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DIMINUTION OF ELECTRICAL ENERGY CONSUMPTION FOR THE PROCESS OF WATER EVACUATION FROM THE LINING MINING PIT OF OLTENIA

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ABSTRACT: In the lignite mining pits from the Oltenia Coalfield appear special problems because of the big quantities of water which come from infiltrations and rainfall. In order to evacuate these enormous quantities of water there are being used pumping aggregates (figure 1) whose number depends on the surface of the mining pit and on the quantity of water which is estimated to be evacuated from that certain mining pit. The electrical energy consume of these pumping aggregates is very high, almost 10% from the total consume of electrical energy from the mining pit. This justifies the efforts which must be done by specialists in order to reduce this consume of electrical energy.

НАМАЛЯВАНЕ КОНСУМАЦИЯТА НА ЕЛЕКТОЕНЕРГИЯ В ПРОЦЕСА НА ИЗПОМПВАНЕ НА ВОДАТА ОТ ВЪГЛИЩНИЯ МИНЕН БАСЕИН ОЛТЕНИЯ

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РЕЗЮМЕ: В минните рудници за лигнитни въглища от въглищен басейн Олтения, специфичен проблем се явява наличието на големи количества вода, които са последица от просмукването и валежите. Ето защо за да се изтеглят тези огромни количества вода се използват изпомпващи агрегати (фиг. 1), чиито брой зависи от повърхността на минната кариера и от количеството на водата, което се преценява да бъде изтеглена от определената минна кариера. Консумацията на електрическа енергия от тези помпени агрегати е много висока, почти 10 процента от тоталната консумация на електоенергия на рудника. Това оправдава усилията, които трябва да бъдат направени от специалистите за да се намали потреблението на тази електроенергия.

1.Introduction

Diminution of electrical energy consumption is a desideratum of specialists in the field of the ligning mining pit. For that, they conceived specifically solutions for each component of technological process, for example: modernization of electrical movements, modernization of protection and switching equipments, of measurement equipments using complex data acquisition system.

The electrical energy consumption for the process of water evacuation is big, approximately 10% of total electrical energy consumption from a lignin mining pit.

In order to reduce this consume of electrical energy, in the first place it is necessary to correlate the energetic parameters (absorbed currents, power factor cos φ etc.) which characterize the electrical engines which drive the evacuation pumps with the technological parameters (the water level in the collecting tank, the warning water level in the collecting tank, the clogging level from the Jomp, the depression from the pump aspiration column, the pressure from the pump discharge under pressure column etc.).

The functional correlation of the enumerated parameters and other parameters can be achieved through a complex informational system which implies the acquisition of the data, the control of the process and command elaboration, as in figure 2.

This system must to achieve the following objectives:
- the working of the pumps in an automated regime in accordance with the water quantity which must be evacuated;
- the monitoring of the energetic working regime of the electrical engines which activate the pumps;
- the control of the pumping aggregates technical state.

For achieve that objectives, it is necessary to do a data acquisition system at the pumping aggregates level, and another ***acquisition system at the electrical house*** level.

2.The Description of the Application

2.1. The local data acquisition system (at the pumping aggregates level). Hierarchical level 1 system

The input quantities of local data acquisition system are following:

