WEB BILLING SYSTEM SCADA AMR

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Abstract: *SCADA AMR is the technology of automatically collecting consumption, diagnostic, and status data from energy metering devices (gas, electric) and transferring that data to a central database for billing, troubleshooting, and analyzing. Digital multi-tariff meters ZMD are widely used for electricity metering. However, existing systems SCADA AMR [1] cannot process data from these counters in the protocol DLMS/COSEM [2]. Therefore, an actual problem is the development of methods and means for the modern protocol systems. The article deals with the elaboration of the architecture and description of the opportunities of system SCADA AMR with data processing multilevel protocols DLMS, HMI.*

Key words: *SCADA, AMR, multilevel protocols, DLMS, HMI.*

INTRODUCTION

The SCADA AMR system [3] is designed to automate the process of control and account of the electricity amount consumed by the station's generators for their own needs, and amount released into the common power system. A distinctive feature of the system is: a wide range of communication channels from PLC to GSM /CDMA VLAN and protocols for exchanging with meters from IEC1107 up to modern protocol DLMS/COSEM. Objectives of the system SCADA ARM are the following:

- automation of commercial and technical metering of electricity;
- providing accurate, reliable and timely information on the generating, releasing and consumption of electricity for own purposes;
- ensuring the fulfillment of the load schedule with the required accuracy;
- reduction of the unbalance level of capacities to an acceptable level;
- ensuring the possibility of creating of tariff zones;

The developed system provides automation of the following processes:

1) Collection and initial processing of information, that include:
   - automatic remote interrogation of meters;
   - transfer (exchange) of information to another SCADA AMR;
   - interrogation of counters by means of the portable computer with the subsequent loading of the information in a DB SCADA AMR.
2) Information processing, consisting of:
   - calculation of the balance of the energy center in accordance with the instruction for accounting for electricity in power systems;
   - calculation of losses in transformers;
   - calculation of the permissible unbalance and comparison with the actual one;
   - presentation of accounting information in the form of tables, graphs, diagrams, trends, representations of mnemonic schemes;
   - calculation of the average values of the measured parameters for certain time periods
3) Information storage, archiving
4) Displaying information with HMI:
   - display of information on the monitors of workstations;
   - obtaining paper documents on printers.
5) Single time service, synchronization by GPS signals.

System SCADA AMR provides:

1) Operational control:
   - constant monitoring of the values of active, reactive and total electrical energy and power.
   - background mode for tracking deviation of specified values from specified values with audible and visual alarm to the duty operator;
   - construction of load and consumption curves with discreteness of construction of 1, 3, 5, 10, 15, 30, 60 minutes;
   - - real time visual control: load current (for each phase), supply voltage (for each phase), frequency of the mains, phase shift between current and voltage.

2) Statistical control:

- Daily graphs of the averaged over the hour intervals values of active and reactive power for each point of external assignment;
- summary graphs of the values of active and reactive power averaged over hourly intervals by external connections;
- current values of active and reactive power from the beginning of the month for each point of.

SYSTEM SCADA AMR ARCHITECTURE

To perform the above functions has been developed multi-level architecture of the system consists of the following components (Fig.1):

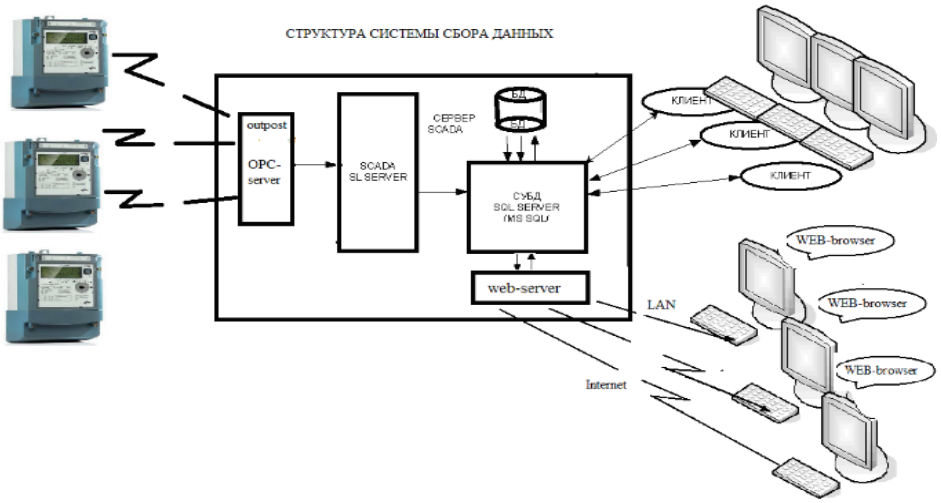


Fig. 1. Generalized configuration of the SCADA AMR.

