CONFIGURABILITY OF A SCADA SYSTEM – APPLIED IN SOMES RIVER HIDROELECTRIC PLANTS

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Abstract: The hydroelectric power plants are in a process of rehabilitation and are upgrading to ensure optimized operation. One possibility of optimizing the power production plants is to provide the remote control of all power production units using a SCADA system. An important characteristic of the telematic Somes SCADA system is its adaptability. It means that the system is able to configure its components concerning some specific requirements, even if these are modified throughout the system's life. It is possible to configure automation equipment components such as: digital input/output, analog input, communication transfer parameters, data acquisition parameters, dynamic screen controls and plant parameters such as: power, voltage and current limits, control loops parameters.

Keywords: configuration, adaptability, SCADA, telematic system

1. INTRODUCTION

In implementation of the telematic system an important asset is the configuration tool. The power plants are functionally similar, but each has its own characteristics. To avoid recreating the same product in different shapes, a configuration tool had to be created. The configuration function is necessary in order to:

- enable the user to update the programs according to the rehabilitation process
- make the implementation work easier
- group the elements on the functional entities
- declare the status of some functional entities
- customize the parameters on the user screens
- customize the report texts
- help the service process by including specific information

This paper briefly presents the configuration functions implemented on SCADA on Somes River. This configuration is drafted on the hydroelectric plant's computer at the local level. The updated configuration file is transported by the communication network to the central dispatching level. This ensures that the whole system works with the same updated configuration at all instances.

2. TYPES OF CONFIGURATION

There are different types of configuration functions, according to the specific field of application. Several categories can be identified:

- **application configuration** regroups the elements that make up each part of the system and contains:
  - the number and the name of the electronic power meters and transducers
  - the number and the name of virtual defined parameters (software virtual power meters)
  - the operating status of the different devices and the characteristics of the connection to the serial bus
  - the configuring of the electronic power meters (type, logic number, transfer parameters, voltage and current multiplication factors)
- **automation equipment components configuration** contains variables that correspond directly to the field automation inputs and outputs (see figure 1)
  - digital input configuration
  - digital output configuration
  - analog input from PLCs
  - analog input from electronic power meters

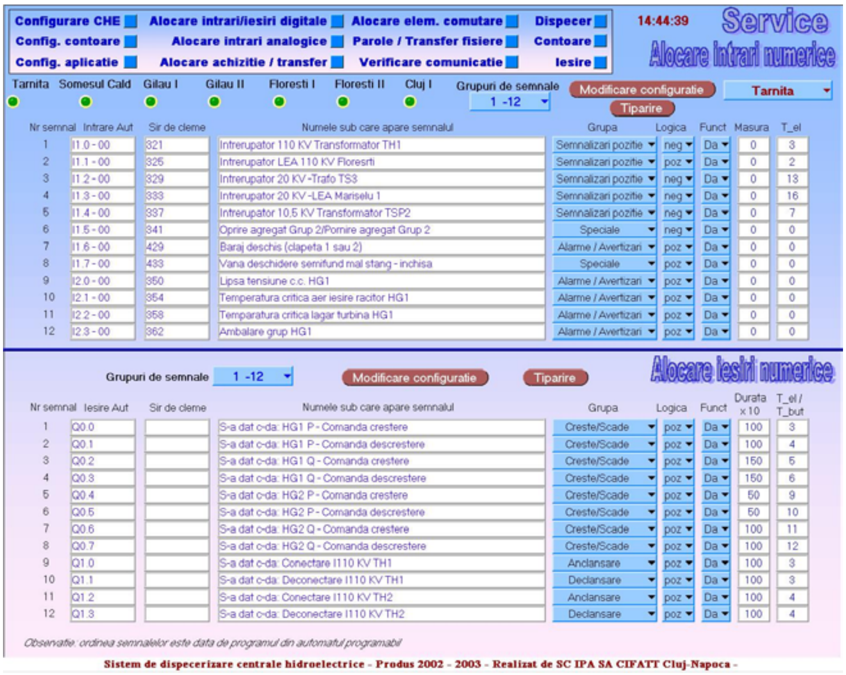

Figure 1 – Digital input Digital output configurations

- **user interfaces configuration** provides liaisons between user interfaces controls and process parameters, it contains:
  - switch elements types
  - configuration of the command buttons
  - measured parameters of customized features on the screen (labels, measuring units, screen appearance)
- **configuration of the automation process** contains variables in direct connection with the automation process:
  - control loops tuning parameters
  - upper and lower limits in the alarm and warning process
  - the timing of critical operation (maximum duration, rate value)
- **customizing the reports**; there are tools for developing a particular user reports containing:
  - configuration of the data acquisition data base (order of acquisition parameters, types and origin of each parameter)
  - representation of the graphical visual data
  - data reports denomination
- **security access configuration** group together information for the system security:
  - defining the access levels

  - configuring the passwords for each type of level and the associated person
- **customizing the communication parameters between local and central level**; this configuration tool allows the transfer between different levels in order to define the important and necessary information, and includes:
  - configuration of the transfer (length, type and origin of the transferred information)
  - special transferred information

All these configuration tools are implemented in different user screens. Each of these contains tables of specific structure, which are represented in files. There is also a correspondence between different tables because of the complexity of the application.

