AUTOMATIC S.A.M.D. MONITORING AND COMMON EQUIPMENT SYSTEMS*

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The paper presents a modern solution for monitoring the energetic and technological parameters as well as the drive of an industrial platform with open architecture using systems with programmable logic circuits (PLC) in decentralized and distributed structures with distance common equipment systems. Data and command transmission is realized by optical fiber networks. Realization of such systems could lead to an efficient and optimal management to realize an excellent workflow, to diminish the stops, to eliminate the technological raffles, as well as to realize a superior quality production in accordance to the implemented quality standards.

1. SYSTEM STRUCTURE

The system is realized and structured on different levels:

Level 1 – local has the role to realize the data acquisition of the primary energetic and technological parameters, to calculate the derived parameters, to monitor the parameters, to generate alarms when certain presets limits are exceeded and to send local commands to the electrical distribution systems and to the execution elements. At this level, data and commands information are individualized on installations and workshops.

Level 1 transmits to level 2 the information on monitored parameters and receives commands to execute from the higher levels (level 2 and level 3).

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This level is realized from 3 components:

1. System for data acquisition and monitoring the energetic and technological parameters;
2. Local and distance command and drive systems of apparatus of electrical distribution and execution elements of the technological process;
3. Local reception desks for workshops and installations for data acquisition, monitoring the energetic and technological parameters, command and drive of execution elements.

Level 2 – manufacture departments is constituted from the manufacture departments and each department has a reception desk with 2 components to realize the energetic and technological management:

a. Energetic reception desk level 2 at the manufacture department;
b. Technological reception desk level 2 at the manufacture department.

Each reception desk is directly connected to the local reception desks of the installations or workshops composing a department.

The departments' reception desks are connected to the Energy-Technological Reception Desk central level – industrial platform or plant, and the technological ones are connected between them at this level, when the technological process impose.

Level 2 transmits to level 3 the information on the monitored parameters at level 1 and receives execution commands from level 3.

Level 3 – central is destined to realize the energetic and technological management at the industrial platform or plant level, realized from a single component:

a. Energy-technological reception desk central level – industrial platform or plant.

It receives information from level 2 and transmits execution commands to level 2 or, in special situations, directly to level 1, *e.g.* command to drive the gate for fire alarm water.

At this level, aside level 2, there are connected also the production manager, the technical manager, the general manager and the platform dispatcher.

The systems' structure is presented in the following.

Inside a manufacture workshop there are organized technological reception desks linked to the manufacture technological lines – Fig. 1. This configuration constitutes the base structure for Level 1 – local, called also S.B.L.T. Function of the technological configuration, the system could be configured on a desired shape, having a special flexibility.

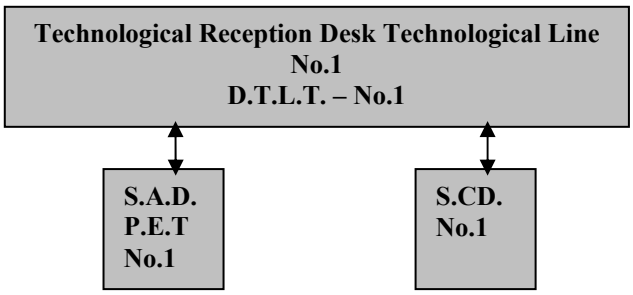

Fig. 1

This structure constitutes the base structure of the local level – S.B.L.T.

2. EXECUTION ANALISYS LEVEL 1 – LOCAL

The configuration of the base system which realizes Level 1 – local has a modular configuration composed from:

1. System for data acquisition and monitoring the electrical and technological parameters – S.A.D.P.E.T.;
2. System for command and drive electrical parameters – S.CDA.P.E.T.;
3. Technological Reception Desk Technological Line – D.T.L.T.

