Metering systems projects
Reference

elster

Leading the World
in Metering Technology

Alpha CENTER
Brand New Metering Technology from Russia

Russia is one of the biggest producers of energy all over the world and now makes liberalization of the electric power industry. In this background new power companies need only a modern metering system, which can enable them to become the most competitive in the market.
And today Elster Metronica is one of the leaders and the main Supplier of the perfect metering solutions in Russia and CIS.

Since 1996 Elster Metronica has been developing metering systems based on innovative digital metering technologies. Today we offer up-to-the-minute Metering technology Alpha CENTER.

Alpha CENTER is the metering system that completely meets stringent requirements of Russian Power Industry. Alpha CENTER suits perfectly both large Utilities and Industrial companies with thousands of meters and small enterprises with several meters.

Hardware
Elster Metronica produces and supplies all the necessary equipment for building metering systems:
- High functional, fully programmable solid state electricity meters ALPHA (ALPHA A2, A1140, A1700, A1800).
- Controllers RTU-325, RTU-327 series (data acquisition, processing and communication units).
- AlphaCENTER program package.
- Communication and essential equipment (Workstations, servers, printers, adapters, cable etc.).

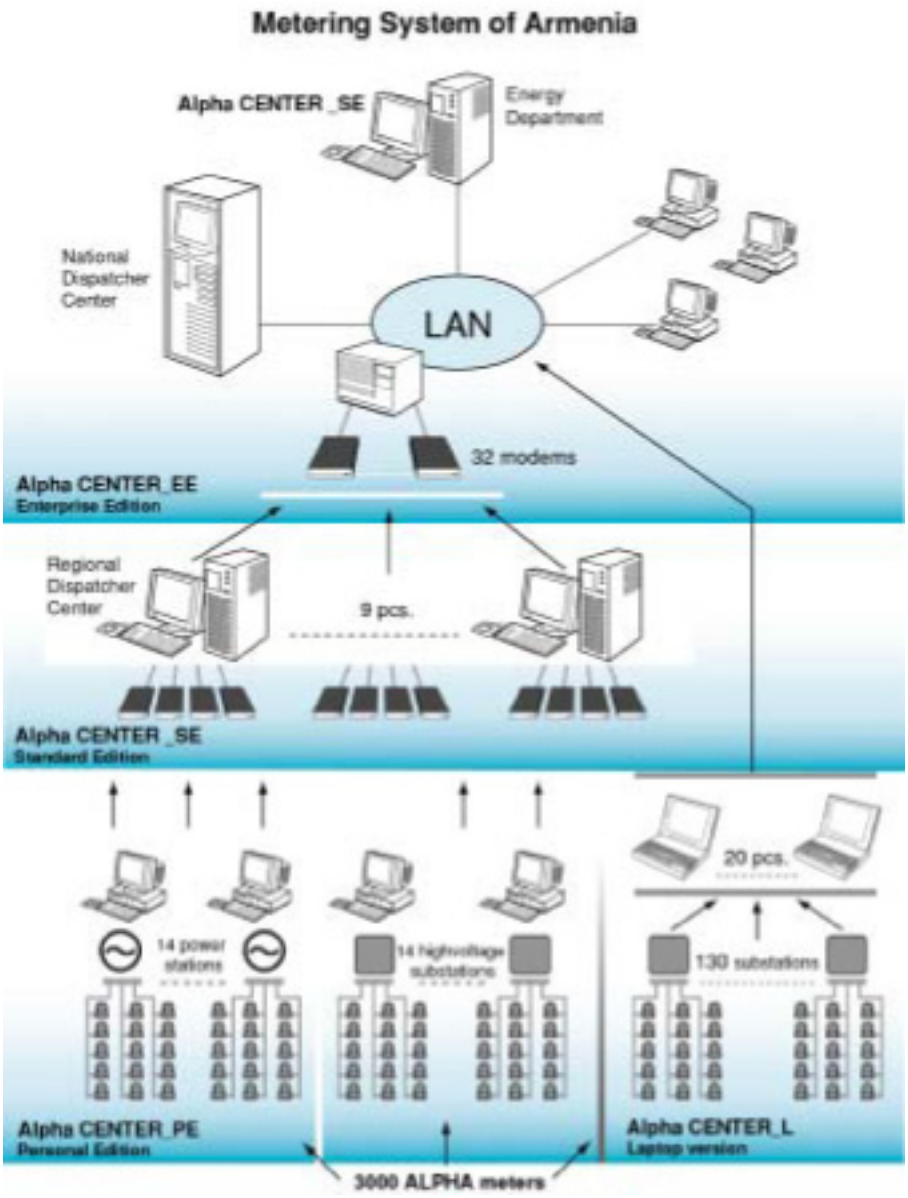
Software
Alpha CENTER metering systems are specially designed for energy and power metering and billing purposes including automated meter reading, data collection, processing, storing, and easy-to-analyze display of received data.
Alpha CENTER is the series of software products; it is based on the principles of clientserver architecture (Oracle, Windows). The program collects and analyzes data from meters, balances the accounts and integrates it into business administration systems.
The system is designed for billing, managing networks or consumption, load management and measuring and analyzing of electricity quality parameters.

Turnkey solutions
Elster Metronica supplies metering systems on a turnkey basis or integrate it in close cooperation with customers. We render support on every stage of metering system implementation, including enterprise investigation, system's installation, adjustment, commissioning, training etc.
Elster Metronica has wide experience of large-scale AMR projects in Russia and CIS.
Further you will find detailed description of some of them.

AMR system of Armenia

In the middle of 2002 the metering system of Armenia was put in commission. Metering project of Armenia metering system began in 1999, when Elster Metronica, Moscow, Russia supplied 3000 meters (are used in system) of 1600 ALPHA type. In the beginning of 2001 year Elster Metronica started introducing it's in-house design - Alpha CENTER metering system. The Alpha CENTER system in Armenia automates electricity metering of whole country and covers 14 power stations and 14 high-voltage substations.

The task of the designed system is to provide all participants of Armenian electricity market with the necessary information about energy generation, distribution and consumption. Specialists of Elster Metronica set the system up and trained Armenian engineers to use the equipment efficiently. The Ministry of Armenia supervises this project and in December the system is being put in commission.



Metering system of Armenia comprises more than 3,000 ALPHA meters

The AMR system in Armenia is a unique automated commercial metering system embracing the whole country (14 power plants and large substations). The metering system is based on Alpha CENTER software and hardware equipment. The AMR system in Armenia provides all entities of the future Armenian electric energy market with essential information on power generation, distribution and consumption.

The AMR system designed for Armenian power grid is the largest project realized by Elster Metronica in the CIS countries. The system incorporates over 3000 multifunction TOU meters ALPHA A1600/A1300. In the course of implementing the AMR system 28 small-scale systems each having 30 to100 meters were deployed, and 14 data collection and processing centers and the main metering center in Yerevan were organized.

•Photoalbum
•Power system of Armenia
•Structure of metering system of Armenia

AMR system is introduced into power grid as a whole, except for distribution networks. However, the control centers of distribution networks should have been provided with equipment and software capable of receiving information on power supplied to each of the a.m. networks.

9 networks incorporate 158 substations equipped with approx. 3000 energy meters. Each network has a regional dispatching center (RDC). Power is generated by 14 main power plants: 1 nuclear power plant, 3 heat power plants and 10 hydropower plants 9 of which are integrated into two cascades: Sevan-Razdan and Vorotan. Armenergo maintains operation of the grid and is responsible for power supply to consumers. That is why the main AMR data collection and processing center is located in Yerevan, in the National dispatching center (NDC) owned by Armenergo.

