PROTECTION AND CONTROL SYSTEM USED IN ENERGY DISTRIBUTION SYSTEMS

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Abstract **– The task of the protecting technique is to guarantee safe operation of the electrical energy systems by use of protective equipment specific to the operating plant, which quickly and selectively separates the operating device affected from the electric mains if dangerous states occur. Although the protection of the operating device continues to be in the foreground, the course of centralization has made it necessary to expand the individual protective systems to form communicating units of an overall system (system technique). This means that each switchboard of switchgear can be monitored and operated from the central station control technique via the protective system with specific communications systems. Tasks entailing the protection of operating plant, supervision of the system, detection and provision of measured values and messages for cases of operation, recording and evaluating measured values and messages for disturbances, control and locking functions as well as various possibilities of communication are to be mentioned here as being of great importance.**

Keywords: *data acquisition, analysis, monitoring, power quality, distribution stations.*

1. INTRODUCTION

The paper illustrates the electrical stations of medium voltage in which there is going to be implemented an automated multivariable system, based of software packages for data acquisition, storing, data transmission, processing, monitoring, analysis and which to allow the monitoring of a large number of measures [2,3,4].

The purpose of the local data acquisition, command and control equipment and of the monitoring system is to befriend the human factor in taking optimal decisions in the plan of monitoring the quality of electrical energy in distribution stations, by offering adequate information in a format specific to the function and work place. Also, using this equipment and so the system, you can record events from electrical stations and from important consumers in the electro energetic system, in order to analyze the quality of the electric energy. The analysis of unwanted post failure events also allows the deduction of the causes of certain events and anomalies in the electrical networks, and also their localization.

The economical effects of using the equipment consist in the reduction of their own technological losses from the electrical networks, the observance of the quality standards of the electrical energy, the minimization of the failure rate, the reduction of the electrical energy consumption.

2. THE ARHITECTURE OF THE MONITORING SYSTEM

The monitoring system within the medium voltage electrical stations, being composed of data acquisition, protection, command and data transmission equipments, is built to assure the following functions:

- acquisition of specific electrical signals for the functioning of the electrical stations (voltages, currents) and digital signals (auxiliary contact states of the switching equipments);
- command of the switching equipments (separators, switches) within the electrical cells that from the electrical station;
- protection functions for the incoming/outgoing cells within the medium voltage electrical station;
- processing of the data acquired from the process and data send to a superior level (dispatcher, unit headquarters, etc) using a physical data transmission media.

The acquired measures are used for permanent monitoring of the functioning of the electrical distribution station.

2.1. System overview

The Architecture of the Monitoring System has the following components:

- Data Acquisition, Protection and Control Subsystem for an Electrical Cell;
- Command and Data Receiver Subsystem for the Medium Voltage Electrical Station;
- Data Communication Subsystem.

2.1.1. Data Acquisition, Protection and Control Subsystem for an Electrical Cell

Each cell within the monitored electrical station contains a complex acquisition, protection and control equipment, (Fig.1), that contains the following two distinct units:

- one main unit in which there are implemented all the necessary functions and interfaces for acquisition, protection and control;
- one display and operating unit which is used as "**M**an-**M**achine **I**nterface" (MMI).

The communication between the two units is established through a CAN link.

The main unit is implemented directly, in a medium voltage cell, without using intermediary command relays, which reduces the manufacturing of the respective cell.

There is the possibility that the main unit can work independently, with the need to be coupled to a display and operation unit, type MMI.

The system can also function within an integrated SCADA system, to which it is connected through a RS485 link or using an optical fiber link.

Access to the systems is done via a central PC, making use of the application software, this way enabling comfortable operation: data read, securing disturbance records as well as (remote) parameterization of the connected devices.

The local operation with the acquisition protection and control system is realized using a display unit which is usually installed on the front panel of the medium voltage cell. By this one there can be rapidly accessed the operating data of the switching equipments (switches, separators), local parameterization of the protection functions of the system and local command of the switching elements [2,4,5,6].

2.1.2. Command and Data Receiver Subsystem for the Medium Voltage Electrical Station

Taking over data form the medium voltage electrical station and also the command of the switching elements within the component cells is realized with a system organized on three levels (Fig.2).