2.1. SYSTEM FOR DATA ACQUISITION AND MONITORING THE ELECTRICAL AND TECHNOLOGICAL PARAMETERS – S.A.D.P.E.T.

S.A.D.P.E.T. is realized with programmable logical circuit and special monitoring devices – DME, which collect, calculate, display and transmit to the PLC system the following electrical parameters: phase and line currents, phase and line voltages, real power L1, real power L2, real power L3, blind power L1, blind power L2, blind power L3, apparent power L1, apparent power L2, apparent power L3, cosines Φ in L1, cosines Φ in L2, cosines Φ in L3, harmonics 1,3,5,7,9,11,13,15 in tension L1-N, harmonics 1,3,5,7,9,11,13,15 in tension L2-N, harmonics 1,3,5,7,9,11,13,15 in tension L3-N, harmonics 1,3,5,7,9,11,13,15 in current L1-N, harmonics 1,3,5,7,9,11,13,15 in current L2-N, harmonics 1,3,5,7,9,11,13,15 in current L3-N, distortions in tension L1- THD U L1, distortions in tension L2- THD U L2, distortions in tension L3- THD U L3, distortions in current L1- THD I L1, distortions in current L2- THD I L2, distortions in current L3- THD U L3, frequency, sum cosines Φ, current in N, sum real power, sum blind power, sum apparent power, mean values for currents, voltages, phase powers and sums, maximal and minimal values for currents, voltages, powers, phase harmonics and distortions, active energy, blind energy.

DME devices collect the above mentioned information from the points where are located, calculate certain derived electrical quantities and transmits through the

unidirectional network MODBUS RTU this information to the PLC. This has a MODBUS RTU network with 32 DME participants which all transmit the information to the PLC.

The PLC takes the information, processes and transmits to the reception desk through an ETHERNET network where communicates with the graphical interface of the server.

Meanwhile, the central unit communicates with a graphical terminal from where minimal and maximal limits of monitored parameters could be introduced.

This system monitors also the technological parameters of the process, as if: currents, voltages on execution elements, temperatures, pressures, densities, concentrations, debits, masses, forces, weights, positions, torques, rotations, speeds, accelerations, angles, levels, lengths.

It is composed from a PLC which has a central unit and analogical input modules which receive unified signals 0-10V, 4-20mA, 0-20mA and convert into binary on 8, 12 or 16 bits, function of the analogical input modules used.

The values of the analogical signals collected from the technological process after processing and scaling are displayed on the graphical terminal.

The programmable logical circuit is linked by Ethernet network to the programmable logical circuit of the technological parameters command and drive system – S.CD., where the values of monitored parameters are transmitted in order to automatically drive of the monitored technological process.

Such a realized system is presented in Fig. 2.