The power sector in Armenia also incorporates 4 power distribution companies: Yerevanskaya, Central, Northern and Southern. All of them are joint-stock companies. Distribution companies are responsible for power supply to the end users. The a.m. companies are main power consumers of Armenergo.

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The project was designed for the use of existing communication channels, i.e. basically the dialup lines. In the case of unavailability of such channels it was suggested that data would be collected by means of laptops.

The project was mainly targeted to general upgrading of the Armenian power sector through introduction of highly accurate and reliable metering of power flows.

General system requirements

The System was aimed at:
•Long-term storage of primary metering data.
•Data protection against unauthorized access.
•Phase and phase-by-phase power monitoring in power plants and some substations (objects provided with local systems).
•Monitoring of data completeness.
•Maintaining of universal time throughout the system.
•Scalability.
•Upgrading capabilities.
•Project realization.

Stage 1. Preparation of conceptual system design

Conceptual design included:
•General concept and architecture of the system.
•General definitions and terms.
•Software and hardware options.
•Updating of software and hardware depending on types of objects planned for automation.
•Preliminary specifications for software and computer equipment.
•System deployment phases.

The following was determined for each phase:
- Initial and final statuses.
- List of woks.
- Root graph of the process.
- Rules and processes.
- Forms of output reports generated as the result of completion of corresponding phases.

•System development.
- Technical and organizational issues.
- Future development options.
- Future software upgrading options.

Stage One – Brief results

Depending on general characteristics, the objects planned for meter installation were subdivided into three main types:
•Objects planned for meter installation - power plants and substations.
•Grid utilities and distribution companies.
•National dispatching center.

On the level of objects the system employs the computer for direct meter interrogation via interface 485. The controllers are not used. For data transfer to other informational levels the database-to-database data exchange is used.

Five software and hardware options were selected for automation:
•PC-based units for meter data collection and processing via direct lines. Based on single-user software version Alpha CENTER AC_PE.
•Data collection and processing center with a local area network (LAN) and users' workplaces. Based on multiuser software version Alpha CENTER AC_SE.
•Billing center receiving data from LAN and users' workstations. Multiuser software version AC_SE.
•Unattended substations with meters integrated via interface RS485. Based on laptop software version AC_L (Laptop) for interrogation and data transfer. Another version - interrogation by means of modem.
•A laptop for data collection and transfer. Based on software version AC_L.

Stage 2. Introduction of the system at pilot projects

The Department of Energy of Armenia announced a countrywide tender for search of a team capable of deploying the system in cooperation with ABB. After the winner was announced, a team of specialists from Metronica flew out to Yerevan to take part in commissioning of pilot projects and personnel training.
A training complex based on supplied equipment (designed for the whole system) was used for comprehensive training of operators who would have then to duplicate the system as applied to any particular object.

Training included:
1) initial installation of each software version,
2) software re-installation,
3) mastering of data archiving and restoration,
4) comprehensive training in handling the software versions.

Then commissioning of the following objects was performed, namely:
- one power plant,
- one attended substation,
- one unattended substation,
- one regional dispatching center (RDC),
- main data collection and processing center

According to the contract, commissioning of each pilot project was performed by specialists from Metronica who simultaneously conducted training of future energy operators, as they say "in combat conditions".
The two-week training appeared to be sufficient and enabled energy operators to master the system deployment procedure.
During the final phase of works under Stage 2 setting and adjustment of communications was performed.

Stage 3. System deployment

Energy operators successfully duplicated the system as applied to objects planned for meter installation (power plants and substations), and further - to regional dispatching centers. Metronica organized a hot line for customer support. Peculiarities of system operation in various locations were also traced. In the course of operation the software was subject to corresponding updating.

In December 2001 the system was put into commercial operation.

Conclusion

Metering system for Armenian power grid is ranking among largest projects realized by Metronica. As concerns hardware, the system incorporates approximately three thousand meters, 16 data collection and processing centers and 28 AMR systems installed on the level of objects. From the organizational point of view, it involves a large number of organizational structures, each taking interest of its own as concerns specified sets of data and billing procedure.

Today, alongside with preparation for putting into commercial operation, the system is being further developed. Today the largest power plants switch over from single-user software versions to multiuser ones. As the result, information will be accessible for both, power engineers and economists.

The Customer Company: Oktyabrskaya railroad (Moscow-Sankt-Petersburg-Murmansk)

Starting point:

The railroads in Russia are among the largest power consumers. Millions of kilowatthours are spent for hauling operations and functioning of enterprises included in the system of the Ministry of Railways of Russia. Currently, a specific share of expenses for electric bills amounts is nearly up to 15% for railroad networks, including 8% for electrified railroads thus exceeding all other costs being second only to the wages fund.

Main objective: Cutting down the cost of electric bills

In modern conditions, when the federal wholesales market of energy and power (FOREM) is being formed, the main way to cut down the costs is nothing but the provision of railroads with the state-of-the-art time-of-use (TOU) meters, introduction of automated meter reading systems (AMR) and entering the FOREM.

Integrated solution: Installation of TOU meters and AMR

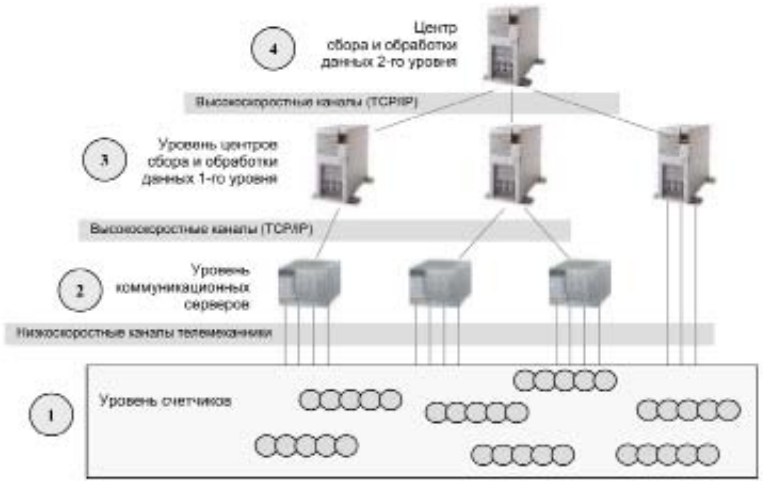
Introduction of new technologies was carried out by stages. During 1997-2000, more than 2,000 electricity ALPHA meters were installed throughout the railroad covering basic commercial billing activities. Total for railroads of Russia it was produced 10,000 ALPHA meters.

