A&QT-R 2002 (THETA 13)
International Conference on Automation, Quality and Testing, Robotics
May 23-25, 2002, Cluj-Napoca, Romania

TELEMECANIC SYSTEM FOR HYDRO-ELECTRIC POWER PLANTS ON SOMES RIVER

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Abstract: Hydroelectric power plants are supervised, according to a certain established schedule. Remote measurement can be accomplished in an automate way using an automatic telemeasuring system. Paper is focused on such kind of system, PC-based distributed architecture with three levels: local and connection interface at the hydroelectric power plant level and the central one at the territorial dispatcher. These kinds of systems handle both software and hardware techniques based on PC, PLC, smart sensors and remote data transferring methods.

Key works: telematic-supervising system distributed automation architecture, dynamic demonstrator, electric power energy parameters

1. INTRODUCTION

Remote measuring and data acquisition system for hydro plants supervising intends to achieve modernisation of telemechanics equipment at all the Somes River hydroelectric power plants. The system implementation starts with Somesul Cald and Tarnita plants. To the existing equipment it's attached a remote measurement and control system, commanded by computing systems and digital processing units.

The telematic system is basically three main levels structured:

a) **local level** – the hydro-electric power plant unit transducers and actuators and data acquisition equipment;

b) **data conexion level** – placed inside hydro-electric power plant, represented by a computing system attached to local level using serial data communication network RS485;

c) **central level** - electric power plant dispacher, based on computing system connected to the data conexion level by a remote data communication system.

Telemechanics system located at the dispatcher level is connected with equipment from hydroelectric power plant using leased line telephone or GSM modems.

2. TELEMECHANICS SYSTEM – BRIEF DESCRIPTION

Tele-mechanics system processes electrical measurements (analog and digital signals) acquired from hydroelectric power plants electric equipment. The digital signal represents the switching equipment and protection level status. The analog signals

include electric parameters such as: voltage, currents, power factor, frequency and energy parameters: active, reactive and apparent power and energies.

The automation system – structured in two hierarchical levels - consists of PC based computing systems, programmable logic controllers - PLC, and smart measuring devices. These computing equipments are located:

- primary level - located at central dispatcher is composed by two computing systems (IBM PC compatible);
- secondary level - located inside hydro-electric power plants is structured by:
  - one computing system,
  - one PLC Simatic S7,
  - a smart powermeter network
  - a flowmeter with serial data communication port.

Hydroelectric power plants Dispatcher Equipment Configuration. Primary level is composed by two computing systems Intranet connected, equiped with multiport serial communication interfaces. Because the system works in real time it provides a serial communication channel for each one of the supervised hydroelectric power plant and its own modem. The central level can be equiped with a GSM modem, which supply the communication task when the telephone line is damaged or disconected. The computing systems are running the software applications for all the hydroelectric power plants dispatching. There are three power plants superized by the first computer and other four plants by the second computer. Figure 1 details the implemented configuration (March 2002).

