

New Paradigm of a Digital Substation: Breakthrough Solution from Russia



O. Rudakov



D. Kishinevskiy

Working in concert with the Ministry of Energy of Russia represented by Russian Energy Agency, International Exhibition CIGRE 2014 in France will demonstrate the joint technical solution of Russian companies LISIS and PROFOTECH. The solution is aimed at automation of substations based on the Digital Substation technology. It includes optical measuring current and voltage transformers, as well as the software complex providing all substation protection and control functions and operating based on generic server platforms. Solution advantages:

- reduction of cost of design, equipment, construction and operation of electrical substations;
- system safety and reliability increase;
- reduction of the construction time;
- project solution typing and conversion to modular ready-to-use substations;
- a possibility to switch over to non-operated substations.

We have discussed this unique development with Managing Directors of both Companies, namely Oleg Rudakov (Profotech CJSC) and David Kishinevskiy (LISIS LLC).

— **What made you begin to develop the new solution?**

O. Rudakov

— Development of the power energy is due to the combining of electrical network and informational infrastructures. Networks become more complicated,

volumes of informational flows that ensure management of electrical network facilities, monitoring of their technical condition, electric power quality control and commercial accounting grow in a geometrical progression. In turn, this leads to the use of expensive smart electronic devices which number and price increase at the facilities. Such devices often use various data transmission standards, and their combining with each other is not easy. Such way impedes the development of power energy and industry as consequence. This is not only true for Russia, it also concerns any industrially developed countries. We believe that now, instead of improvement of any equipment within the old paradigm, we must review principles of the electric power infrastructure construction and approaches.

Profotech, CJSC is a Russian manufacturer of fiber-optic systems realizing a revolutionary approach for application in electric power industry for the following directions: generation, transmission and distribution. Application of this systems are high-precision current and voltage measurements in electric power lines and electric installations, reading out of the measured values via digital interface in IEC 61850-9-2 LE standard intended for use by the secondary equipment - commercial metering devices, remote measuring instruments, electric power quality control, relay protection and automatic equipment.



Lysis, LLC. is a Russian R&D company which is an industry expert in the development and manufacture of innovative substation control and protection systems. The company's products are based on the Digital Substation concept. Our core technology is the state-of-the-art integrated architecture known as the Intelligent Substation Automation System (iSAS). This system is implemented as a scalable software "complex" running on a standard server platform.

— **What was the essence of your method?**

D. Kishinevskiy

— The prerequisite of our solution was active development of Digital Substation technology, namely, development of standards, which describe the information model of a substation and exchange protocols for its components, and equipment, which supports these protocols. The essence of our approach is a modification of substation management and safety systems architecture design based on data digital processing. Application of 61850 Protocol described in the Digital Substation technology allows obtaining a single digital data flow, characterizing the condition of the controlled facility (substation). This allows stepping aside from the existing paradigm of the substation management and safety system design, where each function of automation is performed by a separate device, and switching to the software platform of generic hardware devices and having free functions distribution. Therefore, a possibility to obtain solutions with both fully distributed and centralized architecture appears. Besides, application of a uniform software platform, which ensures implementation and interaction of functions based on the international standard, will allow modifying the hardware devices market in the future to design the substation management and safety systems and switching to the functional algorithms market. In fact, we have developed a software environment similar to Apple or Android to design electrical substation automation system.

We believe that we managed to step aside from established stereotypes of the electric power facility management infrastructure and create a really breakthrough innovation.

Key components, which were used to design the solution, are based on the proprietary developments of two companies: these are optical digital measuring transformers of PROFOTECH and the Digital Automation and Management System of LISIS.

— **Please, describe details of Your solution's components.**

O. Rudakov

— In fact, our system consists of devices, which carry out primary and main

measurement of the electrical network parameters and form digital information flow, transferred via optical cables to the safety and management system implemented on the basis of iSAS@Work software platform for industrial servers. We use optical digital measuring transformers developed and produced by Profotech as system information sources.

