INTRODUCTION

A very important range of issues in the investments field, for a Romanian utility, is represented by the power substation retrofit and modernization, numerical protections, SCADA and DA projects and applications. Even in the case of an advanced degree of physical and moral ageing of the equipment, nevertheless, the present business environment requires a better control and monitoring level, simultaneously with the improvement of the power quality parameters in cost-effective conditions.

Modernization projects were achieved and commissioned mainly in the last ten years and, due to fund shortages, they included only a small part of the existing network. Considering the geographical coordinates of the dispatcher centers, the existing communication infrastructure or feasible by sustainable costs, correspondingly to the organization changes, different solutions and technical variants were adopted in the early stages. It became possible to emphasis on a sum of conclusions about the cost-effectiveness, reliability, expandability and open structure to further developments of the systems we have until this moment.

A more reliable outlook on the subject was subsequently built, inside the firm. The established strategy and criterions allow our company to supply electrical power as required by the performance standard and according to the quality and environmental standards. They also permit a more efficient use of the investment funds for the achievement of an integrated control system of the power network.

Both the technical solutions offered by manufacturers representing brand names in the industry, as well as local solutions are put in work. In the medium voltage network remote control, with reclosers and sectionalisers, local solutions were adopted.

LOCAL CONDITIONS AND MODERNISING CRITERIONS FOR THE POWER NETWORK

The introduction and development of the SCADA systems in the 110 kV distribution network represents one of the strategic long-term objectives of our company. For these investments several criterion and stages are set up. Among the target criterion we mention:

- The consumers’ importance and the amount of the transited energy;
- The importance of the substation as a connection knot;
- The geographical location;
- The availability of the communications support.

ELECTRICA – Muntenia Nord S.A. provides the electricity distribution and supply in the center and east of Romania, on a geographical surface of 29,765 square kilometers, for approximately 1,300,000 clients. The 110 kV power distribution network of the company has 2300 km overhead lines and 121 substations of 110/Medium Voltage. Likewise, there is a number of 84 Medium Voltage substations (most of them being 20/6 kV) and 9500 Medium Voltage/Low Voltage substations or MV connection points (Figure 1).

The company’s power networks covers 6 romanian counties with six relatively important towns and various industrial activities, agriculture and tourism. As operational coordination we have two area dispatchers for the high voltage network and substations, seven local dispatchers for the medium voltage network and MT/LT substations and one dispatcher coordination office.

From the primary equipment and secondary circuits’ condition point of view, the substations range in several categories:

I. Transformation substations with an acceptable technical condition, needing only works for numerical protections and remote control systems;
II. Substations needing the improvement of their technical condition, partial modernization plus numerical protections and remote control systems;
III. Substations needing a complete replacement of the primary equipments and secondary circuits;

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Nevertheless, despite the optimistic division of these substations into several categories, a SCADA concept cannot be created starting from the present electromagnetic protections and automations, existing in most of the electric substations. Taking into account that the numeric equipments combine commands, data acquisition and communications, it is required a common strategy for the entire system of secondary circuits, part of the integrated IT and communication system within the company. Likewise, the commutation equipment, circuit breakers, disconnectors, are old-fashioned, with a low reliability, therefore they must be replaced almost in every substation where retrofit works are being performed.

There is a number of 18 substations driven by remote control panels with transistor equipments and 17 more substations with devices that exclusively allow signaling, based on
transistors’ technology as well, so there is a total of 35 substations with remote control equipment based on the seventies or early eighties’ technologies. Now there are only 4 High Voltage substations with complete numerical protections and SCADA solutions offered by prestigious suppliers in the field. The relatively small number of substations with performance solutions is connected to the investment possibilities in the field. There is a clear medium- and long-term disadvantage in the great ratio between the substations having a technically obsolete remote control system and the ones in which there are modern SCADA systems already implemented or in the progress of being introduced. We must remind in this context that the electricity distribution service is regulated by the performance standard issued by the National Regulatory Authority (ANRE), the number and length of discontinuities being strictly monitored.

If the number and length of discontinuities is exceeded, it may lead to litigations and claims for compensations from our consumers. It is obvious that the electricity supply and distribution in compliance with the supply quality and safety parameters involves monitoring and managing the networks by reliable and updated equipments, from the technological point of view. Ultimately, applying the numerical technologies in the management of the electric distribution networks becomes an essential component in the efficient management of the company.

A number of 70 remote controlled reclosers and sectionalisers were placed in the most important medium voltage overhead lines in the last four years. The remote control package and software is provided by a local firm, on a Windows 2000SF platform, but remains the problem of integrating the application in a SCADA concept.

