SCADA SOLUTIONS IMPLEMENTED IN THE ENERGY SYSTEM

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The main purpose of this paper is to present an example of SCADA configuration used in the structure of actual national electricity system company, implemented by national company of electricity SC ELECTRICA SA Using powerful technologies, based on experience of qualified personal, SCADA applications are created as a main tool for performing management, required by technical reengineering of an industrial company.

Keywords: SCADA, industrial, system, PLC, RTU.

1. INTRODUCTION

Using powerful technologies, based on experience of qualified personal, SCADA (Supervisory Control And Data Acquisition) applications are created as a main tool for performing management, required by technical reengineering of an industrial company. In modern manufacturing and industrial processes, mining industries, public and private utilities, leisure and security industries, control systems are often needed to connect equipment and systems separated by large distances. These systems are used to send commands, programs and receives monitoring information from these remote locations. SCADA refers to the combination of control systems and data acquisition. In the early days of data acquisition, relay logic was used to control production and plant systems. With the advent of the CPU (Central Process Unit) and other intelligent electronic devices, manufacturers incorporated digital electronics into relay logic equipment. The PLC (Programmable Logic Controller) is still one of the most widely used control systems in industry.

Throw the advantages of the SCADA system, we remind:

- the computer control primary equipments, record an store a very large amount of data from process;
- the operator can incorporate real data simulations into the system;
- the operator is assist by computer that recommend actions to keep the system safety;
- many types of data can be collected from the RTUs (Remote Terminal Unit), this creates online the image of the system.

The main purpose of this paper is to present an example of SCADA configuration used in the structure of actual national electricity system company, implemented by national company of electricity SC ELECTRICA SA-ROMANIA. The particularity of this application consist on the fact that the main RTU distributed by TELVENT-

Spain, integrates through standard protocols equipments from distinguished producers. The software used in this application is created by OASYS – Canada and through the RTU integrates equipments dedicated in energy system applications (ABB, SEL, Merlin Gerin, Power Measurement, Trench, etc).

2. SCADA SYSTEM – GENERAL DESCRIPTION

Based on the builder's offer, a newly process concerning Ghimbav 110/20 kV power station modernization was created. This process integrates reliable equipments offered by the well-known energy leaderships. In fact, it was designed as unique command-control system to get all these equipments and Telvent's offer (third worldwide SCADA solutions producer) was accepted. The main characteristic of this solution consists in getting all necessarily information from the equipments, to have SCADA solution for every station, accordingly to the requests from the project description.

2.1 A Short Description of SAITEL 2000DP Equipment – High Technology Platform Designed for Process Automatization and System Management

SAITEL 2000DP product (fig.1) was designed as new equipment which improves the actual requests and is coming up also for the future ones in the control process. It is designed as open system and is capable, first of all, to be interconnected with other standard systems which are currently on the market and, on the other hand, to accept new technologies to be integrated in an easy way.

Fig.1 SAITEL 2000DP Equipment

More precisely, SAITEL 2000DP is the latest control and data acquisition terminal version offered by Telvent company. Some of the features for this equipment are flexibility, modularity, powerful and the most important one is represented by the processor which is offering an easy way of handling with I/O and a lot of possibilities to communicate with other equipments. Because of the fact that it's available in different configurations, it can be used as RTU, PLC or information and data management equipment.

2.2 Description of Ghimbav Application

In order to configure the application supervision of Ghimbav station, the Canadian software – OASyS – is used, which is running under WindowsXP operating system. Thus, SAITEL 2000 equipment integrates all the equipments used by the command and control system and handles on data acquisition. Also, only parts of the information were included, the rest of them are integrated in SEL and ABB equipments. Correspondingly to 20 kV and 110kV bay units, the control and command panels are integrated in the supervisory system presented in fig.2 and are using standard protocols implemented via data starcoupler and adapters.

Further on, the control and monitoring systems implemented in case of 110/20 kV Ghimbav power station, are described as a basic application of the OASyS high-power stations control, monitor and protection numerical system.

This project is based on two separate systems:

1. Station control system.
2. Station monitor system.

The main functionality of these systems is strictly attached to numerical terminals (ABB, SEL, POWER MEASUREMENT and MODICON) and realizes the protection, control and monitoring functions related to bay unit level.