Optical digital measuring transformers are an alternative for traditional measuring transformers and they are used to perform high-accuracy measurements of instantaneous current, power and their phase characteristics, issue of measured values using the digital interface to be used by secondary equipment: commercial accounting meters, telemetry devices, electric power quality control, relay protection and automation. Optical digital measuring transformers developed by our company are innovations. They perform full digital measurements with a minimal uncertainty achievable today. Their integration into structure allows optimizing the architecture of measurement, protection and management systems, as well as electric power quality control. Optical digital measuring transformers are the basis for construction of the Digital Substation.

D. Kishinevskiy

— The LISIS's development is iSAS software and technical complex, which ensures full life circle of the substation management system design: design; tests; set up; maintenance and operation.

iSAS is a software and technical complex (STC) of electrical substations automation based on the unified technological platform with unification of all protection, management, measurement and control functions within the substation based on the software modules, which can be easily installed at any hardware platform running on Linux OS.



Today, iSAS STC implements the full range of 35–220 kW substations automation functions based on a unified platform in accordance with the Digital Substation concept with IEC 61850 full support (“process bus”):

- measurements;
- management;
- relay protection and automation;
- recording emergencies and processes;
- automated regulation;
- technical and commercial accounting of energy resources;
- electric power quality control.

iSAS STC allows implementing the functions of the substation protection with a randomly linked architecture and functional structure — from the set of the connection complexes to unified integrated substation complex.

— What are advantages of your solution?

O. Rudakov

— Our solution is innovative for the power energy. It allows creating a fully digital, reliable complex solution for automation, control, commercial accounting and relay protection of substations. The digital form of data transfer is executed in accordance with the requirements of IEC 61850.

Technical advantages of our solution are:

- Uniquely high accuracy of measurements and their uniformity for all data recipients;
- Easy implementation. Up to a hundred cabinets with secondary equipment are replaced with iSAS@Work server. The measurement part is fully digital. It has considerably less weight and dimensions as compared to traditional measuring transformers to modernize a facility without long operation interruption of the electric power distribution equipment.
- Reliability and Quality. Due to the use of fully digital primary measurement equipment, digital processing and management methods, methods of the whole

system self-diagnostics are increased, and application of optical cables for information transfer completely exclude distortions and interferences in data transferred and processed. Digital data transfer and process methods allow safe and multi-level backup of all systems.

- Safety. High-voltage part needs no maintenance and has a high fire and explosion safety. To connect the primary high-voltage part to secondary devices, only fiber optic cables are used, the galvanic separation unit of which guarantee safety of personnel and expensive secondary equipment.
- Compliance with standards. All components work in accordance with the requirements of IEC 61850, which simplifies technical solutions.

Economic advantages:

Our solution allows reducing expenses at all life circle stages of an electrical substation, from design and construction to operation.

Costs are reduced at the construction stage due to:

- Reduction of the amount of the equipment used and elimination of a large number of copper conductors;
- Less labor-intensity of design, assembly and set up of the equipment;

During operation, digital smart devices and non-serviced measuring transformers at a high-voltage part allow decreasing significantly the number of employees at the substation and maintenance expenses.

Additional saving is achieved through:

- Reduction of check costs by the way of increase of an inter check interval and simpler transformers check.
- Reduction of electric power losses due to the higher accuracy of measurements and elimination of the need in secondary networks regulation load.

Application of devices with high functions backup level and replaceability reduces time required for equipment replacement in case of repair or scheduled maintenance for an object operation with almost no interruptions.

A complex solution of Profotech and LISIS allows creating the optimal structure of the Digital Substation: safe, feasible, with a possibility to implement remote control functions, leading to switching to a non-serviced substation.

I would like to notice that full compliance with the international standards allows applying our solution at both Russian and international markets.

If you are interested in the nearest future of the power energy, please visit Stand No. 282 of PROFOTECH and LISIS at the Exposition of Russian Energy Agency at CIGRE exhibition in Paris. The description of our solution can be found at www.op2tech.com.