1. The information collection system "Outpost" (OPC server) is designed to collect information from devices for collecting current and historical data from meters by means of available communication channels (Ethernet, RS485, etc.).
2. The server program "SCADA-SL Server" is designed to collect readings from meters and other operational data and to write them to the SQL database for storage and subsequent display in the operational and retrospective modes.
3. SQL DBMS - is designed to store the collected information.
4. Sec-Admin - a program that allows to administer the rights of users of the system to access data.
5. Information display system "SCADA-SL Client" is designed to display information stored in the DBMS. This program differs in its extended capabilities and assumes highly professional staff.
6. WEB-server - provides an interface between the data base SQL BMS and users of the Internet, which by means of any WEB-browser at their disposal, can view the information intended for them in on-line mode. This feature is relevant for residential consumers.

This system has following technical characteristics:

- The number of meters connected to the AMR is unlimited;
- The number of client programs simultaneously connected to the AMR database is unlimited;
- The period of storage of information in the AMR database is unlimited;
- Frequency of automatic interrogation of meters is in accordance with the specifications and in fact is limited by the characteristics of the communication channel and the protocol of the exchange of the counter;
- Types of connected meters are ZMD, SET, CE, Indigo and any other counters with digital interface and exchange protocol such as DLMS (Device Language Message Specification) or COSEM (COmpanion Specification for Energy Metering);

7. Complete correspondence of meter readings and information in the DB MS SQL as the counter reading is done via industrial network interface Modbus RTU, convertors Ethernet.[4].

• Coordination of the operation of the complex with IS "Denergo"(DnestrEnergo).

The most significant to the user is the Program "Client". Dwell on the description of this program.

The information display system "SCADA-SL Client" consists of the following main components:

1) Programs.

With the help of programs all incoming information is displayed in different ways:

- operational - FRAMES - Kadry;
- retrospective - VEDOMOSTI - Vedo.

The program "FRAMES" is intended for graphic display of:

- current (last received) readings of sensors, meters installed at the facilities (Fig.2);
- synthetic values, calculated on the basis of current values using formulas;
- fictitious values specified by means of Graphs or Manual Input;
- current state and context switching of Switches;
- the current state of Tele signaling;
- current status of communication channels.

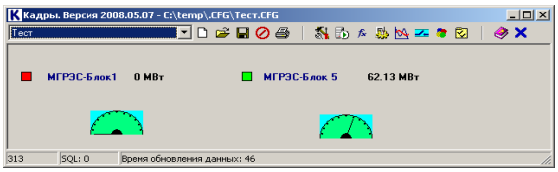


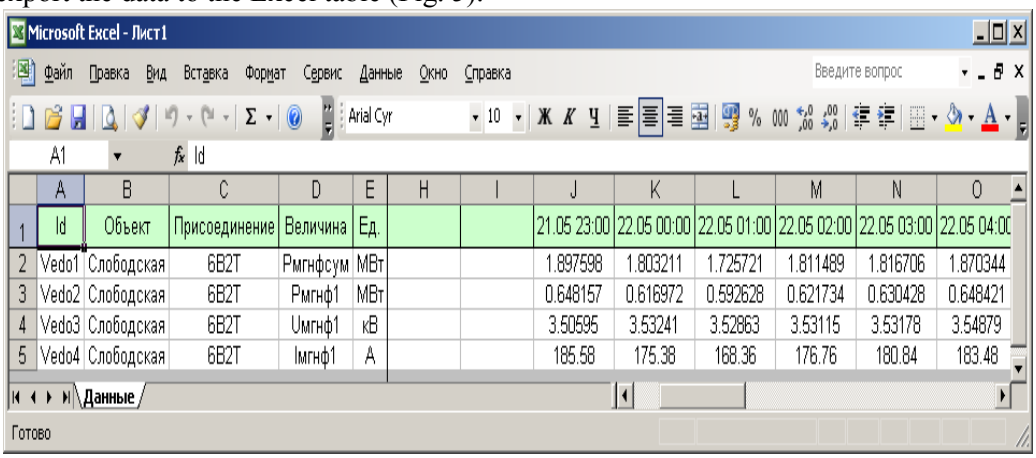
Fig. 2. Frame "Test", containing a variety of visual objects, "Working" mode.

