentation for a sample of automated workstation of the EME monitoring system was developed.</p> <p>Operational documentation for the prototype of the EME monitoring system was developed.</p> <p>A programme and methodology for acceptance testing of the EME monitoring system was developed.</p> <p>Acceptance tests of a set of electrical equipment of the EME monitoring system installed on electrical equipment of SS 110/35/6 kV N-4 Rostovenergo Western Electric Networks production department were conducted, as well as received from the National Research University four sets of electrical equipment of the EME system, installed by the staff of the above-mentioned production department on electrical equipment SS 110/35/6 kV N-1, N-8, SS 110/35/10 kV N-9 and SS 110/10 kV N-13</p>	<p>Facility SS 110/35/6 kV N-4, N-1 and N-8 substation, SS 110/35/10 kV N-9 and SS 110/10 kV N-13 substation of Rostovenergo Western Electric Networks production department</p> <p>Effect Installation of the mobile (portative) automated EME monitoring systems on the above mentioned substation will allow:</p> <ul style="list-style-type: none"> > register, in the current time mode, levels of electromagnetic effects exceeding the maximum permissible or close to them values established by the regulatory and technical documents for various types of electrical equipment used at SS; > analyse the causes that result in equipment malfunctions and determine measures to eliminate deficiencies; > quickly and timely carry out work to eliminate violations, preventing the occurrence of emergency at substations
		<p>Expected result Creation of a mobile (portative) automated system for monitoring the electromagnetic environment (EME) at substations, which allows:</p>	

Research work (R&D) entitled "Development of methodological basis for the metrological support of digital substations" (R&D Contract No.10001801000215 dd. September 24, 2018, concluded with CIT Scientific and Production Association LLC)

Start date of implementation
september 24, 2018 **Planned completion date**

June 1, 2019

Result at the end of reporting period

1. The following standards, regulations and specifications were developed for metrological provision of measuring channels 61850, measuring instruments included in measuring channels 61850, reference measuring instruments intended for metrological support of the measuring channels mentioned above, and measuring instruments intended for carrying out their revision:
 - > Company standard "Methods of digital CT 6-750 kV calibration";
 - > Company standard "Methods of digital VT 6-750 kV calibration";
 - > Company standard "Methods of digital CT and VT 6-750 kV calibration";
 - > Company standard "Technology for measuring systems for verification of electric energy metering instruments with digital inputs and outputs in accordance with IEC 61850 standard";
 - > Company standard "General technical conditions of digital combined CT and VT 6-750 kV";
 - > Company standard "General technical requirements for measuring complexes of digital CT and VT calibration";
 - > Company standard "General technical requirements for measuring systems for verification of electric energy metering instruments with digital inputs and outputs in accordance with IEC 61850 standard";
 - > Company standard "Measuring instruments for revision of digital substation measuring channels".
2. Technical requirements "Production of digital measurement tools for metrological support of digital substations" (First edition), as well as a general (summary) report on the implementation of the first and second stages of research were developed.

Facility

The staff of the relevant production structural divisions of the executive office of the IDGC of the South PJSC, as well as the management offices of its branches and production departments

Effect

Transition to digital signal transmission at all control levels of substations will allow:

- > significantly reduce material costs of cable secondary circuits and their laying channels bringing the sources of digital signals closer to the primary electrical equipment;
- > improve the electromagnetic compatibility of such modern secondary electrical equipment as microprocessor devices and secondary circuits, due to transition to optical communications;
- > simplify and ultimately reduce the cost of design of microprocessor intelligent electronic devices by eliminating the input paths of analogue signals;
- > unify the interfaces of IED devices, simplify their interchangeability (including replacement of devices of one manufacturer with devices of another manufacturer), etc.

Expected result

Development of a set of regulatory documents harmonized with existing international standards (methodological basis for digital measurements), regulating the conducting metrological control and supervision of measuring channels 61850, as well as requirements for integrating a unified information data transfer protocol from electricity metering devices into a digital substation information bus

TECHNICAL POLICY AND REGULATORY SUPPORT

Information on key, special or major projects of the IDGC of the South PJSC, which used innovative advanced technical solutions, advanced technologies, materials and equipment that comply with the Company's technical policy (including the Programme of innovative development)

In 2018, the IDGC of the South PJSC carried out phases of work on itemised projects listed below, in accordance with the current Regulations of Rosseti PJSC on a unified technical policy in the electric grid complex, approved by the Board of Directors of Rosseti PJSC (Minutes No.252 dd. February 22, 2017).

No. i/o	Branch of the IDGC of the South PJSC	Facility name	Key engineering parameters
1	Rostovenergo, Volgogradenergo, Astrakhanenergo and Kalmenergo	Programme apparatus complex (PAC) for operational X-ray examination and control of technical condition of high-voltage low-oil switches VMT-110 on-site without isolation and opening, created during the performance of R&D entitled "Research and development of technology and instrumental-analytical support of X-ray examination high-voltage low-oil switches", in accordance with the terms of the Contract No.10001601000088 dd. 23.06.2016	<p>1. X-ray examination of high-voltage switches will allow to detect such defects as:</p> <ul style="list-style-type: none"> > contact surface wear; > moving parts curvature; > cracks in structural internal elements; > insulators hidden defects; > corrosion; > presence of metal cuttings; > lack of structural elements. <p>2. The proposed technology is also a convenient tool for rapid assessment of the state of high-voltage switches in a group or of the same type of switches, but operated at different electric power facilities. This is the way the problem of ranking switches can be solved quickly</p>
2	Volgogradenergo	Implementation of active-adaptive electrical network project in the distribution electric grid complex of Volgogradenergo, a branch of the IDGC of the South PJSC, which provides for comprehensive automation of 10 kV overhead lines introducing a Smart Grid in the Petrovalsky Distribution Zone of Volgogradenergo Production Association reduction of such performance targets as index of the average number of customer outages in the system (SAIFI) and index of the average duration of consumer outages (SAIDI)	<p>The project provides the following solutions:</p> <ol style="list-style-type: none"> 1. Installation of automatic partitioning points on 10 kV OHL on PBA/TEL reclosers (TER_Rec15_AL_L5) integrated into ENTEC TEL SCADA system; 2. Replacement of existing 10 kV MV (type VMG-133, VK-10 U2, VMP-10P) with OHL 10 kV OHL/TEL at SS 35-110 kV, their telemechanization with integration into SCADA system; 3. Relay protection and automation device on the upgraded cells of 10 kV (Smart); 4. Application of intelligent digital damage recorders IKZ-VZZ-MRZ with organization of data transmission via GSM/GPRS channels to the dispatch RES centre; 5. Telemechanisation of modernized 10 kV cells and implementation of SCADA in the system; 6. Intellectual metering systems of the automated system for commercial accounting of electric power accounting and automated process measurement system with data transfer function to the SCADA system of the network control center of the branch. <p>Network architecture of the SCADA system processes and manages:</p>