- Level 1: contains data acquisition protection and control equipments, mounted at the level of each cell within the electrical distribution station. Each one of these equipments acquire data referring to the electrical parameters (currents, voltages, powers,

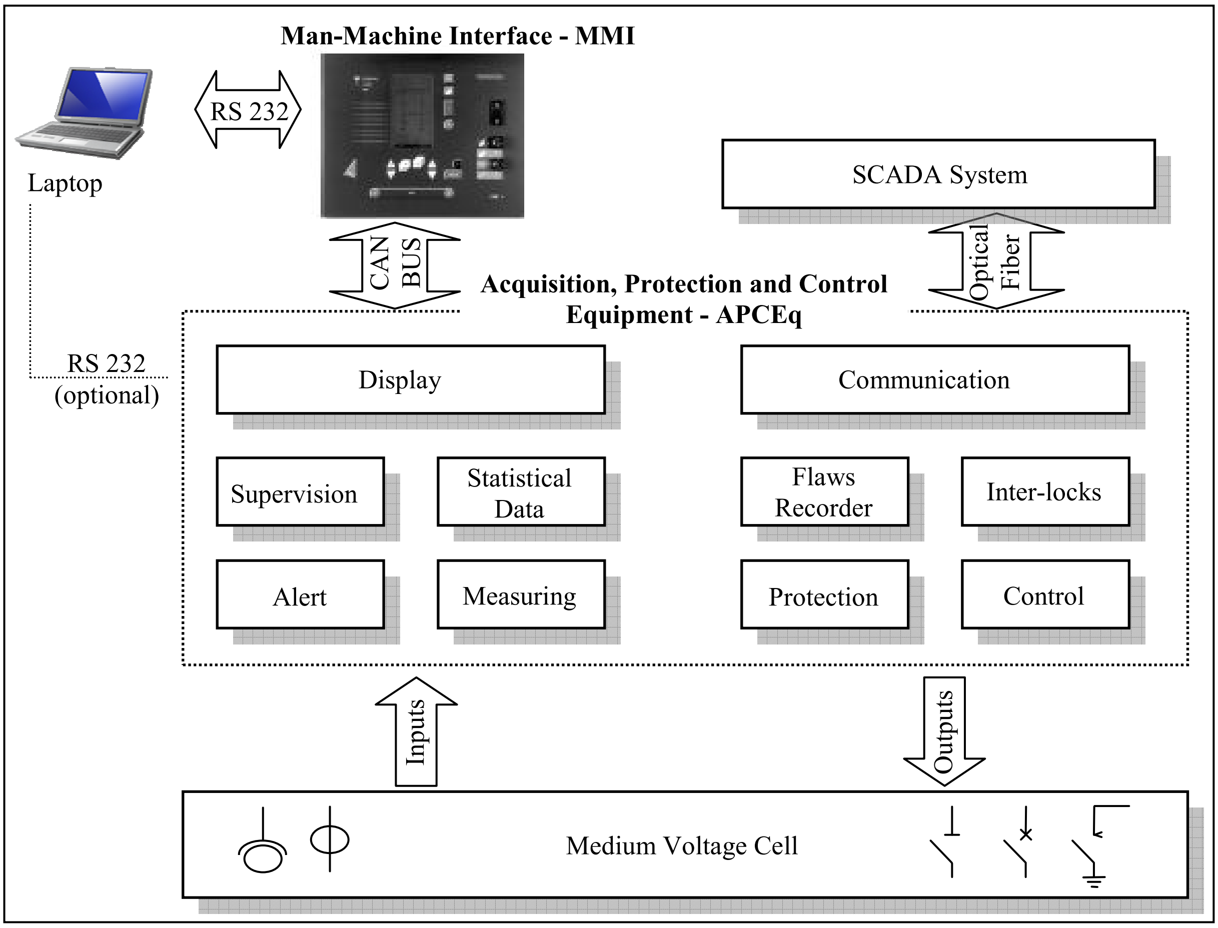

Figure 1: Block diagram of the acquisition, command and control equipment for an electrical cell