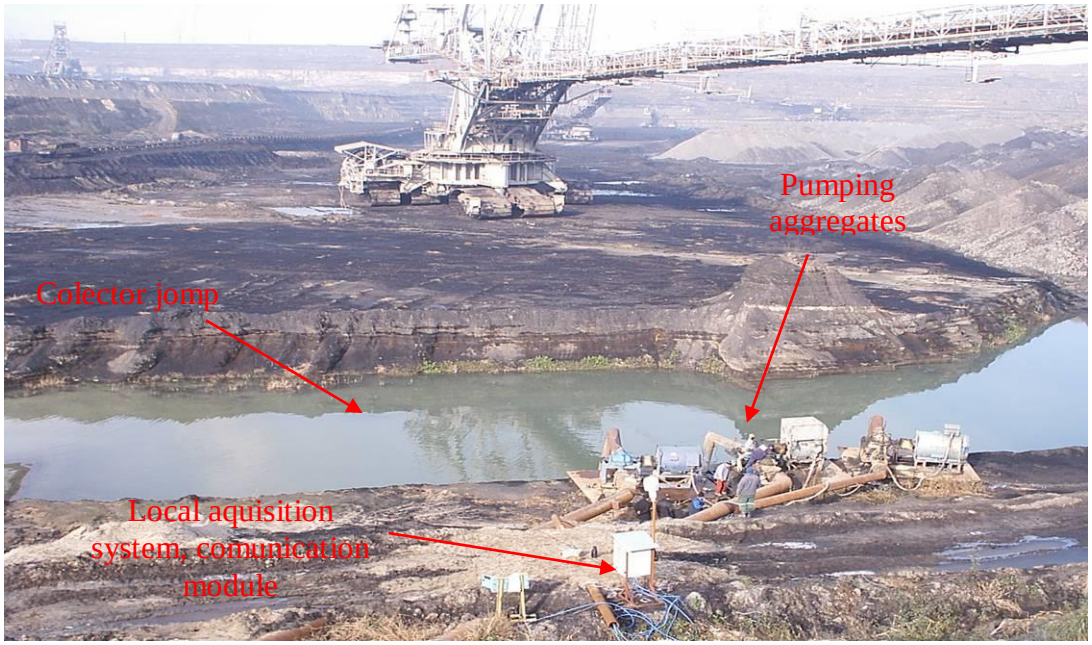


Fig. 1. General View

1 – h_1 [m] – level of water in Jomp (analogical signal, provided by level transducer 1, in unificat signal 4-20 mA or 0-10 V);
2 – h_3 [m] – level for warning (digital signal);
3- h_2 [m] – level for clogging (analogical signal provided by level transducer 2, in unificat signal 4-20 mA or 0-10 V);
4 – Δf_{M2} – analogical signal from vibrations transducer, which provided information about frequency range and amplitude of vibrations from engine 2.
5 – P_{22} – upending pressure of pump 2 (analogical signal);
6 – P_{12} – pressure (negative) from aspiration column from pump 2 (analogical signal provided by pressure transducer in unificat signal 4-20 mA or 0-10 V);
7 – Δf_{P2} – analogical signal from vibrations transducer which provided information about frequency range and amplitude of vibrations from pump 2;
8 – Δf_{P1} – analogical signal from vibrations transducer which provided information about frequency range and amplitude of vibrations from pump 1;
9 – P_{11} – pressure (negative) from aspiration column from pump 1 (analogical signal provided by pressure negative transducer in unificat signal 4-20 mA or 0-10 V);
10 – Δf_{M2} – analogical signal from vibrations transducer, which provided information about frequency range and amplitude of vibrations from engine 2;
11 – P_{21} – upending pressure (negative) from aspiration column from pump 1 (analogical signal provided by pressure negative transducer in unificat signal 4-20 mA or 0-10 V);
12 – P_{21} – upending pressure (negative) from aspiration column from pump 1 (analogical signal provided by pressure negative transducer in unificat signal 4-20 mA or 0-10 V);

The local acquisition system (the hierarchy level 1), at the pumping aggregates, takes over the input quantities and transfers them through the serial interface towards the process computer from the electrical house.