The program "VEDOMOSTI" is intended for graphic display of:

- retrospectives of the readings of sensors, meters installed at the facilities;
- synthetic values calculated on the basis of retrospective values with the help of Formulas;
- retrospectives of fictitious values specified by Graphs or Manual Input.

The program "VEDOMOSTI" allows to:

- view the retrospective data in the form of a table through the "VEDOMOSTI" program (Fig. 3);
- calculate on the basis of the Balance sheet data (Fig. 4);
- export the data to the Excel table (Fig. 5).



	A	B	C	D	E	H	I	J	K	L	M	N	O
1	Id	Объект	Присоединение	Величина	Ед.			21.05 23:00	22.05 00:00	22.05 01:00	22.05 02:00	22.05 03:00	22.05 04:00
2	Vedo1	Слободская	6В2Т	Рмгнфсум	МВт			1.897598	1.803211	1.725721	1.811489	1.816706	1.870344
3	Vedo2	Слободская	6В2Т	Рмгнф1	МВт			0.648157	0.616972	0.592628	0.621734	0.630428	0.648421
4	Vedo3	Слободская	6В2Т	Umгнф1	кВ			3.50595	3.53241	3.52863	3.53115	3.53178	3.54879
5	Vedo4	Слободская	6В2Т	Iмгнф1	А			185.58	175.38	168.36	176.76	180.84	183.48

Fig. 3. Example of Sheets in the "Work" mode.

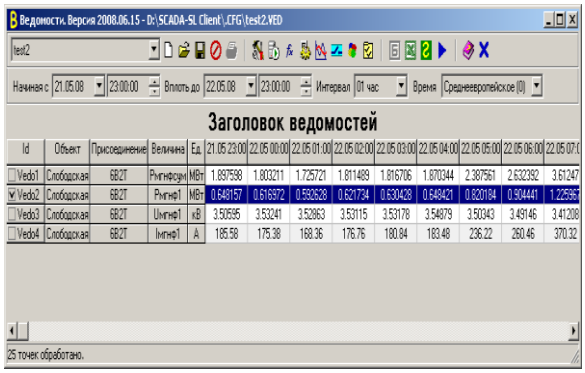


Fig. 4. The balance sheet based on the VEDOMOSTI data after pressing the "Show Balance" button.

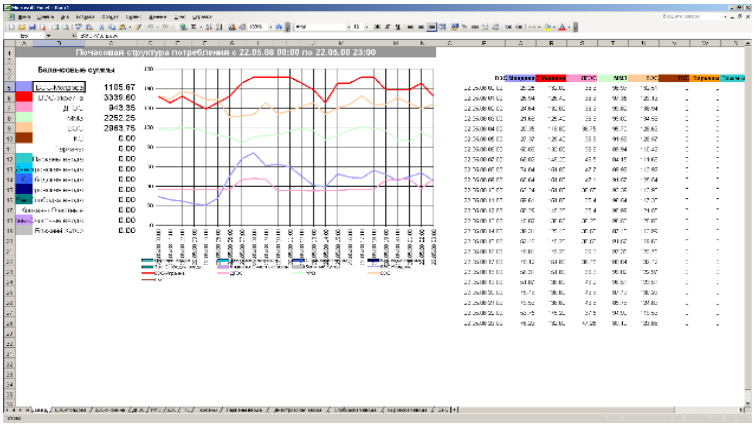


Fig. 5. Table in Excel, after clicking the button "Export to Excel".

2) Directories. Editors and directories allow to manage the parameters and characteristics of the system that affect the calculation and display of data.

• Formula Editor - allows to create and modify the calculation formulas.

• ShowGuide - allows to assign names to the incoming values in accordance with the objects and connections to which these values correspond, assign values to coefficients, offsets, and other characteristics.

• The graphics editor - Graphics - allows to insert the values for telemetry on a daily schedule, composed by hand

• The manual input editor - Subst - a simplified analogue of the graphs (for quantities that do not change during the day).

• Switches Editor - Switches - allows to create and edit Switches, give them names.

3) Help - Help files contain help and a description for programs and directories.

CONCLUSION

The elaborated system now is in a trial operation at the enterprise Denergo. The implementation of developed system architecture allowed additionally to read data from 125 meters in the protocol DLMS. The readings of digital meters located within the boundaries of the RM come online every 15 minutes from 32 substations 330/110kV. This system greatly enhances and improves the quality of accounting and control of energy consumption both in a separate company and throughout the country.

References

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