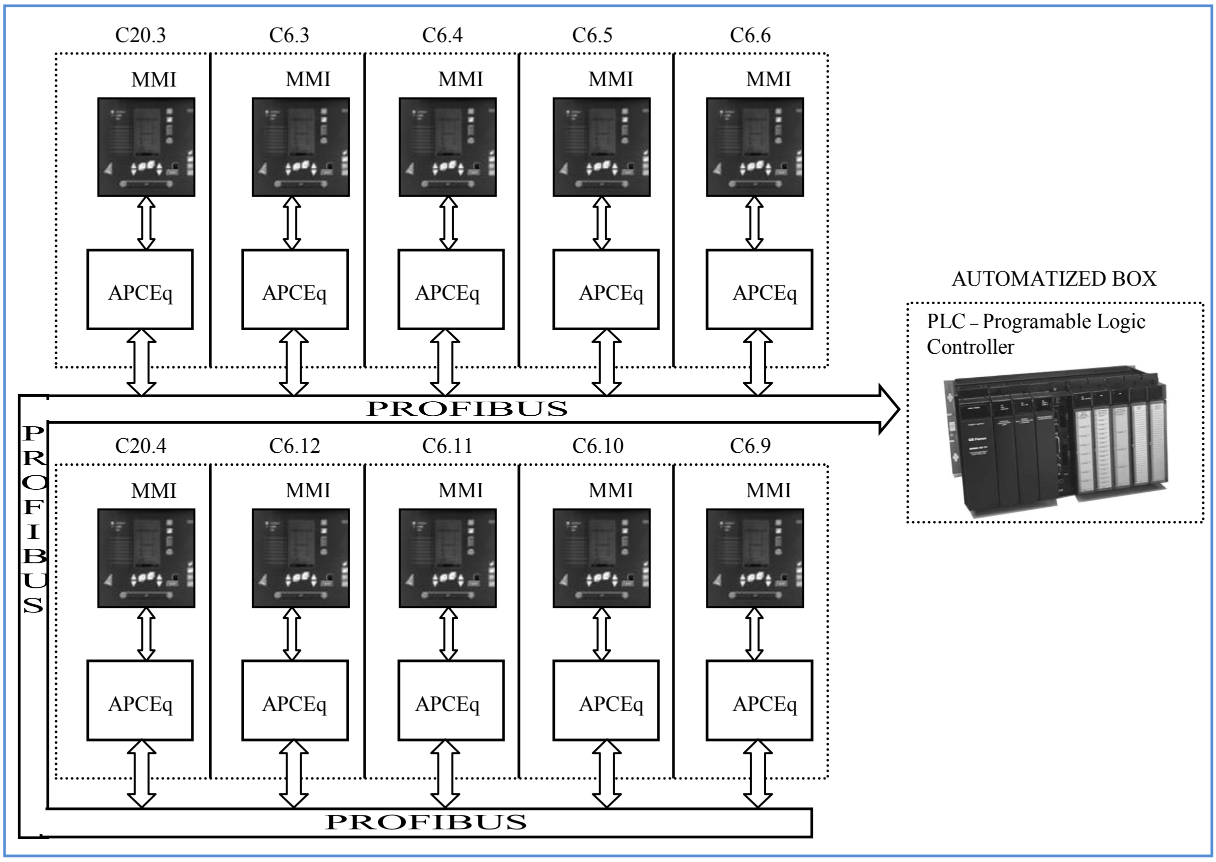

Figure 2: Block diagram of the data receiver and command subsystem

switching elements state, protection state at that respective moment, statistical data, etc) of the respective cell.

- Level 2: is realized by the internal data transmission bus, RS485 type, which is operating based on an industrial high speed communication standard, PROFIBUS type. Through this bus there are taken over, in minimum time and with maximum safety, data referring the functioning of each cell within the station by the PLC that is mounted in the automation unit. Also by using the same bus, there are sent the commands to the switching elements from the cells within the electrical station, according to the program written in the PLC.
- Level 3: is represented by the Programmable Logic Controller (PLC) mounted in the automation unit. This assures the mixing of the data referring to the functioning of all elements within the station, data that are used in two main ways:
  - providing input data for the program that is implemented in the PLC and which coordinates the functioning of the station;
  - providing data, using the data communication subsystem, for the SCADA system implemented at the dispatcher level, when this is needed.

Also the PLC sends the necessary commands for the correct functioning of the station, using the PROFIBUS communication line and using the data acquisition protection and control equipments, according to the internal functioning program, according to the state of the internal locks that exist between different execution elements, and also according to the needs of the local or central (dispatcher) level operators [2,4,6].

2.1.3. Data Communication Subsystem

Using the data communication subsystem there is realized the information flow referring to the functioning of the electrical station from the process and there is assured the receiving of transmitted commands to these stations (Fig.3) [1,2,3].