S.A.D.P.E.T. SYSTEM CONFIGURATION

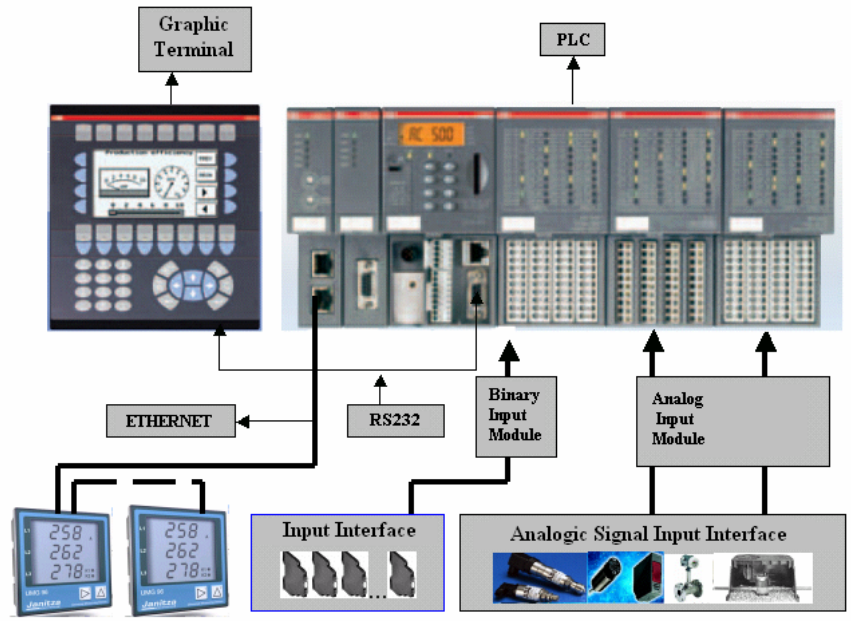

Fig. 2

2.2. SYSTEM FOR COMMAND AND DRIVE ELECTRICAL AND TECHNOLOGICAL PARAMETERS – S.C.D.

The system is realized with PLC destined to monitory the states and alarms, with their transmission towards the graphical interfaces systems for each switch with the possibility for local and distance command for on and off state:

– Monitoring switch state: on/off, stitched/non-stitched;
– Monitoring alarms to trig switch;
– Local and distance command on/off switch;
– Realizes commands from the graphical terminal.

The central unit is composed by binary inputs modules, binary outputs modules, configurable binary inputs/outputs modules, analog input modules, configurable analog input/output modules, temperature modules, specialized fast counting modules.

Concurrently, the central unit communicates with a graphical terminal where the alarms and some monitored parameters could be visualized and from where the monitored automatic switches could be commanded.

This system realizes also the lead of the processes by drive and control functions of type: PT, PI, PD, PID, or realizes these functions from mathematical models. The analogue output signals act on execution elements to realize the lead of the process.

The S.CD. system configuration is presented in Fig. 3.

S.CD. SYSTEM CONFIGURATION

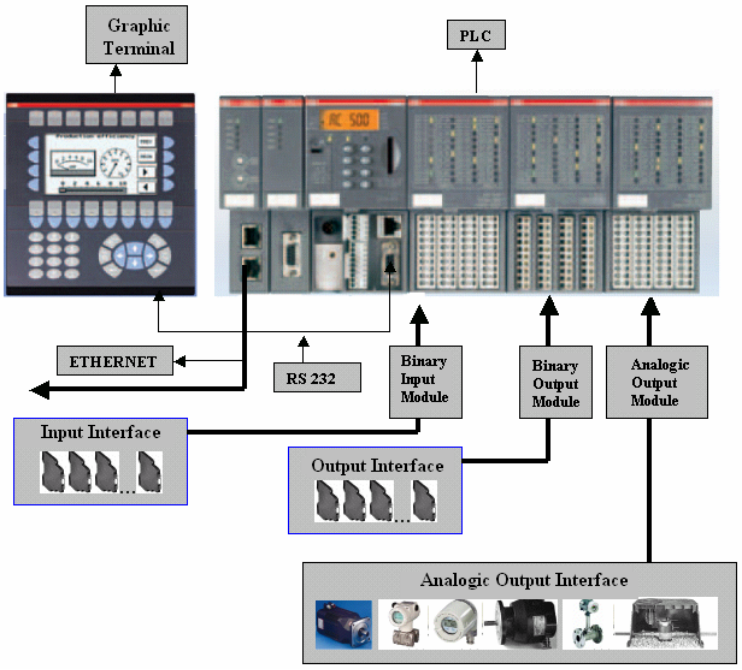

Fig. 3

2.3. TECHNOLOGICAL RECEPTION DESK TECHNOLOGICAL LINE – D.T.L.T.

This reception desk has two SCADA type systems composed from:

– Computer with operator console and engineering to monitor and energetic system commands;

– Graphical interface energetic system;

– Computer with operator console and engineering to monitor and technological process commands;

– Graphical interface technological process.

The configuration is presented in Fig. 4.