3. CONNECTION BETWEEN DIFFERENT CONFIGURATIONS STUCTURES

The system is created from modules but represents a unit. The configuration process is a complex one. It is recommended that experts acknowledge all the implications of the different changes within the configuration tables. Figure 2 presents the correlation between different types of configurations steps, as well as their influence in the whole process.

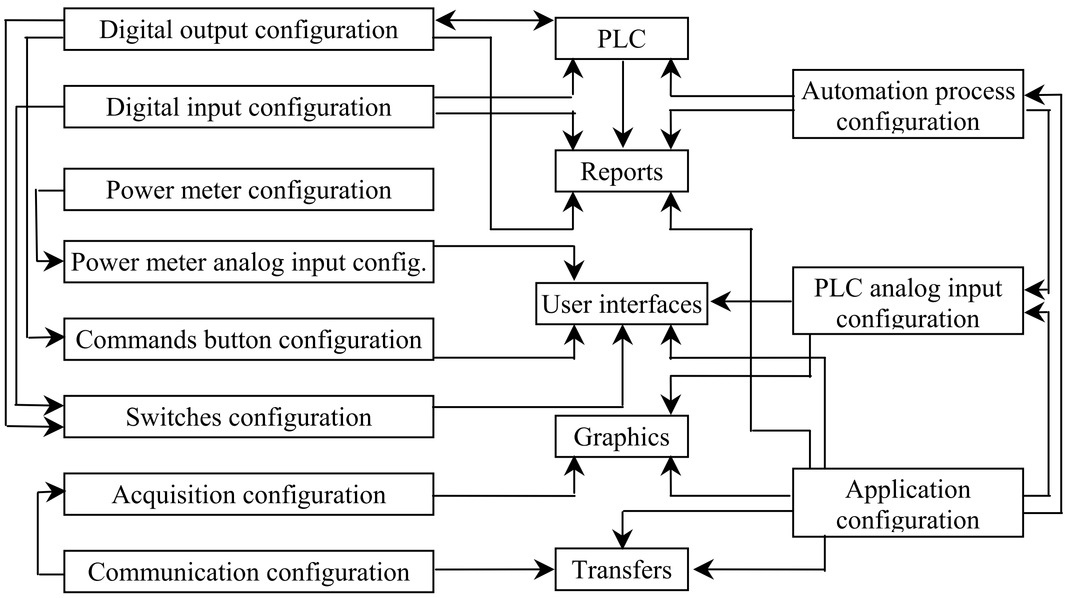

Figure 2 - Correlations between different types of configurations

For instance, a change in the digital input configuration has implication on the switch configuration (if the change is made to a switch), has implication on the PLC (where the image of that specific switch is cached) and influence the report.

For practical reasons it is good to have the possibility of increasing the telematic capabilities. Some switches on user screens, which are not yet remote controlled, are prepared to perform this function in the future. In the switch configuration interface a switch can be:

- remote controlled with feed back position
- local controlled with feed back position

- remote controlled without a feed back position from the process
- local controlled without a feed back position.

The digital output configuration creates an output (declared, but not functional) and all the liaisons between the two types of connection are made. Digital input configuration creates an entry for the switch position (declared, but not functional) and the correlation between the switches configuration and digital input one are made. The process connection (cables) are put in place.

Thus, a switch that is not remote controlled yet, is prepared to turn into a remote controlled one in the future only by changing some of the configuration tables (type of switch and two functional declarations), operations that may be completed by the user.

4. CONFIGURATION STRUCTURE

The whole program includes different configuration tables. In this chapter we shall present some examples of such allocation possibilities.

a) Digital inputs configuration

The elements that can be configured regarding digital inputs are in connection with different parts of the application. We shall present the scope and use of this structure:

a1 - signal number (all inputs are numbered, depending on the four multiplying selection types)
a2 - the position in the PLCs input channel
a3 - the connection in the automation board
a4 - the name of the signal (the name that appear in the report spreadsheet)
a5 - type of entry; it can represent:
= a switch position (connected or disconnected)
= an alarm (on or off)
= a special signal in connection with the user interface (starting position, closing one, type of command)
a6 – the logic level (positive or negative) of the signal
a7 – the functionality status of the signal
a8 – the affiliation to a functional group
a9 – the connection between such an element and a table with all the switches from the screen (see bellow).

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2	I1.1 - 00	325	Intrerupator LEA 110 KV Floresrti	Semnalizari pozitie	poz	Da	0	2

The configuration of a single component influences: the automation configuration zone, the report area, the user interface customization and the service.

b) Analog inputs configuration

There are two different configurations according to the origin of the analog signal. If the signal proceeds from the PLCs, its structure is:

b1 - signal number
b2 - the position in the PLC – input channel
b3 - the name of the signal (the name that appears in the report spreadsheet)
b4 – the operating status of the signal

b5 – the resolution for computing the measured value (CAN source values by the PLC)
b6 - the displacement for computing the measured value
b7 – the offset for computing measured value
b8 – name of the parameter in the user interface
b9 – the measured unit represented in the user interface
b10 – the number of the decimal digits
b11 – the upper limit in the alarming process
b12 – the lower limit in the warning process

If the signal is provided by the universal power meter there are some differences regarding:

- the origin of the signal (power meter number and the signal represented)
- the multiplying scale factor needed for representation in the user screen (in opposition with the base unit)

c) Electrical power meters configuration

An individual user screen represents the configuration of the electrical power meters. As it can be seen in figure 3 one can program: the type, logic number, transfer parameters, voltage and current multiplication factors. A selection control makes changes between different plans.