2.2.1 Station Control System

This system is designed to command the primary equipments by the station operator or, directly by the dispatch center which informs the operator the basic and secondary equipments state. The control system contains the following components:

- PC HP Compaq PIV – used to command the station by the operator and it's applied in the command room; also, it's the hardware support for MyOASyS application;
- MyOASyS application – represents the interface "human-machine" between the operator (from the command room) and process (basic and secondary equipments);
- PC HP Compaq PIV – used for communication with the dispatch center, where the dispatch can command the basic and secondary station circuits;
- Command-panels for every bay unit, as a backup for SCADA command;
- Command-control-protection equipment, as a component of SCADA system, main functions: primary equipment commands; primary and secondary equipments functionality tracking; cell's protection and automatization;
- The communication between the local PC and some bay terminals is realized through the integration and management equipment for the used protocols, based on different types of communication lines. Another role of SAITEL 2000 DP is to adapt the following protocols (IEC 870-5-103, SPABUS, DNP 3.0, Modbus) to the next equipments: REF, SEL, SPAU, SPAF, SACO, POWER MEASUREMENT, MODICON;

- Terminal's internal time synchronization; in order to get a clear sampling of the produced events in the controlled process, all the terminals that are making part from the control system, should have a common time base (synchronous behavior). To fulfill this request, a small resolution (one millisecond) is used for the synchronization tact, which is periodically generated by a GPS device (Global Position System) that is placed in the local computer. The synchronization tact is send to the SAITEL 2000 DP RTU device, which is synchronizing all the used equipments (ABB, SEL,-POWER MEASUREMENT, -SCHNEIDER Electric);
- The communication between cell terminals and RTU is realized on FO and based on master-slave principle presented in fig.2 (RTU is the master of communication and the terminals represent the slave part).

This system is made from the below components:

- Software packages: MyOASyS program realizes the terminals' parameters setup;
- Bay terminals (REF, SEL, ION, SPAU, SPAF, SACO, MODICON);
- The communication between cell terminals and RTU.

2.2.2 Station monitor system

This system is made from the below components:

- Software packages: MyOASyS program realizes the terminals' parameters setup;
- Cell terminals (REF, SEL, ION, SPAU, SPAF, SACO, MODICON), as a part of the system, are configured with dedicated software and parameterized through MyOASyS program (both operations – parameterization and records reading – can be done from the station PC);
- The communication between cell terminals and RTU is realized on FO and based on master-slave principle (RTU is the master of communication and the terminals represent the slave part). The transfer speed of communication based on FO is set to 1,2 Mbit/s. RTU connectivity with PC is done through a switch which is connected to one of SAITEL 2000 DP processor communication port.

2.2.3 Network Computer

MyOASyS system is installed on the Personal Computer (PC) and is running under Windows 2000 operation system. In dispatch center, an identical computer used for monitoring and/or remote operations is tied in TCP/IP network with station RTU. The connection between the dispatch computer and RTU is redundant realized through phone modem and FO. The network contains the following components: a printer for events/alarms, phone modems and FO switches.