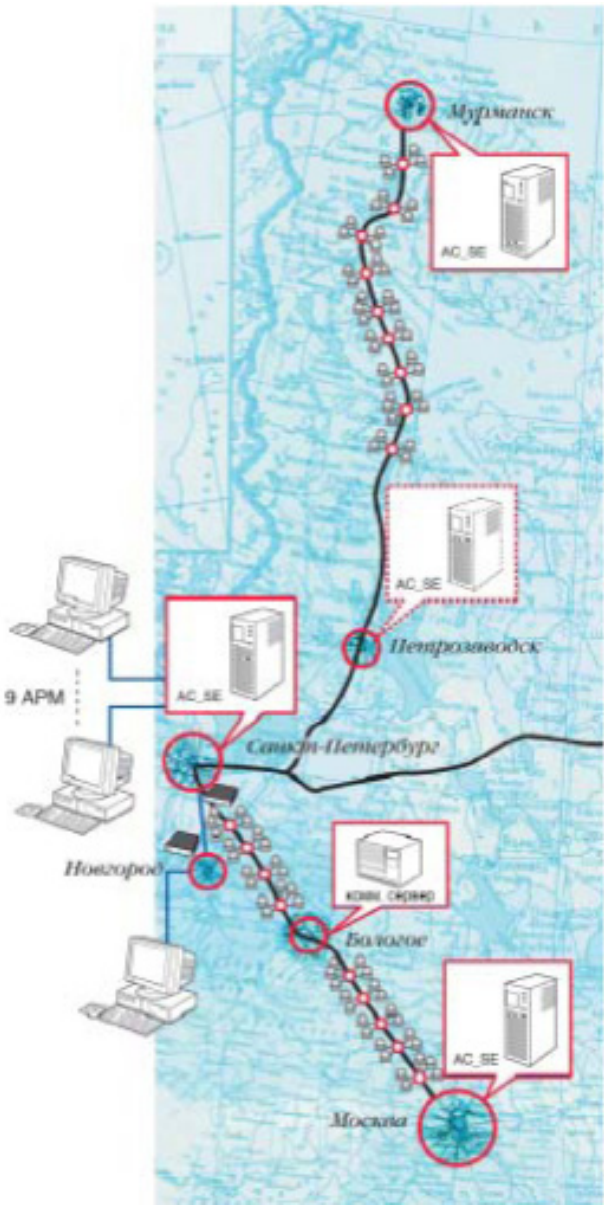
In the year 2000, in the framework of metering automation activities, the Alpha CENTER AMR system was launched. The Alpha CENTER AMR system was designed by Elster Metronica's engineers and programmers with regard to specific needs of large consumer enterprises and power utilities. Data collection and processing centers form the basis of the system.

System structure

In the framework of the project, the data collection and processing system as well as the data display system can be distinguished. The structure of the data collection system is represented by the four-level architecture:

1. Meters level.
2. Communication servers level.
3. 1st-level data collection and processing centers level.
4. 2nd-level data collection and processing centers level.





This architecture made it possible to organize data collection from a vast territory. Currently, three communication servers located in Moscow, Bologoye and Petersburg are collecting data from traction substations spaced at several hundred kilometers. The specific feature of this project is a joint utilization of communication channels with the remote control system that imposes limitations on the meters handling rate (50 Bd). Communication servers collect data according to a schedule that can be flexibly adjusted.

For instance, if the meters interrogation is performed by means of conventional telephone lines (automatic telephone exchange), then in the day-time the lines can be used by the plant personnel, and at night can be switched over to the data collection system.

Every communication server simultaneously collects data from several communication lines. Several communication servers operating in parallel deliver data to one database server (the 1st level data collection and processing center). Data collection and processing are fully automated.

The software package keeps a continuous track of data completeness and performs additional collection of data that are missing. Then these data are automatically involved in calculations. As the result, the system users continuously follow actual power demand conditions. Information in this case can be represented with a various degree of detailing.

The data collection and processing centers are organized on the basis of servers Windows NT. The professional multiuser ORACLE DBMS is used as the database. The software has the client/server architecture.
In the Alpha CENTER version 2.05.5 the applications load balancing has been performed, thus making it possible for remote users to communicate with the database using conventional telephone lines. Alongside with this, the entire system has a multi-level data protection system (on the OS level, on the DBMS level, on applications level).

Software content

Applied software and maintenance documentation are supplied on CD (415 Mb).

Applied software includes:

- Communication server.
- Calculations server.
- System control modules.
- Package for generation of a basic set of users with an access right differentiation
- Database scheme image (dump) with a completed reference data system.
- Client's software (screen interfaces, reports generating modules).

The delivery includes a coordinated DBMS ORACLE (standard edition) version provided with engineering support for a period of one year and a complete set of applications software installation packages for applications server, communication server and the user workstations.

The advantages of integrated solution represented herein are as follows:

- Parallel data collection
- Parallel calculations and diagnostic system.
- Multiuser mode of operation
- Client/server architecture
- Scalability and extensibility

Final results:

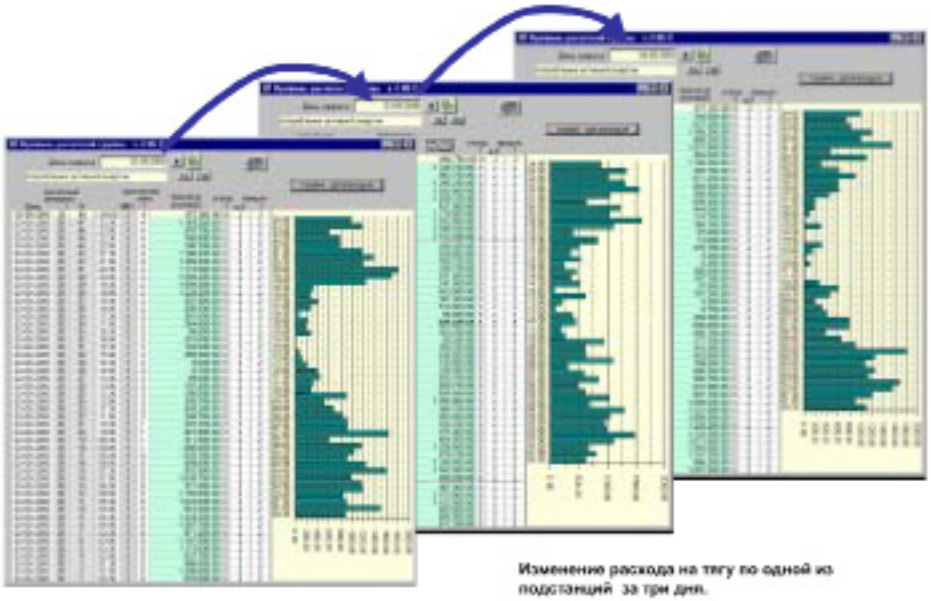
The meters and the system handling expertise testifies to a high efficiency of the solutions applied, namely: reduction in power consumption for hauling operations, overall cutting down of the railroad electric bills costs and reduction in the unit power consumption per unit of cargo conveyed.

These results were obtained due to

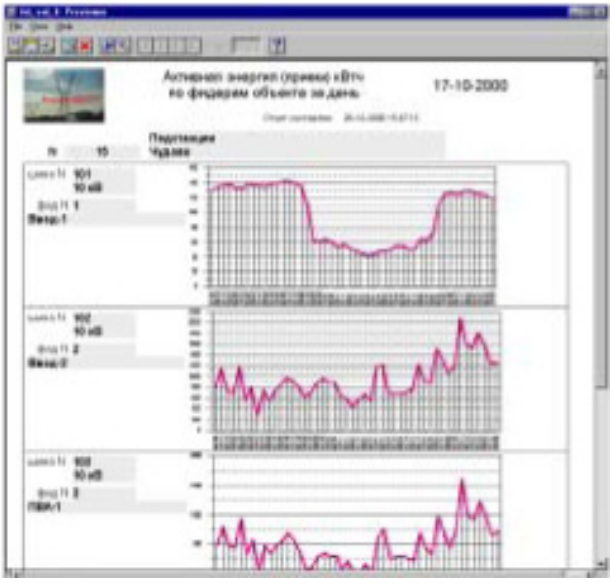
- Increased energy metering accuracy.
- Transition to time-of-use energy billing.
- Reduction of the customer contract demand during the power system peak hours.
- Load control.
- Organization of data collection from the ALPHA meters installed.