ACHIEVING A SIMPLE SCADA SYSTEM

Significant modernizing actions for a large number of substations were impossible to sustain, so that lead to the trend of achieving a simple SCADA system, with the help of our own specialists. Firstly, this was feasible for the substation with obsolete remote control panels. A retrofit associated with an up-grade of the system was established both for reliability/availability reasons as for service operations cost. This development took several years, being fulfilled by the IT personnel and followed closely by the dispatching and safety specifications. The software application uses the Visual Basic and the Windows Xp platform and allows managing a large amount of information, user-friendly graphical interface and the remote control of the substation. This approach offered the possibility to implement SCADA functions in several substations with, comparatively, very low price. Also, it can be adapted for various distribution automation applications, such as MV substation monitoring and control. Initially, the software allowed the disappearance of the classic control panels with transistors from the dispatching points and the computer management of the power substations. Later on, the software has been improved, up to the present variant TLM-04. Likewise, adaptations of the drafts have been necessary, namely the achievement of some new montages for the equipment’s time basis and a multiplexer in the control post. The software must permanently roll, the computer being dedicated. This solution has solved a punctual problem, allowing the dismantling of the old panels with transistors, light bulbs, analogical gauges and command keys. Most of these elements generating faults
have been eliminated. For the moment, a part of the substations still uses the initial execution panels. Subsequently, the same personnel made a step further by conceiving an RTU and a IED bay terminal for the purpose of controlling other substations without previous remote control systems, but using the software they developed.

Nine 110/MV and one MV/MV substation benefit from this gradual development of their remote monitoring and control systems, with limited funds, but with positive results in terms of reliability, availability and operation cost. This approach has given promising results and there is still place to apply the technical solution conceived inside the firm [1].

TURN-KEY SCADA PROJECTS

For our first modern 110/20/6 kV substation (Figure 2) it was adopted a control system with functionally decentralized structure. There are three levels of control:

- Local level no. 1: emergency maneuvers equipment. They allow the operator a rapid control without password;
- Local level no. 2: control panels from the control room for maintenance or back-up of the centralized level;
- Central level: the normally status for the substation control, allowing a complete configuration of the system and peripheral devices.

Two protection groups, each of them with basic and back-up protection, were adopted on the overhead lines and power transformers, as a new switching substation for a very important consumer. A designing error was the cause of the only brake-down we had, the deterioration of the server internal source. Also, a misjudgment in the training strategy caused a more difficult understanding of the software, for the personnel.

We distinguish between two levels of control (Figure 3), as follows:

A. The 6 kV bay level including numerical protections and the transformer differential protections to carry out function of protection and control. These IEDs are connected by optical fibre with the RTU, using IEC 60870-5-103 protocol. The control functions are:

- 3 switching devices control and monitoring;
- signal acquisition;
- analog values acquisition;
- bay single-line diagram display;
- status LEDs;
- accessible event logging/fault logging;
- measured value supervision;
- timing resolution;
- serial port for local maintenance;

Substation protections and automations:

- 6 kV busbars protections;
- close command interlockings;
- breaker failure protection (ANSI 50BF);
- underfrequency protection (ANSI81U);
- backup closing automation;
- oscillographic fault recorder in the control room;

B. At the substation level, the following equipments and functions are implemented:

- the substation computer (RTU);
- connection monitoring of the FO with IEDs;
- substation level interlocking;
- GPS time synchronization;
- signal monitoring and control;
- communication with the IEDs via standard protocol;
- communication with the HMI (human machine interface);
- serial communication and local maintenance via modem;
- communication with the SCADA control center (local dispatcher) via IEC 60870-5-101 protocol;

The software components of the HMI:

- Windows NT 4.0 platform;
- the on-line process software;
- object oriented graphical user interface;
- SQL data base;
- events list, alarm list, filter capabilities after time or field.

As it was already mentioned, for the moment there are only 4 substations with numerical protection and a modern SCADA system, included in the technical trends, each of them being supplied by a different manufacturer. Positively, it is not the best way for the interoperability of an integrated system, so this will be one of our concerns for the future.
CONCLUSIONS

The first steps in the retrofit of the remote control systems, substations' secondary circuits, protection, control, and the achievement of the SCADA systems brought us to the importance of an articulated strategy in the field. The economic efficiency and a performant availability of the electric power supply for the company’s clients is a challenge we face, and our development concepts should be tailored following these goals. Certain documents of the National Regulatory Authority, like The Power Network Technical Code, stipulate the requirement of an integrated SCADA system.

The trend for the future SCADA extensions is the integration of the overall system from the bay level to the control center interface with fast data handling and reliable operations. However, the concepts and settings should support a direct exchange of data at the bay level, avoiding communication bottlenecks.

In the following years we’ll probably choose relatively simple solutions, cost-effective and involving low commissioning and training. We even think it is the right moment to re-examine some of our projects.

The integration of different manufacturers' devices in a interoperable system structure with, preferably, the latest IEC 61850 standard protocol will be an essential requirement. Supplementary functions and options must be added when necessary, in a flexible manner, subsequently to the investments possibilities.

REFERENCE

1. Ion Paun, Mihai Contescu, Daniel Craciun, Adrian Ionescu, A new approach in the substations remote control and monitoring based on a gradual development, R.4-08., CIRED Regional Conference, Herceg Novi, October 2004.