The data communication subsystem has 3 levels:

- Level 1: it is represented by the local level data communication network (electrical stations);
- Level 2: it is represented by the data communication network between each electrical station and the dispatcher, witch is realized by high speed radio modems;

Level 3: is represented by the data communication network from the level of the Dispatcher and the level of the Station. This network is a high speed (100Mbps) LAN and assures the intercommunication of all the computational equipments from this level so that all the clients that take part to the drive and supervision of activity within the Station to have access to the data taken from the process and to allow the coordination of the process activity, from an energetically point of view.

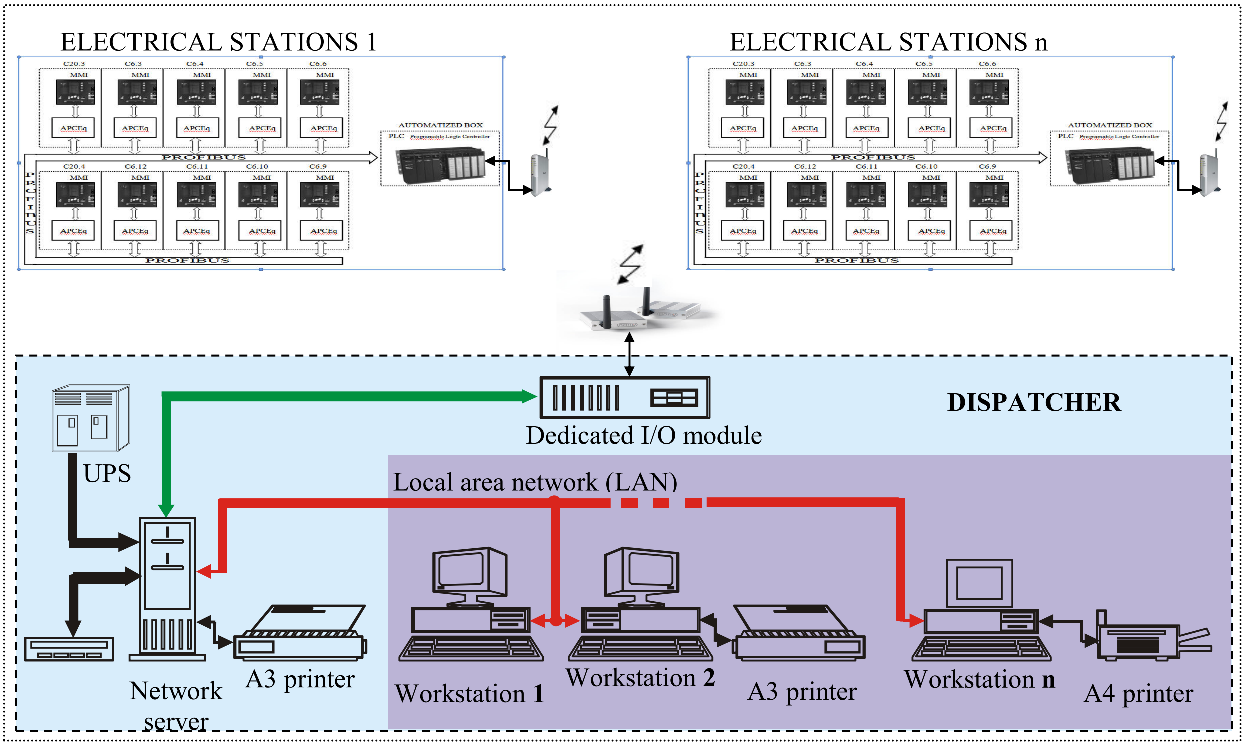

Figure 3: The block diagram of the data communication subsystem

3. CONCLUSIONS

The innovation level of the presented system is reflected by:

- Development of a product which offers as many functions to the user as possible, at a reduced attractive price;
- Possibility of adapting the system for each user;
- Usage of the same equipment for different types of technological processes (installations); their customization being done using software parameters;

This equipment can take part within a complex system for energetic monitoring that is based on process analysis of the mode for operative driving and exploitation of it, of conditions and constraints regarding the safe functioning. It is proposed a solution for an integrated informatics system of type Decision Support System/Management Support System – SCADA which to lead to an optimal drive of the process and to a greater safety in exploitation.

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