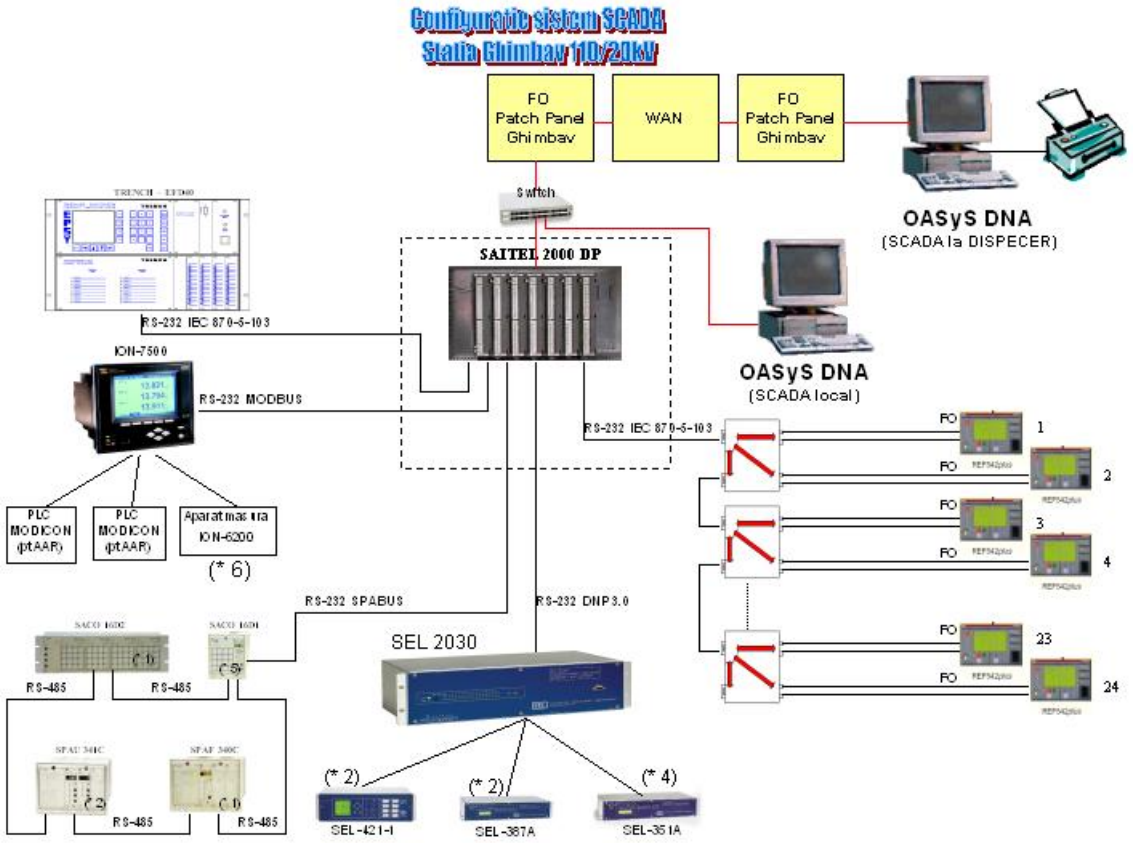

Fig.2 Ghimbav 110/20 kV Station - SCADA System Configuration

2.3 Protection and Command Terminals Integrated in Remote System

2.3.1 REF 542 Plus Terminals

The remote system integrates all the information related to bay level 20kV through the REF 542 Plus terminals. These are connected to the SAITEL 2000 DP RTU through FO/RS232 converters (CR2F type). This terminal is used as an individual terminal for every 20kV bay from substation. It can assure all the command, control and protection functions for a cell in general, but in Ghimbav case, only parts of these functions are implemented:

- circuit breaker command from cell;
- primary equipments interblocking (this blocking of the equipment it depends on the other primary equipments positions from the station);
- reservation function of an equipment which is under a command (one single apparatus can be commanded in the same time);
- active and reactive power, frequencies, voltages and currents measurement;
- events records;
- serial communication through FO.

2.3.2 SEL 421, SEL 387A Protection Terminals

The main purpose of SEL 421 terminals is 110 kV line protection from Ghimbav 110kV substation. Accordingly, all the line bay are covered by the SEL 421 protection. Main functions of this equipments are:

- distance protection blocking at voltage disappear;
- active and reactive power, voltages and currents measurement;
- fault locator and failures recorder;
- RAR(Automatic reclosure) with synchronous control;
- voltage monitoring from the continues power supply.

On the other hand, SEL 387A terminals are protecting the power transformers. Herewith, some of the main functions are described below:

- differential protection;
- maximum protection in case of current overflow;
- failures recorder.

2.3.3 ABT (Automatic Busbar Transfer)

These automatizations are realized using the Modicon-Schneider Electric programmable controller, which are integrated in SCADA system according fig.2. Through the available I/O was established the command logic which is doing the automate switching in of the backup. Also, distinct equipment are assured for low and medium voltage.

3. CONCLUSIONS

Using dedicate equipments to control, command and protection functions, offered by well-known vendors from energetic equipments domain, the presented application integrates SAITEL 2000DP equipment, through one of the international leaderships in SCADA projects. The application is answering to the modernization requests of a 110/20 kV station. This project can be extends in the future both in case of modern projects as well in case of building of new objectives. The preceding was created, tested and is answering to the request.

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