Billing system SCADA ARM

Vladimir JDANOV
Technical University of Moldova Departament SDE
Jdanov1@yandex.ru

***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. This technology mainly saves utility providers the expense of periodic trips to each physical location to read a meter. Another advantage is that billing can be based on near real-time consumption rather than on estimates based on past or predicted consumption.**
AMR technologies include mobile and network technologies based on GSM/CDMA platforms, }wired Ethernet or powerline transmission.
In the article is considered the program complex SCADA ARM which is developed together with SA Sandrologic]1]} and is used in the power system of the Republic of Moldova.
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 DLMS/COSEM[2].
Index Terms-SCADA,AMR,multilevel protocols,DLMS,HMI.

1.INTRODUCTION

The SCADA ARM system[3] is designed to automate the control and accounting of electricity generated by the station's generators consumed for the plant's own needs, received and released into the power system.
.Objectives of the system SCADA ARM :
- automation of commercial and technical metering of electricity;
- providing accurate, reliable and timely information on the generation, release and use of electricity for own use;
- 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 tariff zones;
- Unification of accounting in the electricity market of the Republic of Moldova.

The list of functions and tasks subject to automation:
1) Collection and initial processing of information
- automatic remote interrogation of meters;
- control of the reliability of information;
- grouping of counters for total accumulation (parameterization);
- grouping of information (read data);
- diagnostics of hardware and software;
- information exchange between system components;
- manual input of information;
- transfer (exchange) of information to other 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
- 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;
- Information processing with the purpose: 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
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;
- visual control, in real time:
o load current (for each phase);
o supply voltage (for each phase);
o frequency of the mains;
o 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 connection;
- total values of current values of active and reactive power from the beginning of the month by external connections;
- Daily graphs of the averaged over 15 minutes (3-minute) intervals of active power values for each generator;
- total daily charts of the averaged over 15 minute (3-minute) intervals of active power values for all generators;
- current values of active electricity from the beginning of the month for each generator
- total values of current values of active electricity from the beginning of the month for all generators;
- total values of the current values of the consumption of active electricity for own needs from the beginning of the month;**2. SYSTEM SCADA AMR ARCHITECTURE**

The multi-level architecture of the system consists of the following components(Fig.1):

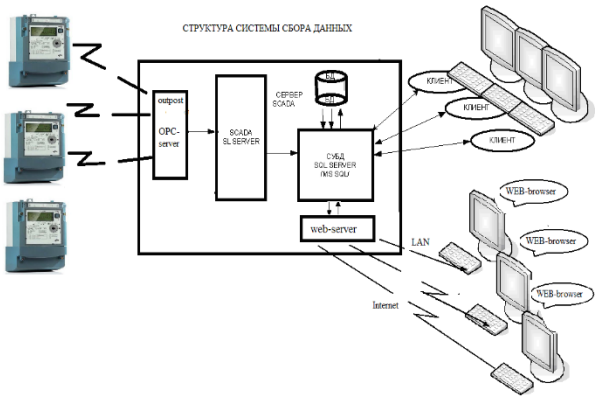


Fig. 1. Generalized configuration of the SCADA AMR.

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 data collection devices 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 you 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 wide possibilities, its use is supposed by the qualified personnel of the enterprise.
6) WEB-server - provides an interface between the DB SQL:MS and users of the Internet, which by means of any WEB-browser at their disposal, can view the information intended for them in on- mode. line

Brief technical characteristics of the complex:
• 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 - in accordance with the specifications (in fact limited by the characteristics of the communication channel and the protocol of the exchange of the counter)
• Types of connected meters - ZMD, SET, CE, Indigo and any other counter with a digital interface and a exchange protocol such as DLMS:
"Device Language Message specification•/COSEM: "COmpanion Specification for Energy Metering"
Complete correspondence of meter readings and information in the DB MS SQL.
The counter reading is done via industrial network interface Modbus RTU, convertors Ethernet. [3].
• Coordination of the operation of the complex with IS "Dnesrtrenergo".

Program "Client" is the most significant to the user.
The information display system "SCADA-SL Client" consists of the following main components:
1) Programs.
2) 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:
- 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 Telesignaling;
- current status of communication channels.