CONFIGURATION OF THE TECHNOLOGICAL RECEPTION DESK

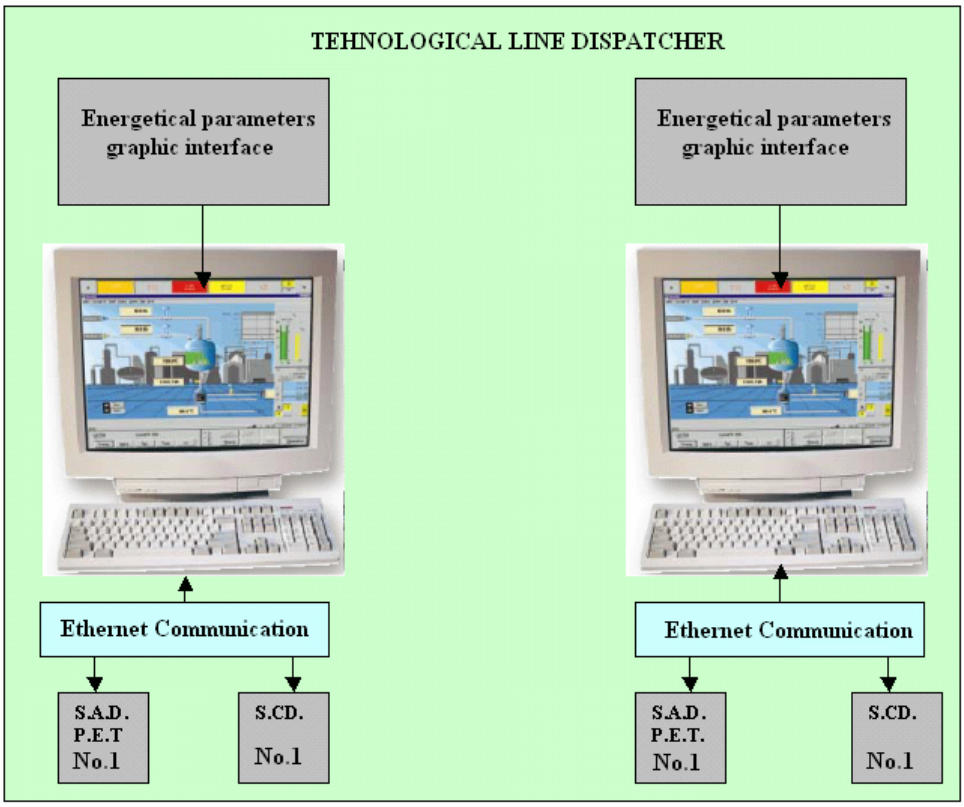

Fig. 4

The base structure S.B.L.T. is into the structure of Level 1 – local workshops, which has a technological and energetic reception desk. This structure constitutes the base structure of level 2 departments – S.A.E.T. Inside a department reception desks are organized at manufacture workshops level.

The configuration is presented in Fig. 5.

The technological and energetic reception desks receive information from the technological and energetic reception desk of the technological lines by mean of Ethernet optical fiber networks.

From this level commands could be transmitted to the automatic switches of the energetic system corresponding to different technological lines, as well as for the lead of the technological processes.

CONFIGURATION OF THE S.A.E.T. SYSTEM

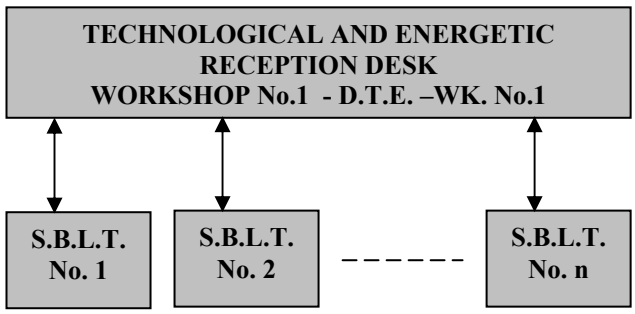

Fig. 5

3. EXECUTION ANALISYS LEVEL 2 – DEPARTMENTS

The base component for Level 2 is the configuration shown in Fig. 6, where all the energetic reception desks are connected by Ethernet network to the Department No. 1 Reception Desk.

The Department Reception Desk is composed from:

Energetic reception desk with a SCADA type system with:

– Data acquisition server,

– Computer with operator console and engineering to monitor and energetic system commands,

– Energetic system graphical interface.

Technological reception desk with a SCADA type system with:

– Data acquisition server.

– Computer with operator console and engineering to monitor and technological process commands.