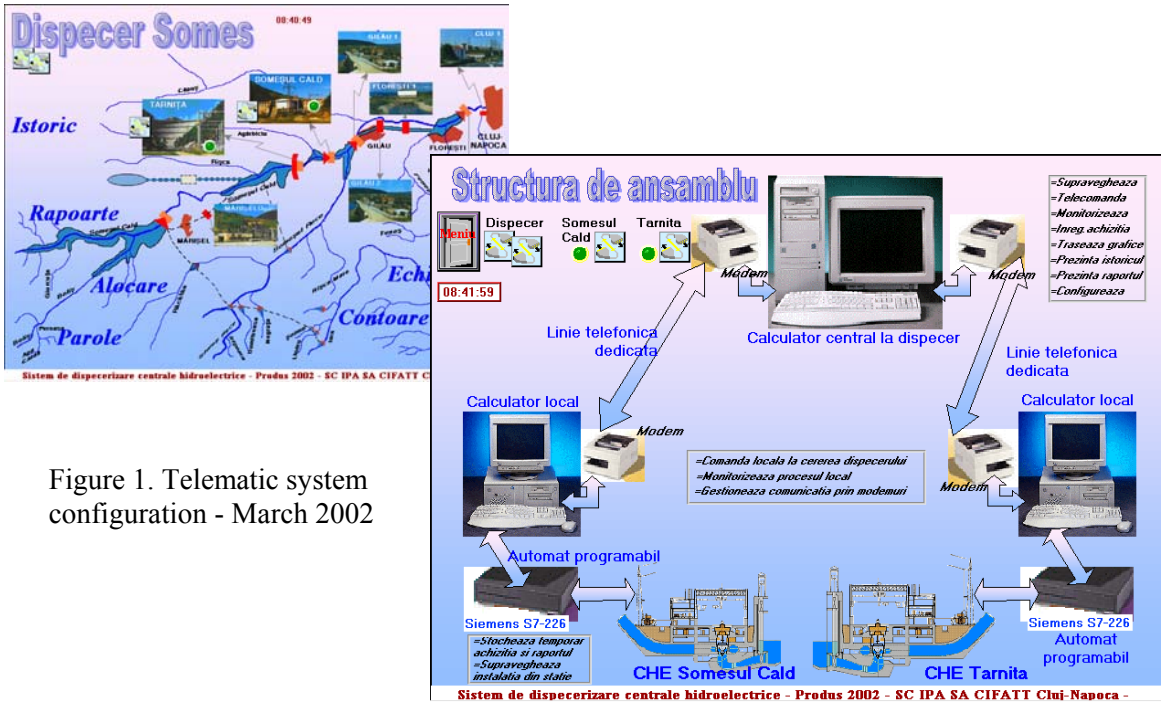

Figure 1. Telematic system configuration - March 2002

Hydroelectric power plant equipment configuration. The secondary automation level is composed by:

- computing system - IBM PC compatible;
- process interface Simatic S7 Siemens PLC;
- digital and analog signal acquisition block (equipment acquired signals adapter);

- actuators command and power amplifying block relays;
- electric and energy parameters measurement block;
- digital smart flowmeter block;
- digital signal conversion module (RS-232/RS-485);
- data communication equipment – leased line or GSM modems;
- plant floor - secondary level acquires and process analog signals (standard electric signals); digital signals status parameters or relay position; signalling and protection circuits and actuators elements auxiliary contacts.

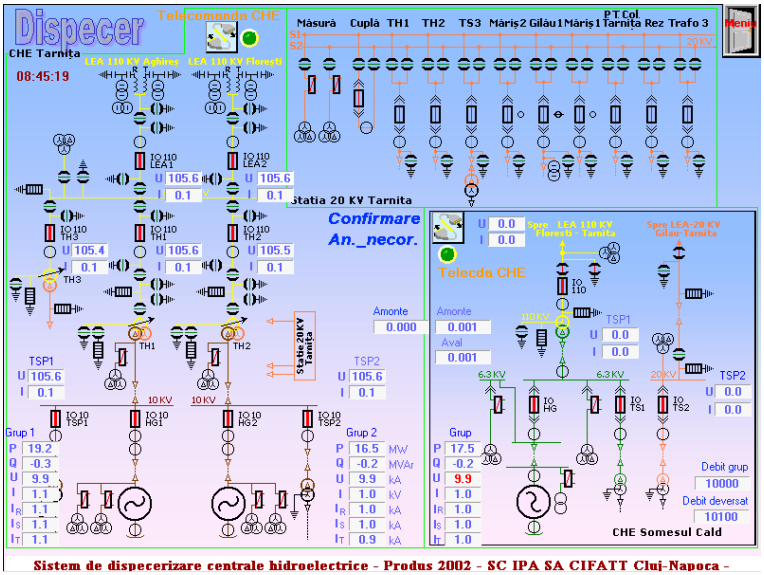

Figure 2 – Centralized management of the hydro-power complex Dispatcher Interface

Automated system acquires and process the smart devices hydro-power complex parameters according to specified protocols (energy parameter, flow, pressure, water level transducers).

Automated system provides the following functions:

- digital signal acquisition representing switches position, equipment functional status, relay-based protection loops, substation distribution units, and utilities status;
- digital and analog parameters reception and processing;
- hydro-electric power station commands launching and transmitting (using general dispatcher interface and hydro-electric power plants specific interfaces);
- records digital and analog parameters functioning duration and their time evolution (historical data acquisition and report files);
- records actuators switches on/off number used in service and maintenance management;
- detailed synoptical diagram related to Somesul Cald or Tarnita hydro-electric power substation;
- historical files display in graphical or spread-sheet format (selected by operator);
- real-time hydroelectric power plants and substations dispatching (based on communication system with multiport interface card and data transmission equipment (lease-line modems).