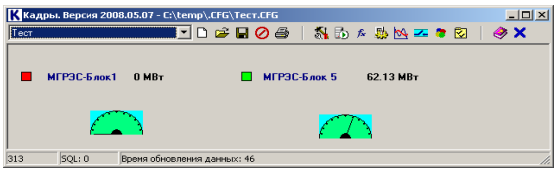


Figure 2. Frame "Test", containing a variety of visual objects, "Working" mode.

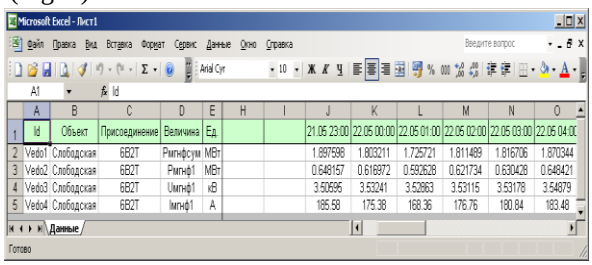
The program "Vedomosti" is intended for graphic display:
- retrospectives of the readings of sensors, meters installed at the facilities;
- synthetic values calculated on the basis of retrospective values with the help of Formulas;
- Retrospectives of fictitious values specified by Graphs or Manual Input.

The program "Vedomosti" allows:
1) view the retrospective data in the form of a table through the "Vedomosti" program (Figure 3);
2) calculate on the basis of the Balance sheet data

(Fig. 4);

3) export the data to the Excel table (Fig. 5);

4) build on the basis of the data Graphs in Excel (Fig. 6).



. Figure 3. Example Sheets in the "Work" mode

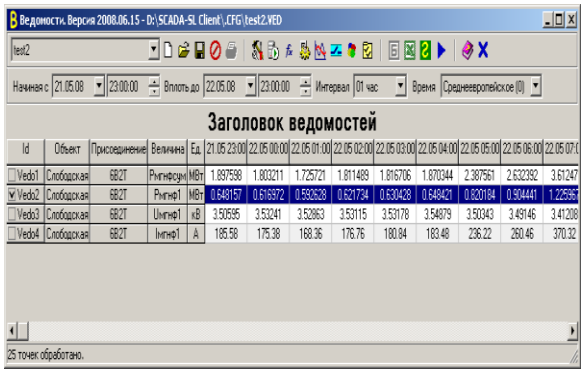


Figure 4. The balance sheet based on the Vedomosti data is the result of pressing the "Show Balance" button

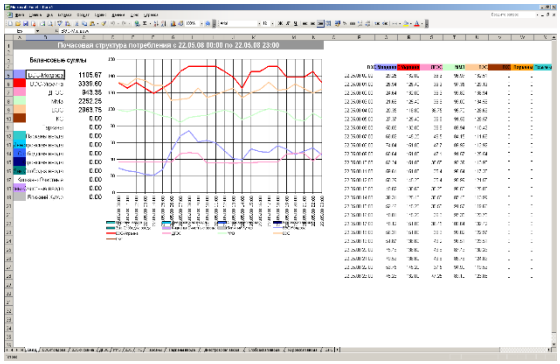


Figure 5. Table in Excel, created on the basis of the data Sheet - the result of clicking the button "Export to Excel".

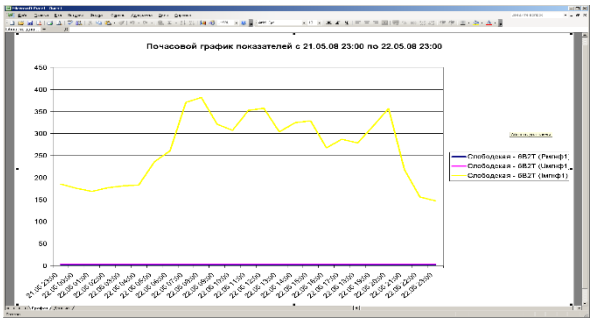


Figure 6. The graph in Excel, built on the basis of the data Sheet - the result of clicking the button "Show graphs."

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

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

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

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

CONCLUSION

The system is successfully operated in the power system of the Republic of Moldova, showed its reliability and efficiency. the readings of digital meters from the borders of the RM come online every 15 minutes from 32 substations330/110kv.

REFERENCES

[1] SCADA SL.http://www.sanrologic.com.

[2] DLMS/COSEM/http://dlms.com.

[3] Vtyurin V.A. Automated control systems for technological processes. Fundamentals of automated process control system- SPb: SPbGLTA. 2006. - 152 pp.

[4] Industrial Network Solutions Moxa. http://moxa.com.