– Technological process graphical interface.

BASE CONFIGURATION LEVEL 2

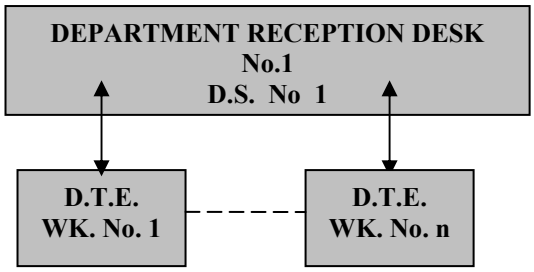

Fig. 6

Level 2 has the configuration shown in Fig. 7, being constituted from the department reception desks which communicate with:

a. Central Reception Desk,

b. Between them, when the technological process is developed in many departments until the final phase,

c. With the workshops technological and energetic reception desks.

Communication between the department reception desks, the Central Reception desk and the workshops technological and energetic reception desks is made by optical fibre Ethernet networks.

CONFIGURATION LEVEL 2

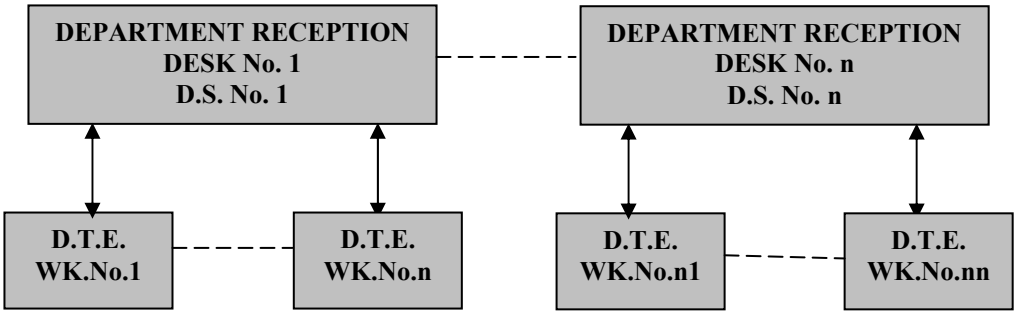

Fig. 7

4. EXECUTION ANALISYS CENTRAL RECEPTION DESK

The Central Reception Desk has the following components, as shown in Fig. 8:

1. Energetic Central Reception Desk – D.C.E. having a SCADA type system composed from:

– Data acquisition server;

– Computer with operator console and engineering to monitor and energetic system commands;

– Energetic system graphical interface.

2. Technological Central Reception Desk – D.C.T. having a SCADA type system composed from:

– Data acquisition server;
– Computer with operator console and engineering to monitor and technological process commands;
– Technological process graphical interface.

CONFIGURATION CENTRAL RECEPTION DESK

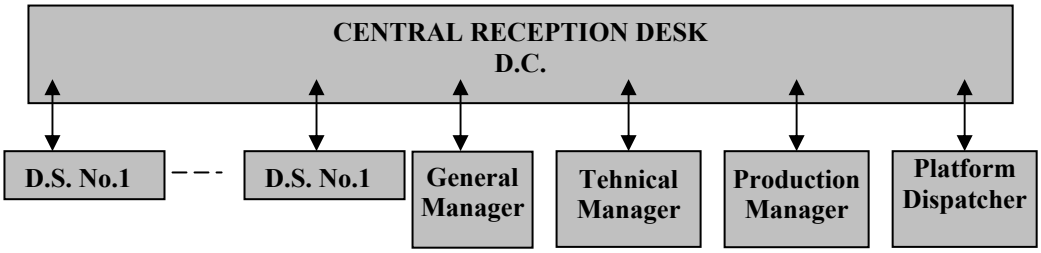

Fig. 8

At the Central Reception Desk are connected the General, Technical and Production Managers, which represents the Coordination Level for realizing the optimal energetic and production management, as well as the platform dispatcher for coordination the activities of shifts 2 and 3.

Transmission with the inferior level and with the coordination level is realized by Ethernet network.

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