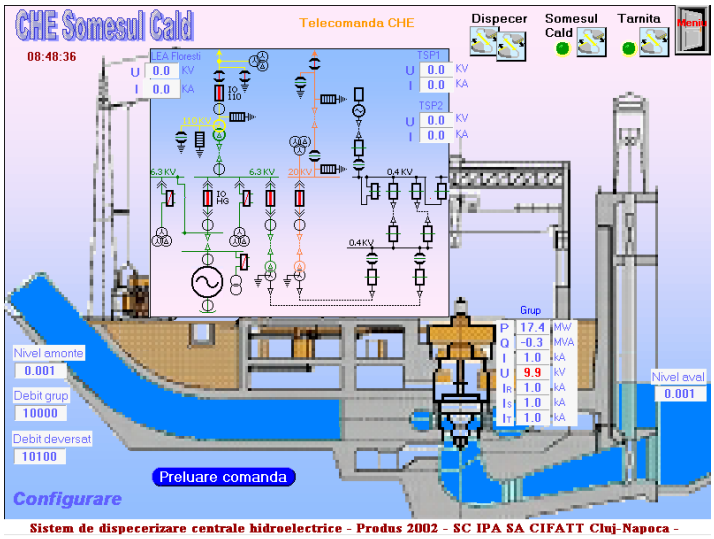

Figure 3 – Somesul Cald technological scheme Interface (on Somesul Cald plant computer display)

Telemechanics system uses a software application program, composed by five units:

- one unit implemented at the dispatcher computing system (identified as HIDRO_DISPECER);
- two units implemented on the Somes and Tarnita hydro-electric power station computing system (data conexion computer and local operator display); units named HIDRO_SOMES and HIDRO_TARNITA;
- two programm units implemented in Somes and Tarnita hydroelectric power station PLC called Somes.mwp and Tarnita.mwp.

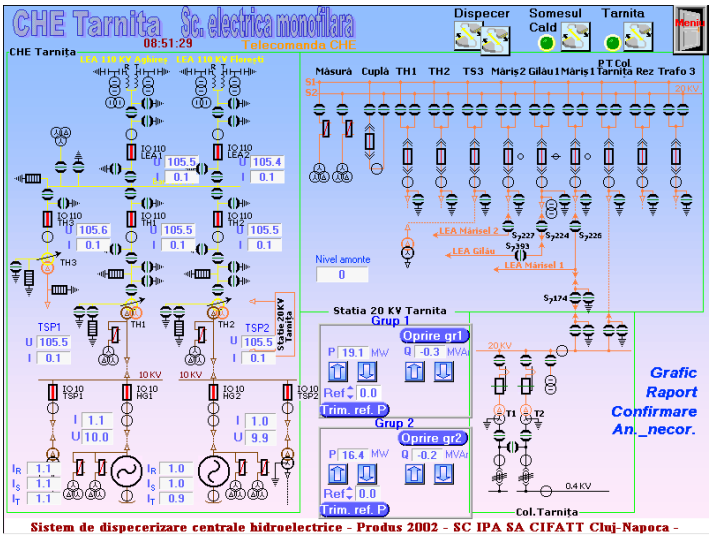

Figure 4 – Tarnita Dynamic user Interface (on Tarnita power plant computer display)

HIDRO_DISPECER, HIDRO_SOMES and HIDRO_TARNITA application programs are LabWindows/CVI development environment supported. These software applications include synoptical diagrams for all hydroelectric power plants and substations; user panels offer real time informations concerning the main equipment status.

HIDRO_SOMES and HIDRO_TARNITA software application communicate with HIDRO_DISPECER package using modems.

PLC level Somes and Tarnita software packages are achieved using assembly language, under Step7 MicroWin32 Siemens development environment.