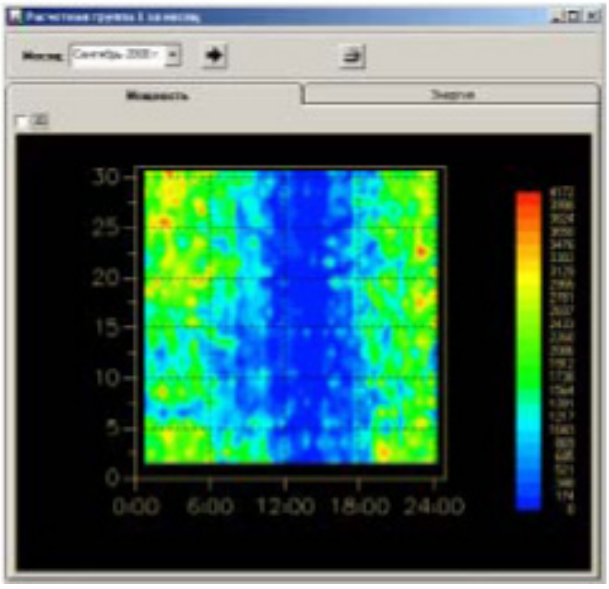
Comprehensive energy resources metering

The next step in the work planned to develop the integrated AMR system for Oktyabrskaya railroad will be elaboration of the automated energy resources metering system for the Oktyabrskaya railroad energy-intensive enterprises (depots, terminals, stations). Introduction of this system will allow the enterprise to organize metering of consumed electrical and thermal power, including hot and cold water, gas by means of installation of energy, heat, water and gas meters and, consequently, to proceed with payments for consumed and metered resources in settlements with their suppliers.



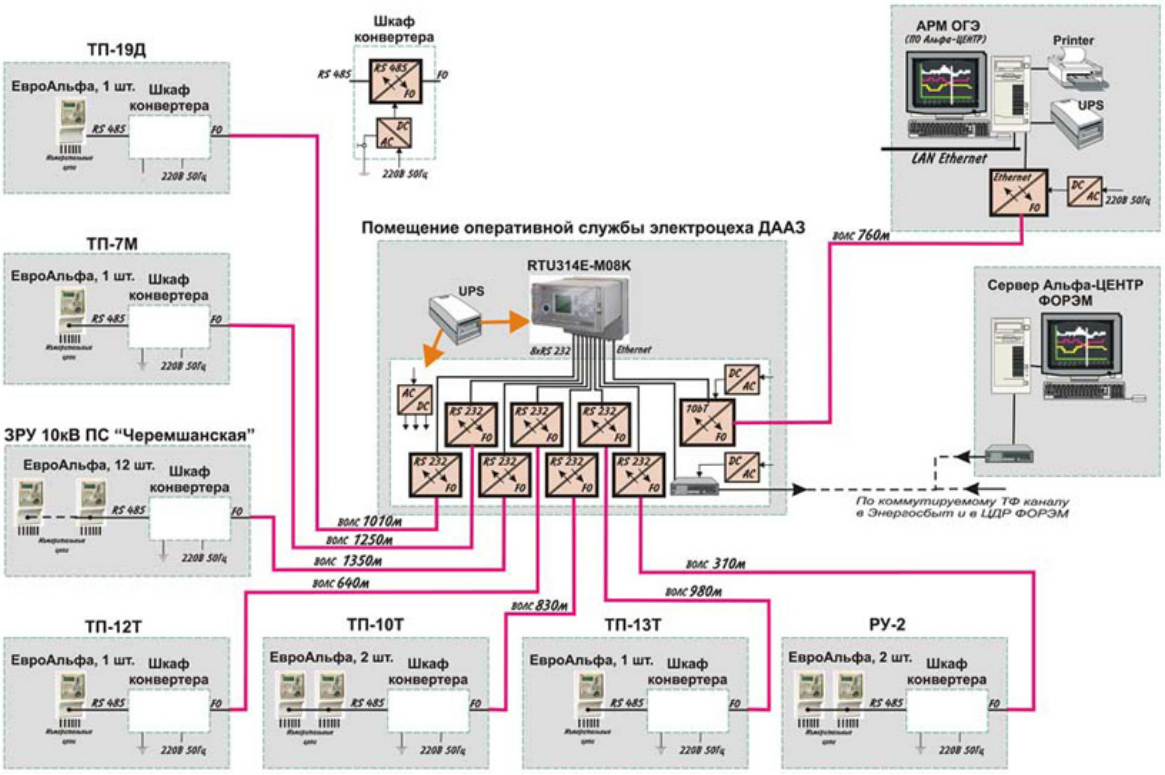
Изменение расхода на тягу по одной из подстанций за три дня.





Examples of Alpha CENTER AMR system screens

DAAZ metering system



In 2001, due to installation of modern metering system the DAAZ managed to enter the FOREM (Federal electricity market).

The DAAZ plant in Dimitrovgrad is a major Russian supplier of carburetors and headlights. The plant manufactures over 1600 various types of products. The article will give you an idea of the ways used to achieve this goal, the equipment which will be installed, and the benefits the plant management is awaiting as the result of metering system introduction.

Initial conditions

At present, most of consumer enterprises purchase energy from the revenue metering departments of regional power utilities. In this case, the pricing is based on the cost of energy purchased in the FOREM, federal customer charges, power utility overheads, cross-subsidizing of preferential customers (residential customers, budget-dependent organizations, etc.) and, consequently, is twice as mush as in the FOREM.

The condition of the energy metering technical basis indirectly, still, considerably affects the energy costs. For instance, the operator-on-duty at the substation which supplies energy to the plant has to daily attend all the meters available and enter their readings in a logbook (it takes 40 to 60 minutes), then pass over these data to the Chief Power Engineer Department. The delay in time and poor accuracy of manual data input and processing are unavoidable. This makes the obtaining of overall plant balance more complicated while making settlements with "Ulyanovskenergo" and residential and commercial customers.

Purpose

To cut the cost of production, the DAAZ management took a decision to change to energy purchase from the FOREM.

For this purpose, the negotiations with "Ulyanovskenergo" were conducted and a permit from the Regional Energy Committee was obtained.

Since one of the basic prerequisites for working with the FOREM is the availability of a certified metering system designed according to the FOREM operator requirements, an agreement for supply of energy billing equipment and a means to organize the energy billing system was concluded with Metronica.

Solution

The system based on metering system Alpha CENTER soft/hardware fully corresponding to specifications delivered by ZAO CDR FOREM was offered for installation at the plant to resolve problems associated with commercial energy billing.

The metering system includes EuroAlpha meters types EA05RAL-B-3, EA05RL-B-3, EA10L-B-3 providing commercial energy metering in billing points of substation "Cheremshanskaya" included in OAO "Ulyanovskenergo" electric networks of the city of Dimitrovgrad, 6 other substations, and residential and commercial customers. Microprocessor based energy meters EuroAlpha provide bi-directional multirate active and reactive energy measurements, logging of load profile data, and recording the maximum demand. The meters are equipped with interface board RS485 (bus interface up to 1,2 km).