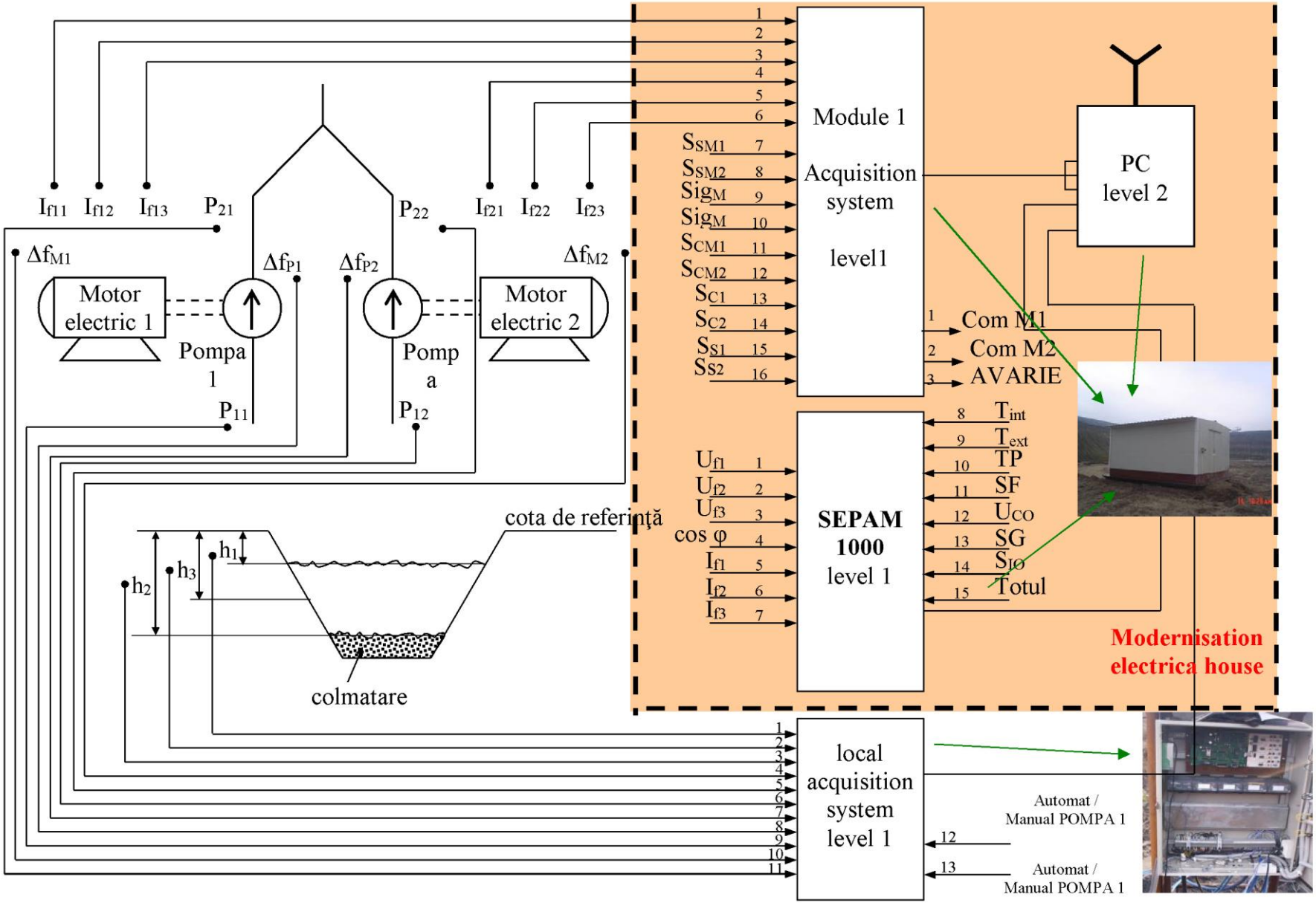
1.2 **Data acquisition system from electrical house. Hierarchical level 1 system**.

The acquisition system from the electrical house (the hierarchy level 1) is made of two modules: one of them takes over the quantities with a general nature at the electrical house level (the electrical current, the electrical potential, the consumed energy and the cos φ), and the other one which takes over the quantities with specific nature and also realise and electrical protection functioning (SEPAM 1000).

The both modules transfer the information (data) through the serial interface towards the process computer. And also, through the serial interface, the system receives commands, decisions, which are send by the superior hierarchic system.

a) Module 1, witch purchases the following quantities:

1 – I_{f11} – analogical signal, phase electrical currents 1 of engine 1, provides by current transducer TC1, in 0-5 A
2 – I_{f12} – analogical signal, phase electrical currents 2 of engine 1, provides by current transducer TC2, in 0-5 A
3 – I_{f13} – analogical signal, phase electrical currents 3 of engine 1, provides by current transducer TC3, in 0-5 A
4 – I_{f21} – analogical signal, phase electrical currents 1 of engine 2, provides by current transducer TC4, in 0-5 A
5 – I_{f22} – analogical signal, phase electrical currents 2 of engine 2, provides by current transducer TC5, in 0-5 A
6 – I_{f23} – analogical signal, phase electrical currents 3 of engine 2, provides by current transducer TC6, in 0-5 A
7 – S_{SM1} – contact's state of electrical separator from engine 1 (digital signal);
8 – S_{SM2} – contact's state of electrical separator from engine 2 (digital signal);
9 – S_{igM1} – fuse's state from engine 1 (digital signal);
10 – S_{igM2} – fuse's state from engine 2 (digital signal);
11 – S_{cM1} – contact's state of contactor from engine 1 (digital signal);
12 – S_{cM2} – contact's state of contactor from engine 2 (digital signal);
13 – S_{c1} – reading short circuit protection from engine 1 (digital signal);
14 – S_{c2} – reading short circuit protection from engine 2 (digital signal);