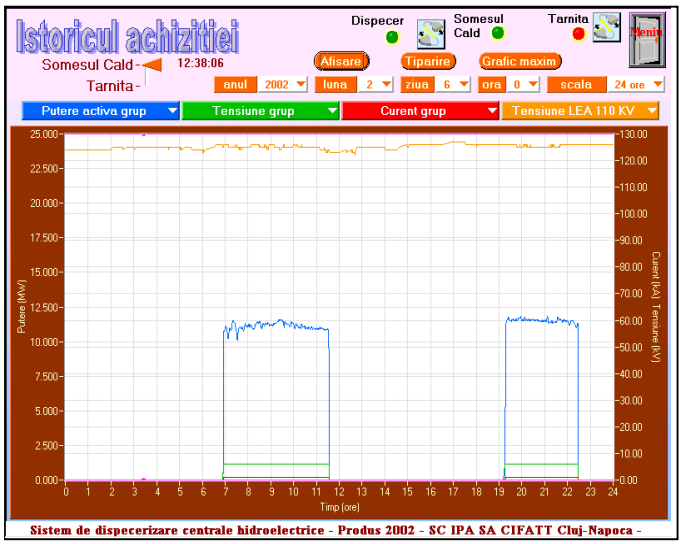

Figure 5 – Aquired data displaying Interface

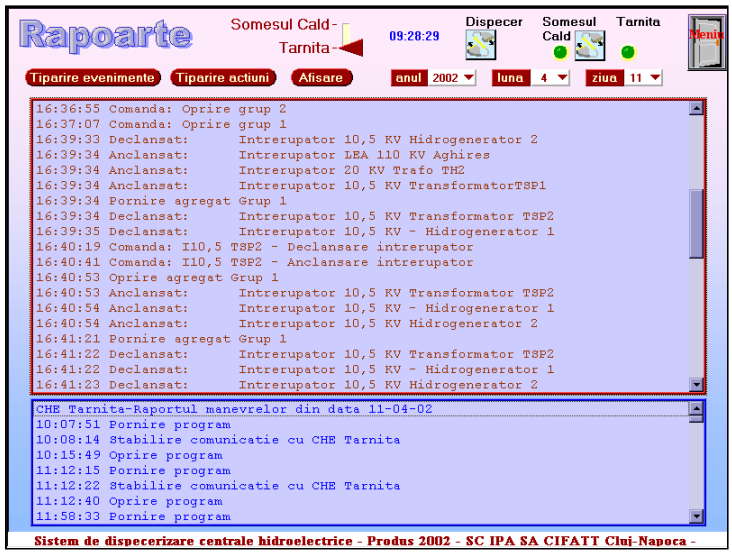

Figure 6 – Event reports viewer Interface

Software programms assure the following capabilities:

- dynamic synoptical scheme graphical configuration;
- measurement and commands loops implementation;
- historical files generation for data acquisition, files for actions, allarms and events;
- switching equipment status and configuration;
- real-time reading/command transmission (switching equipment configuration commands) to/from central dispatcher;
- generated electric energy yield data-base visualisation;
- data acquisition displaying (fig.5-analog measurement, fig.6-event report displaying)
- input/output signal dynamic allocation in system implementation stage (fig. 7);
- automatic system devices configuration and supervising limits configuration;
- critical operations equipment protection (based on password access system).

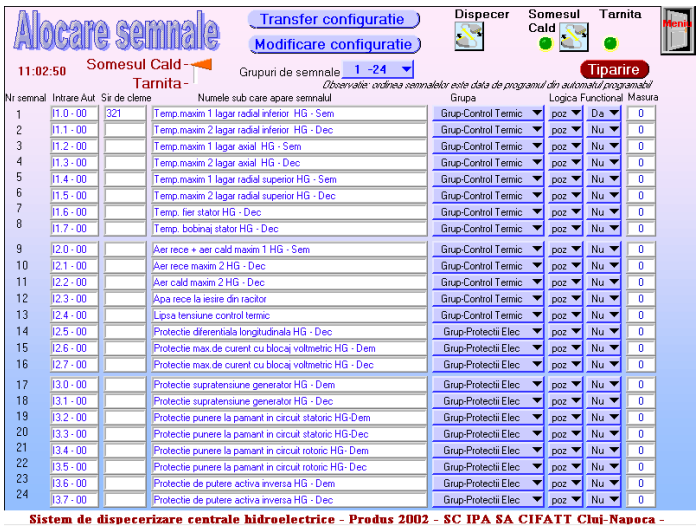

Figure 7 – Input/output signal dynamic allocation Interface

CONCLUSION

The PC based automation system assist the valley control operator to manage the different plants according to the power schedule; it provides the dams control and reservoir level regulation. It offers the hydro power plant control by active and reactive power management.

Capacity- performance:

Digital logic variables: 256 per power plant; sample time 1s
Analogic variables: 16 per power plant; sample time 1 s
Logic commands: 32 per power plant
Setpoints: 2 per hydro power generator
Dynamic elements: 124 per user diplay
Communication of the control data; diagnostic messages; sequence control

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