For long-distance data transmission it was planned to use the fiber-optic cable providing high speed, security and noise immunity.

The meter data are communicated via digital and fiber-optic communication channels (RS-485, FOCL) to data collection and transmission units (RTU) RTU314E-B04K. RTU-300 are designed for automatic meter readings collection, processing, storage and transmission via telecommunications channels to the higher level.

Meter readings are collected in parallel via several lines with interface converters, if required, IRPS in RS485 and RS232. Data are sent to the manager workstation in the order the meters are interrogated with the following real-time displaying. The manager workstation provides the database generation, data retrieval capabilities, printout of output reports and generation of filing layouts.

Data are transmitted via fiber-optic communications line to the workstation in the DAAZ Energy Billing Department (by means of Alpha CENTER), to "Ulyanovskenergo" Revenue Metering Department and ZAO CDR FOREM via the dialup channel.

ABB VEI Metronica prepared a preliminary design of a system, manufactured and supplied energy meters, RTU, software and other metering and communications equipment. Mounting and supervision was carried out by specialists from the Central Supervisory Department "Elektrocenternaladka".

Achieved results

The first stage of metering system introduction at the plant consists in organizing a real-time energy metering system. At any moment, the shift engineer can obtain overall data on the load profile for plant divisions and individual workshops, including daily average load patterns at any specified time period.

For the second stage realization it is planned to integrate into the system, which has already been put into operation, the capability of measuring the consumption of energy carriers: hot and cold water, steam and gas. Further system development will provide the remote on-line disconnection and control of substation cubicles in the event of the power limitations. In this case, the shift engineer can use the control panel to connect or disconnect any object, substation or switchgear at the energy manager command.

This is especially important in existing conditions, since several independent units have been organized at the plant: lighting fixtures department, production of radiators, bushings and metal-ceramic ware.

All these subsidiary production units make individual energy payments. The introduction of metering system provides the possibility for more accurate determining the cost of products manufactured by each production unit.

All measured quantities are sent to the computer in the Energy Billing Department which handles all settlements with the suppliers. Load patterns for the entire plant and for each individual department are created on the basis of the energy billing system information.

At present, the system is in pilot operation. This year the plant will enter the FOREM.

According to Vladimir Ivanovich Toporkov, the DAAZ chief engineer, "during this year only at the expense of entering the FOREM the plant will save over 30 mln rubles". This will be achieved due to comprehensive commercial billing automation, its higher accuracy and appropriate targeting.

The Customer Company: Surgutneftegaz (oil & gas)

Surgutneftegaz – one of the leading oil & gas companies in Russia.

Starting point:
In recent years, Surgutneftegaz, like all other Oil and Gas companies, was facing the problem associated with a raised share of expenses in the cost of oil.

Main objective: Cut down the cost of oil at the expense of comprehensive updating of electricity metering
One of the ways to raise the efficiency of energy management at the enterprise is mainly associated with energy resources demand metering, and particularly, the electrical energy. That was the reason why Surgutneftegaz took a decision to carry out comprehensive updating of
electricity metering through installation of digital time-of-use meters and organization of advanced automated meter reading system (AMR).

Integrated solution: Installation of time-of-use meters and AMR system introduction
The updating was carried out by stages and finally has been introduced throughout Surgutneftegaz AMR system.

At the first stage of the project the master power-supply sources and some one-part consumers were provided with 2,000 ALPHA meters. The ALPHA meters developed by Elster Metronica were accepted for application as the result of comparison of all electricity metering products available on the market with regard to such features as price/quality, functional capabilities and operation within the AMR system. The ALPHA meters provide electricity and power metering with an accuracy of 0,2S, bidirectional active and reactive energy measurements, storage of billing data for a period of up to 6 months and have digital interfaces for their integration into metering system.

The second stage – integrated AlphaMet solution.
The important task to be solved at the first stage of the ALPHA meters introduction was the formation of a basis for introduction of the AMR system that would be capable of energy and power demand management. In the framework of the AMR system development it has been decided to collect the ALPHA meter readings via various communication channels using the AlphaMet system.

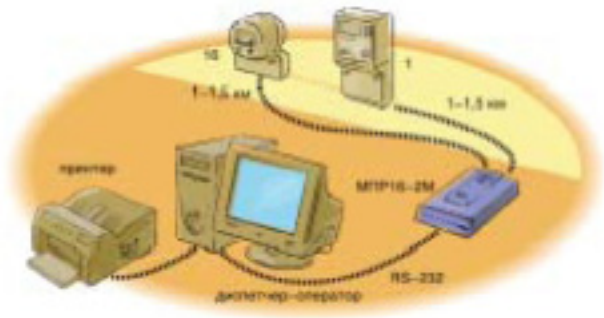
The AMR system allows to perform:
• Active and reactive energy demand metering (including reverse flows) for given time intervals including individual meters, preassigned groups of meters and the whole enterprise with due regard for the time-of-use capability.
• Calculate average (half-hourly) active power (load) values during day- and night-time maximum demand periods including individual meters, preassigned groups of meters and the whole enterprise.
• Generate half-hourly and, if required, three-minute load patterns needed to organize efficient power consumption at the enterprise.
Surgutneftegaz made use of several standard versions of the AMR system organization with regard to the enterprise specific features:

AMR for meters interrogation via optical port

The system of this type was used when the meters were spaced at too large distances, and communication channels were unavailable. In this case the number of meters is not limited since the interrogation is performed "individually" by means of a portable computer via Unicom Probe cable.

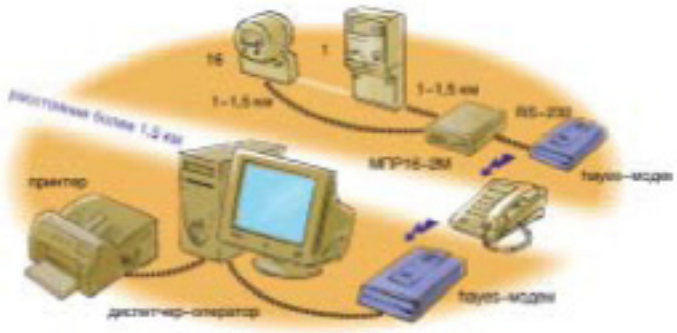
AMR for meters interrogation via multiplexer

For this AMR type the meters interrogation is performed by means of Elster multiplexer which provides possibility for connection of up to 16 meters. In this case the meters are placed at a distance of 1-1.5 km from the computer to which a multiplexer is connected.



AMR for meters interrogation via modem

This way of the system organization was realized at substations having reliable communication channels, the meters were integrated by means of a multiplexer and were placed at a distance of not above 1.5 км from the local computer.



Final results:
Remarkable economic efficiency and reduced cost of oil.

Today, the Metering System system collects and processes data coming from over 2000 energy meters. For the first time, after the meters were installed at master substations, there were obtained virtually true data on the demand quantities and patterns. The forecasting accuracy in energy and power demand remarkably increased and became much more simple.

Expertise in ALPHA meters and AMR system operation at Surgutneftegaz testified to considerable economic efficiency of their application amounting to 88 thous. rubles per one meter p.a. It was attained due to:
- Modernization of commercial and technical billing.
- Remarkable costs reduction due to strict power supervision.
- High forecasting accuracy in probable future demand.
- Optimization of electrical networks performance at the expense of cutting down active energy and power demand.
- Limitations of the power system peak hours active power demand.