Fign 2. Simplify presentation of acquisition system

15 – S_{c1} – reading overhead protection from engine 1 (digital signal);
16 – S_{c2} – reading overhead protection from engine 2 (digital signal).

b) Module 2 (SEPAM 1000), which purchases the following quantities:

1 – U_{f1} – analogical signal, phase electrical potentials 1, provides by tension transducer TT1 in 0-100 V;
2 – U_{f2} – analogical signal, phase electrical potentials 2, provides by tension transducer TT2 in 0-100 V;
3 – U_{f3} – analogical signal, phase electrical potentials 3, provides by tension transducer TT3 in 0-100 V;
4 – cos φ – power factor (analogical signal);
5 – I_{f1} – analogical signal, phase electrical currents1 of transformer station, provides by current transducer TC7, in 0-5 A
6 – I_{f2} – analogical signal, phase electrical currents2 of transformer station, provides by current transducer TC8, in 0-5 A
7 –I_{f3} – analogical signal, phase electrical currents3 of transformer station, provides by current transducer TC9, in 0-5 A
8 – Tint [^{0}C] – inside temperature from electrical house (analogical signal, provides by integrate temperature sensor in mV/^{0}C;
9 – Text [^{0}C] – outside temperature (analogical signal);
10 – TP – input (analogical signal) from rainfall transducer;
11 – SF – fume sensor from electrical house (digital signal);
12 – U_{COM} – existence potential for command (digital signal);
13 – SG – contact's state of general electrical separator 6 kV from electrical house (digital signal);
14 – S_{IO} – contact's state of general electrical switch 50,6kV;
15 – reading state – all STOP – (digital signal).

OUTPUT QUANTITIES

1 – command for electrical engine 1 (digital output);
2 – command for electrical engine 2 (digital output);
3 – warning – average (digital output).

2.3 The process computer (Hierarchical level 2 system)

The function of this system is:

1. To take over and to administrate the information to results from all hierarchical level 1 systems;
2. To create a data base with following information :
   - the state of the pumps: working or pause;
   - number of hours in witch the pumps are working: on a day, on a month , on a year;
   - pumping aggregates electrical energy consumption: on a day, on a month, on a year
   - evacuate water quantities: on a day, on a month, on a year, for each pumping aggregates;
   - damage in pumping aggregates working;
   - pumping aggregates performance;
   - evacuate water quantities according to origin
3. To elaborate the following commands:

3.a. Command of pumping aggregates working in order to:
   - to assure a pumping aggregates equilibration utilization;
   - to assure the working of pumping aggregates number in according to water level from gathering basin;
   - to take over of the loads of one damaged pumping aggregate by the available pumping aggregates;
   - to start "no frost" working program when the temperature decrease under -3^{0}C and correlating this working program with external temperature;

3.b. To elaborate warning signals in following situations:
   - starting of protections;
   - appearance of the mechanical damage at the electrical motors and the pumps;
   - appearance of the rainfall;
   - overtaking level for clogging;
   - reaching of warning level for water in the jump;
   - appearance of pumps hydro-dynamic damage (unstriking, low debit, unbalance between pumps coupled on the same evacuation column);

4. The transmission of the information (dates) towards dispatcher in following two modes:
   - usual (consumed electrical energy, momentary power, number of pumps in working state, water level in gathering basin, number of working hours for pumps);
   - on demand (every other information witch is in the data base).

2.4. The dispatcher (hierarchical level 3)

The function of this system is following:
- to receive the information from the process computers (hierarchical level 2) located in all electrical house;
- to create a global data base on whole mining pit;
- to inform the human operator about unusual situation mentioned from inferior hierarchical level;
- to elaborate the warning signals about maintenance cycles as well as report about the origin of the damage;
- to elaborate decisions of force starting or force stopping.

3. Conclusions

The complex automation of the water evacuation system from the lignite mining pit leads to lower consume of electrical energy and to the growth of the pumping aggregates reliability, from the following reasons:
- pumping aggregates together with electrical motor witch drive them, working only is necessary, in according to information provides by data acquisition system (level transducers);
- by acquisition system from electrical house are controlled all electrical parameters and it is possible to improve the power factor in order to lower the consumption of reactive power;
- by modern protection system (numerical system) is prevented extension of possible damage or diminution of possible losses create by electrical damage.

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