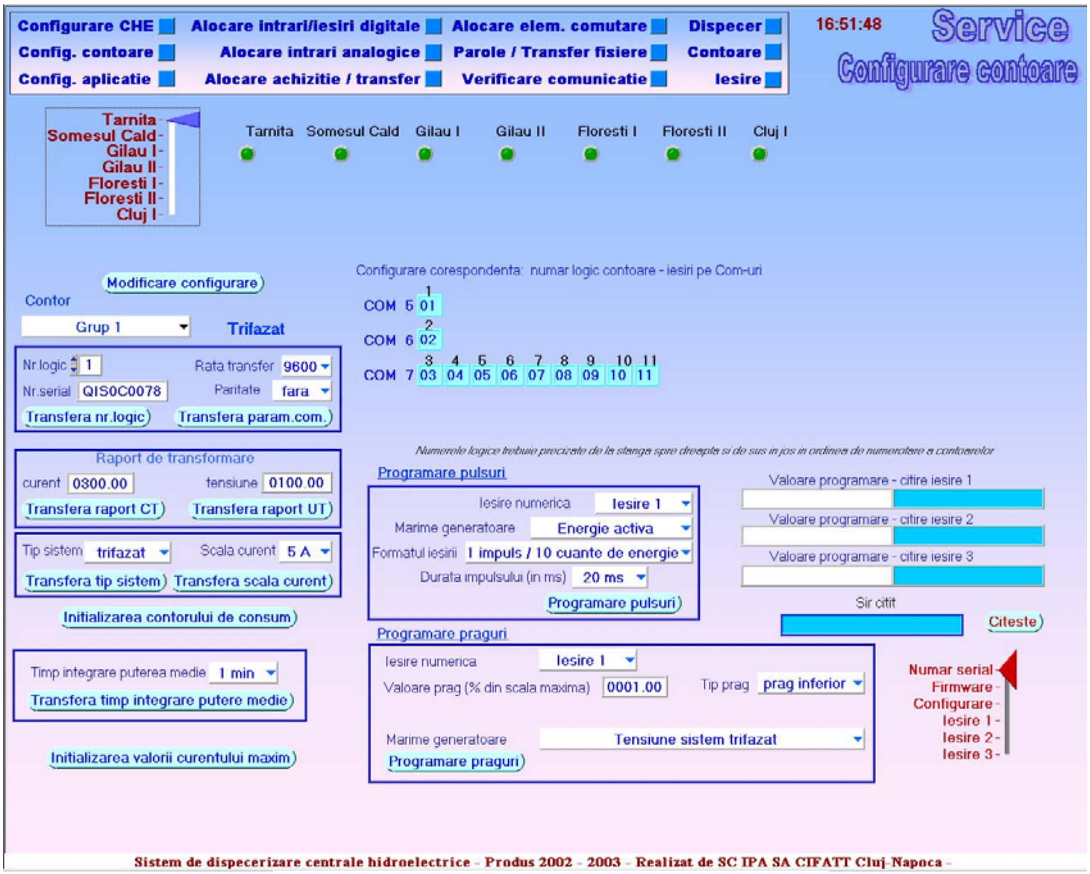

Figure 3 – Power meters configuration

According to different devices, it is necessary to have special interfaces to program the specific parameters.

5. STANDARD CONFIGURATION

A problem that has to be confronted by this complex configuration is avoiding the intruder modifications. Due to service reasons it is possible to make some changes and than forgets to go back to the initial conditions.

The program creates a **Standard configuration.** This configuration is declared only after the entire test is completed and for a long period of time it remains the base configuration.

When one of the fourteen configuration tables is changed another file corresponding to that configuration is created. All the changes affecting the standard configuration are stored in special reports, which can be consulted at any moment. The dispatcher or other authorized person can consult the modification, their date and author. A configuration history is thus created. This ensures that an old report be compatible with the present configuration.

6. CONCLUSION

The need to develop high quality and flexible software programs is nowadays stringent. Even if software developing is not an easy job and requires excellent skills, it still has to be done, as it allows reducing of the implementation costs and ensures a repeatability of the modules, which can be reused in similar applications. It can also avoid some unpleasant events occurring at program installation; the system can thus continue to work even if some components are damaged.

Another important issue is the level of competence and skill of the persons who implement the program. With flexible programs, persons with a medium level of studies can perform the implementation.

It is possible that in the future the configuration of programs attain such complexity that it requires inventing a new human profession: *the configurator*. He would know what to do in order to implement without knowing how the software was developed. The *configurator* would be involved in the installation process, while the user would do the continuous updating of the program.

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