A fairly important consequence of the meters and the system introduction is an ever-growing mutual confidence between "Surgutneftegaz" and the Surgut power utilities (who have also installed the AlphaMet system). This became possible due to strict meter data readout supervision mutually performed by the enterprise and by the power utility. Now both, the producer and the customer only enjoy advantages from mutually beneficial cooperation. The former enjoys significant savings in energy demand, and the latter has a reliable client who timely clears the electric bills.

The Customer Company: Kolenergo (power system)

Starting point:

Today, the transition to the market economy requires radical changes in organization and activities in the national power-engineering sector. In recent years, the program for the development of the Russian Federal Wholesales Market of Electrical Energy and Power (FOREM) has been rapidly elaborated. However, this process faces a number of problems, one of them being associated mainly with the necessity to carry out large-scale re-equipment of electricity metering devices and organize automated meter reading systems (AMR).

Main objective: Entering the FOREM

In the framework of transition to the FOREM, Kolenergo outlined its activities as follows:
• Updating of electricity metering. Installation of the time-of-use meters of high class of accuracy 0.2S.
• Elaboration of systems for meters data collection and introduction of higher-level software for data storage and data processing.

New equipment in this case should undergo metrological certification, be certified by the Gosstandart Russian Authorities and be capable to assure proper protection of commercial information

Integrated solution: Organization of the advanced AMR system

In November, 1999 at "Kolenergo Ltd" an intelligent AMR system with the Alpha SMART distributed data processing system was put into commercial operation. The project lasted as long as two years and included the ALPHA meters installation, arrangement of the automated data collection system and a prolonged period of pilot operation. This article will give you the knowledge of the results obtained during the year after the system was put into commercial operation.

Elster Metronica supplied equipment to "Kolenergo Ltd" substations and performed a full scope of work on the system introduction at these substations, system upgrading to meet the Utility and the North-West Integrated Dispatching Service (IDS) requirements including testing of communication channels and the complete system adjustment.

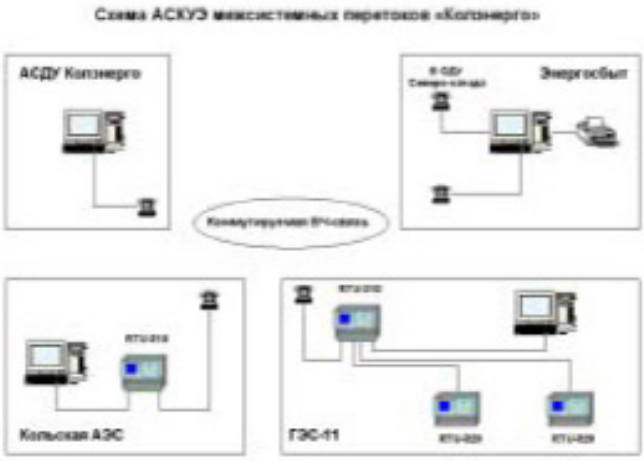
System structure and functions

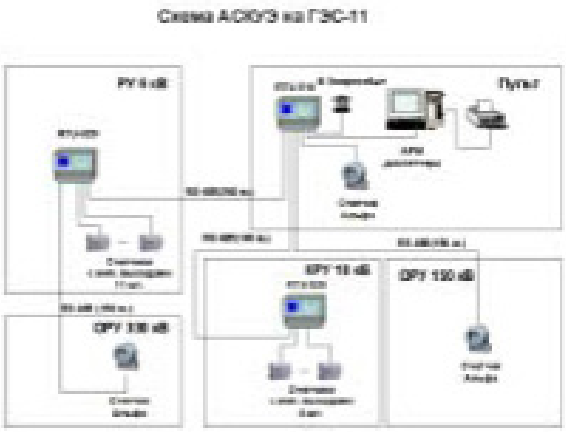
The system includes the Kolenergo intersystem connections with the Kolskaya nuclear power plant and Karelenergo. The system integrates two substations: the Kolskaya nuclear power plant and the hydro power plant GES-11.

The meters data are automatically (in 3-minute intervals) delivered from these substations to data collection and data processing units RTU-310. (The system block diagram is given in figures).
At substations, the RTU employs interface RS-485 for meter data readout. At the Energosbyt and the Automated Dispatching System (ADS) the dial-up PLC channels are used.

Time-shared RTU data are delivered via dial-up channels to:
Energosbyt (once a day) for generation of commercial reports on Kolenergo intersystem connections.
These reports are transferred to the Energosbyt billing department.

The substations are provided with the higher-level software that provides the real-time monitoring.





Works performed

Under this project, Elster Metronica, alongside with production and supply of basic equipment, performed the work as follows:

- Development and coordination of the AMR project.
- System upgrading according to Kolenergo and the North-West IDS requirements.
- Supervision of installation, start-up and adjustment.
- Personnel training.
- System certification at the substation and putting into commercial operation.

The company has undertaken to support the system throughout the whole period of its operation. The warranty period for the whole equipment will be 3 years.

Final results

- Volume and validity of the obtained data on energy flows in the AMR system meet requirements set forth in regulatory documents.
- Data stored in the ALPHA meter fully coincide with information read by PCs.
- The AMR sample output reports meet Kolenergo users' requirements.
- Intercomputer data exchange on interstate flows between Kolenergo and the "North-West" Integrated Dispatching Service (IDS) via dial-up channels was organized.
- Data transmitted to the North-West IDS meet the FOREM commercial metering and billing requirements.

System development

The expertise in the Metering system handling testifies to correctness of engineering solutions applied and shows vast prospects for AMR system based on digital meter data transmission.
In this connection, a decision was taken to continue further development and improvement of electricity metering by means of the following programs:

- Increase the amount of meters at the Kolskaya nuclear power plant to make it possible to calculate the overall balance of the plant.
- Organize dedicated channels between the substations and the Kolenergo ADS to provide supervision of operating conditions.
- Organize the higher level in Kolenergo and Energosbyt making use of UNIX servers and ORACLE database for billing procedure automation.

Metering system for power plants of Dneprovsky cascade

Elster Metronica introduced a unique Alpha CENTER metering system for all eight Ukranian hydropower plants incorporated in the Dneprovsky cascade. The system includes several thousands of ALPHA meters.

By the end of 2002 Metronica has successfully completed introduction of a unique metering system for Ukranian State company "Dneprhydroenergo" which incorporates eight hydropower plants included in a well-known Dneprovsky cascade: Kievskaya, Dneprovskaya, Kremenchugskaya, etc. The system based on ALPHA CENTER metering system includes thousands of ALPHA A1600/A1300 meters, modern controllers RTU300 series, up-to-date computer equipment needed to organize the workstations, dedicated software and communications equipment (modems, multiplexers, etc.).

"Dneprhydroenergo" is the leader among power generation companies in the Ukraine and plays a noticeable part in covering the on-peak demand, control of frequency and demand within the power pool of the country. The company has 8 hydropower plants, its total installed capacity attains 3906,9 MW.

Purpose of metering system introduction

Before implementing the metering system the means of automation in power plants of the Dneprovsky cascade were practically unavailable. Meter readings were collected manually, and operators-on-duty had to regularly visit substations taking readings and handing them over to "Dneprhydroenergo" metering departments for further processing. Another reason that necessitated the introduction of metering system was associated with a highly important part played by "Dneprhydroenergo" power plants in intersystem connections and frequency control within the related power pool, and the need to cover output and demand balance in daily and maximum demand zones of the load profile in the Ukrainian power pool as a whole.

Implementation of the system made it possible to provide means of automation for commercial and technical electricity metering for all power plants, including monitoring of electricity quality parameters, and improve the on-line demand management, cut power losses and increase accuracy of electricity metering.

Realization of the metering system project allowed to secure accuracy of measurements of output and demand including power flows in intersystem connections of "Dneprhydroenergo" neighboring systems; introduce automated collection, processing and storage of obtained data; organize electricity metering in power plants and assure continuous automated monitoring of their operating modes.

Moreover, due to reduction in power losses, extra revenues were correspondingly received. It means that power losses were reduced not only due to higher metering accuracy and validity alongside with shorter time needed for data collection and processing. Introduction of the system allowed to use basic equipment in the most efficient way and improve maximum demand management, analysis, forecasting and planning of power demand depending upon various tariff zones.

The metering system that was introduced made it possible to resolve the following problems:

- attain higher accuracy, validity, integrity and prompt receipt of data on quantitative and qualitative parameters of generated, delivered and received power;
- receipt and archiving of data on power generation and consumption in "Dneprhydroenergo" grid boundary points;
- assure on-line control of execution of operator's load profile schedule for each power-generating unit and increase operability of demand management on the whole;
- reduction of working losses;
- automation of functions used to determine output/demand balance;
- obtaining of actual daily, monthly and yearly load profile intervals of power generating units installed in all power plants based on various energy tariff systems, including real-time tariffs;
- protection against unauthorized access;
- creation of common information environment aimed at observance of commercial interests of each entity acting on the electric energy market

Organization of electricity metering and metering system structure

On the whole, 293 supervised metering points were organized in the power plants of Dneprovsky cascade. To assure higher accuracy, all metering points were equipped with multifunction TOU meters ALPHA A1600/A1300 with an accuracy class of 0,2S and 0,5S designed for TOU tariffs based metering of active and reactive power and demand, as well as for monitoring of electricity quality parameters.

Apart from energy meters, the system includes data collection, processing and transmission units - controllers RTU-314, dispatching centers (workstations) based on Alpha CENTER software, and communications equipment. The system has a two-level structure. The lower level is represented by AMR of all power plants. The higher level – metering system dispatching center (DC) located in the office on the territory of Kievskaya hydropower plant in the city of Vyshgorod.

Metering systems installed in power plants are organized as independent structures which communicate with the dispatching center using dedicated telephone or voice-frequency channels. Power plant data on generated and consumed power is read from controllers RTU-314 by means of modem connected to communication channel. ALPHA A1600/A1300 meters, acting as a primary means of metering, are connected to RTU via digital interface RS-485. Consequently, there are two to four independent communication channels.

A dispatching center (PC based operator's workstation) organized at every power plant and designed for controller data processing, storing and readout is located in the building where the main control panel is installed (control room of a power plant). Its functions include: presentation of electricity metering parameters in the form of displays, documenting of metering parameters in the form of output reports, presentation of information on current status and configuration of the system, provision of the system security based on a system of passwords etc. Interaction between controllers and the operator's workstation is performed via interface RS-232. In the case the two controllers are installed, communication is realized using local area network Ethernet via multiplexer HUB. An uninterruptible power supply (UPS) is provided to assure reliable operation of PCs installed at workstations.

So, information from dispatching centers of power plant metering systems is communicated to the main dispatching center in "Dneprhydroenergo", and then to neighboring grids and other energy market entities.

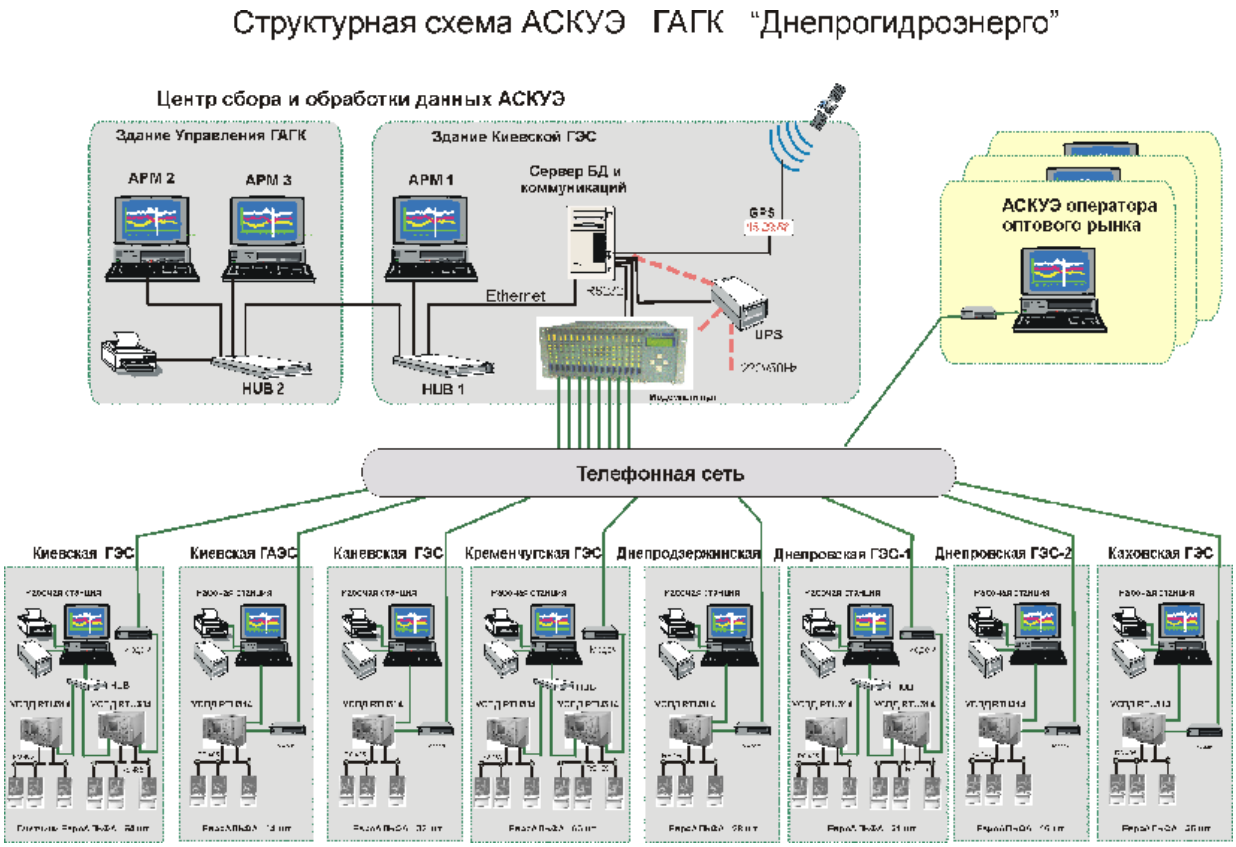
Basic structural components of the dispatching center are represented by the database server, communication server, electricity metering workstations, means of telecommunications (modem pool) etc. Interaction between the dispatching center and power plant metering systems is performed automatically and includes data collection on the level of the power plant, common diagnostics of the system, and system time synchronization. In this case the process of data exchange can be adjusted so as to take place either intermittently, according to preassigned interrogation time, interval and duration, or in compliance with daily schedule of communication sessions, or on operator's instructions.

Conclusion

The implementation of a fully automated electricity metering system laid a basis for reliable and efficient operation of all power plants included in the Dneprovsky cascade and "Dneprhydroenergo" itself known as a major power generation company in the Ukraine.

Perfectly due to the use of the state-of-the-art equipment and software it would be possible to provide comprehensive and highly accurate metering, prompt control of power demand, and consequently improve technical and economic indices of each power plant and reduce power losses.

Introduction of metering system also adds to formation of a unified informational basis for operation and secures commercial interests of any entity acting on the Ukrainian wholesale electric energy market.



Metering systems projects reference list

AMR system Alpha CENTER of "Prospector's Artel Neiva in Sverdlovsk region

This system combines 5 substations that have time-of-use solid-state A1600 ALPHA meters. The information of power consumption is picked up through the optical port. Then this information is recorded into the computer of the operator's desk and then to the Sverdlovenergosbyt's Power Utility server.

Kirovsk region's metering system

Most of Kirovsk region's industrial enterprises use meters of the ALPHA family and AMR systems for control of electric energy demand produced by Elster Metronica. Such largescale enterprises as Kirovochepetsky chemical factory, Kirovsky tyre factory, Kirovsky factory of non-ferrous metals processing, Engineering plant "Molot", Kirovsky factory of leatherette processing and others are among them in Kirovsky region. They consume about a quarter of energy output of Kirovskaya power grid.

All plants that installed the AMR systems has a possibility to settle accounts with power system by differential rates as the one-part consumer. The pay-back period was 1 month on average. The next is installation of the system at 2 plants in Kirovsky region. They are the "Engineering plant named after the 1st of May" and "AVITEK".

AMR system AlphaSMART at Permskaya Hydro Power Station

Permskaya Hydro Power Station is the biggest one in Europe. The system consists of about 40 ALPHA meters, 2 controllers of data acquisition and transmission equipment RTU-300 (for substation 500/220 kV and Dispatching Center) and operator's desk. The information about the installed models 63002 is delivered to the SC "Permenergo" and to the Regional Dispatching Center of Ural.

AMR system of Oil-pipe lines "Druzhba"

The system is built on the basis of ALPHA meters, data acquisition and transmission equipment RTU-300, Alpha CENTER Software. The system covers 3 regional oil departments of the oil-pipe line "Druzhba".

Ferganaazot AMR system

In 2001 Elster Metronica accomplished the implementation of AMR system for "Ferganaazot", leader in producing fertilizers in Uzbekhistan. The system consists of A1600 meters and AlphaMet 2.20 software.

Integrated AMR system of Astana (Kazakhstan)

At the end of 2001 Elster Metronica accomplished the implementation of AMR system in Astana (new capital of Kazakhstan). The system is built on the basis of the software and hardware produced in Elster Metronica (Alpha CENTER system, A1600 meters and data acquisition and transmission equipment of RTU-300 family).

Metering system of UPG of Russia's central power networks

In 2002 Elster Metronica accomplished the implementation of AMR system for United Power Grid of Russia's central power networks (MES of Center). The system covers 19 regions of central Russia including Moscow and consists of: 500 ALPHA meters, controllers RTU-300, primary and support equipment for AMR, PCs, communication servers, Alpha CENTER software.

Power Utilities

AMR system Surgut netorks (1996-97)
Tyumenenergo, Russia, West Sibiria
Equipment: ALPHA polyphase multifunctional meters (500 pcs), software, primary and support equipment for AMR (Automated Meter Reading system)
Solution: AlphaMet ver.2.16

Modernization of metering equipment (1996-97)
Tyumenenergo Russia
Equipment: ALPHA meters (4000 pcs), AlphaMet software, primary and support equipment for AMR, Establishing of Service Center in Tyumen region
Solution: EmfPlus, reading through optoport

Automation of metering in Tbilisienergo (1999-2000)
AES Telasi, Georgia
Equipment: ALPHA meters, software, primary and support equipment for AMR, AMR Alpha SMART
Solution: Alpha SMART

AMR systems of generation of Yarenergo (1999-2000)
Jarenergo, Russia
Equipment: ALPHA meters, software, primary and support equipment for AMR, AMR Alpha SMART
Solution: Alpha SMART

AMR Kolenergo (Appatity, Severo-Nickel, mining and processing enerprise, Murmansk port) (1999 – 2000)
Kolenergo, Russia
Equipment: ALPHA meters, controllers RTU-300, ALPHA meters, software, primary and support equipment for AMR, AMR Alpha SMART, PC, communication servers, data bases. Establishing of Service Center with Calibration and Testing laboratory
Solution: Alpha SMART

AMR system for Power Utilities of Armenia (USAID finance) (1999-2000)
Ministry of Energy of Armenia
Equipment: ALPHA meters (10,000 pcs), controllers RTU-300, ALPHA meters, software, primary and support equipment for AMR, PC, communication servers, data bases, Alpha CENTER (Oracle + Windows NT/2000)
Solution: Alpha CENTER

AMR system MES CENTER (2001-2002)
United Power Grid of Russia
Equipment: ALPHA meters (500 pcs), controllers RTU-300, ALPHA meters, software, primary and support equipment for AMR, PC, communication servers, data bases, Alpha CENTER (Oracle + Windows NT/2000)
Solution: Alpha CENTER

AMR system turnkey project for Dneprohydroenergo (2001-2002) (EBRD finance) Alstom for Ukraine customers
Equipment: ALPHA meters (350 pcs), controllers RTU-300, ALPHA meters, software, primary and support equipment for AMR, PC, communication servers, data bases, Alpha CENTER (Oracle + Windows NT/2000)
Solution: Alpha CENTER

Industry

Organization of metering in Noyabrsk Oil and Gas company (1996)
Noyabrsk Oil and Gas company, Russia
Equipment: ALPHA meters (400 pcs), AlphaMet software, primary and support equipment for AMR
Solution: EmfPlus, optoport

AMR Surgutneftegas (1997-2000)
Surgutneftegas, Russia
Equipment: ALPHA meters (2000 pcs), software, primary and support equipment for AMR, AMR AlphaMet, PC, communication servers, data bases. Calibration and testing laboratory
Solution: AlphaMet 2.19, dedicated, dialup lines, optoport

Modernization of meters on Tatneft (Oil & Gas) (1999)
Tatneft (Oil & Gas)
Equipment: ALPHA meters (1000 pcs), software, Calibration and testing laboratory
Solution: EmfPlus, AlphaMet

Udmurtneft (Oil & Gas) (2000)
Udmurtneft
Equipment: ALPHA meters (500 pcs), software
Solution: EmfPlus, AlphaMet

AMR systems for Urengoygazprom, Tymentransgaz, Lentransgaz, Mostransgaz, (1996-99)
Gazprom
Equipment: ALPHA meters, software, primary and support equipment for AMR
Solution: EmfPlus, AlphaMet

AMR system for Oil pipeline "Druzba" (1999-2000)
Transneft
Equipment: ALPHA meters (1,000 pcs), controllers RTU-300, ALPHA meters, software, primary and support equipment for AMR, AMR Alpha SMART, PC, communication servers, data bases
Solution: Alpha SMART

AMR for Russian Railways (1996-2004)
Ministry of Railways of Russia
Equipment: ALPHA meters (10000 pcs), controllers RTU-300, ALPHA meters, software, primary and support equipment for AMR, PC, communication servers, data bases, Alpha CENTER (Oracle + Windows NT/2000)
Solution: EmfPlus, Alpha CENTER

In all projects: development of requirements specifications, project specifications, training, verification and commission

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