

## MONITORING SYSTEM FOR OPEN PIT EQUIPMENTS

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**ABSTRACT:** The functioning of open pit equipments is very difficult to be monitored considering the complexity of equipments and their spreading area. For the efficiency of this process it was designed and implemented a monitoring system SCADA of type.

In the same time with the designing and implementing of monitoring system for the functioning of open pit equipment, can be also monitored and controlled the technological operations, and the system is offering information about the profit maximization and for the minimization of losses and by this it can become a decision center. At the issuing of this, we had in view the obtaining of a maximum flexibility, in the sense of modulation, and the programmability of monitoring system.

### СИСТЕМА ЗА МОНИТОРИНГ НА СЪОРЪЖЕНИЯТА В ОТКРИТ РУДНИК

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**РЕЗЮМЕ:** Работата на съоръженията в един открит рудник е много трудно да бъде проследена, като се има предвид сложността на машините, както и широкия обхват на тяхното действие в района на рудника. За изпълнението на този процес беше проектирана и осъществена система за мониторинг от типа SCADA.

Чрез осъществяването на мониторинговата система за работата на съоръженията в открития рудник, технологичните операции също могат да бъдат проследени и контролирани, като системата предоставя информация относно увеличаване на добива и намаляване на загубите. В този смисъл предлаганата система наподобява т.н. команден център. Като следствие от всичко това съществува възможността за максимална гъвкавост на процеса, и възможност за програмиране на мониторинговата система.

## 1. MOTIVATION FOR CREATING THE MONITORING SYSTEM OF EQUIPMENTS

The open pit production activity is very difficult to be monitored and administrated.

In a classical approach, the monitoring of open pit equipments was made by placing in key points of technological chain, of some measurement instruments and by forming field teams that had the role to read the values displayed by instruments or to make measurements with portable measurements equipments, to communicate the values to responsible persons and to execute the operations requested by them.

The communication of read values towards the open pit leadership, and reverse sense was made by phone, or by sending receiving stations, a proceeding that was very slow and that needed supplementary personnel due to the necessity of going to different measurement points, respective execution elements (bucket-wheel excavator, belt conveyors, spreaders).

For the efficiency of values reading and for making of some operation from distance, there were introduced tele-measuring technologies, respective remote controlling

This thing is possible due to development and to the decreasing of numerical instruments prices, due to the availability of modern means of communication and of calculation equipments, that became more and more performant and cheaper, allowing the development of such a system.

In the same time with the issuing and implementing of such a monitoring system of open pit equipments, the operations can be monitored and controlled and the system is offering information that can be used for increasing the profit and reducing losses, by this is becoming a decision center.

Because the monitoring system allows the receiving and transmitting of information, all the persons that are using it can beneficiate a view of entire ensemble, for installing and functions of system.

Such a system can lead to the reducing of personnel number and decreasing of physical effort.

The monitoring system was designed as an architecture of SCADA type, being considered a pilot application, used a base for all measuring, acquisition, testing and monitoring systems, that can be implemented in all open pits where is necessary the monitoring of equipment functioning.

When drawing up this system, one of the targets was the obtaining of maximum flexibility from modulation point of view and the programmability of monitoring system.

## 2. GENERAL ARCHITECTURE OF MONITORING SYSTEM – EQUIPMENTS

The *functions* of monitoring system of equipments driving (Picture 1), system that is containing components of different nature, connected between them and conceived as a monitoring and administrating system of equipments driving, are:

- taking over the parameters that are characterizing the functioning of monitored equipments: power supply, absorbed current by the equipment driving motors, status of relay contacts, stretching force of the belt, stretching force of the mechanic cable, temperatures in the bearings of gear boxes of belt conveyors, temperatures in the bearing of gear box of bucket wheel, instant flow of the excavated material and optionally active and reactive power for each equipment;
- permanent visualizing and in real time of the parameters took over from the equipments driving systems;
- visual and sound alarming in the case of surpassing the normal functioning values for the monitored parameters;
- information registration in a data base, ensuring by this way the possibility of processing them any time is necessary;
- statistical analysis of the data for the issuing of prognosis and strategies on long and average term;
- interconnection with energetic controller for completing the information referring to power consumption for each driving system;
- interconnection in a computer net;
- data transmitting to a central controller that can monitor the entire assembly of equipments driving from the monitored open pits;

*The component for extracting the information* are represented by *translators* for electrical and non-electrical parameter, that together with the conditioning circuits have the role to translate the measured parameter in a unified signal.

*The subsystem is designed for data collecting* and is represented by data collecting equipments (ECD) that have the role to:

- take over all parameters (currents, voltages, contacts status, stretching forces, temperatures) from the monitored driving systems;
- primary processing of collected data;
- information transmitting from the local equipment level to superior level (controller) using a main data communication line or a radio modem.

*Controller subsystem* with the following main functions:

- visualizing of technological chain at the level of open pit operations;

- monitoring a set of electrical parameters for each equipment that is at the base of the diagnosis for equipment defect;
- monitoring the causes of equipment functioning interruptions;
  - selecting an equipment an respective of electrical or mechanical parameters;
  - obtaining of specific reports, momentary or on specified periods of time;
- monitoring the power consumption for each equipment (optionally).

*Hardware components* will offer the processing, storing, introducing, displaying, graphical and printing support for data, using different equipments and the role of each one is well determined. From safety reasons, there is optionally the possibility of doubling of some elements for preventing the data loss or the interruption of functioning.

*Software components* are offering on one side the support for processing (operating systems, program running environment) and on the other side are ensuring the monitoring, visualizing, processing means of the data.

*the communication components* are ensuring the connection means between different components, that can be radio, but considering the complexity and costs, there are used physical channels of connections. In the central processing system, that contains interconnected equipments by a local net (LAN – Local Area Network), in situation that these are placed in a central headquarter and the connection between the central processing system and the remote elements (measuring components, local decisional equipments) is made by other communication means: serial communication lines type RS 485 or radio modems.

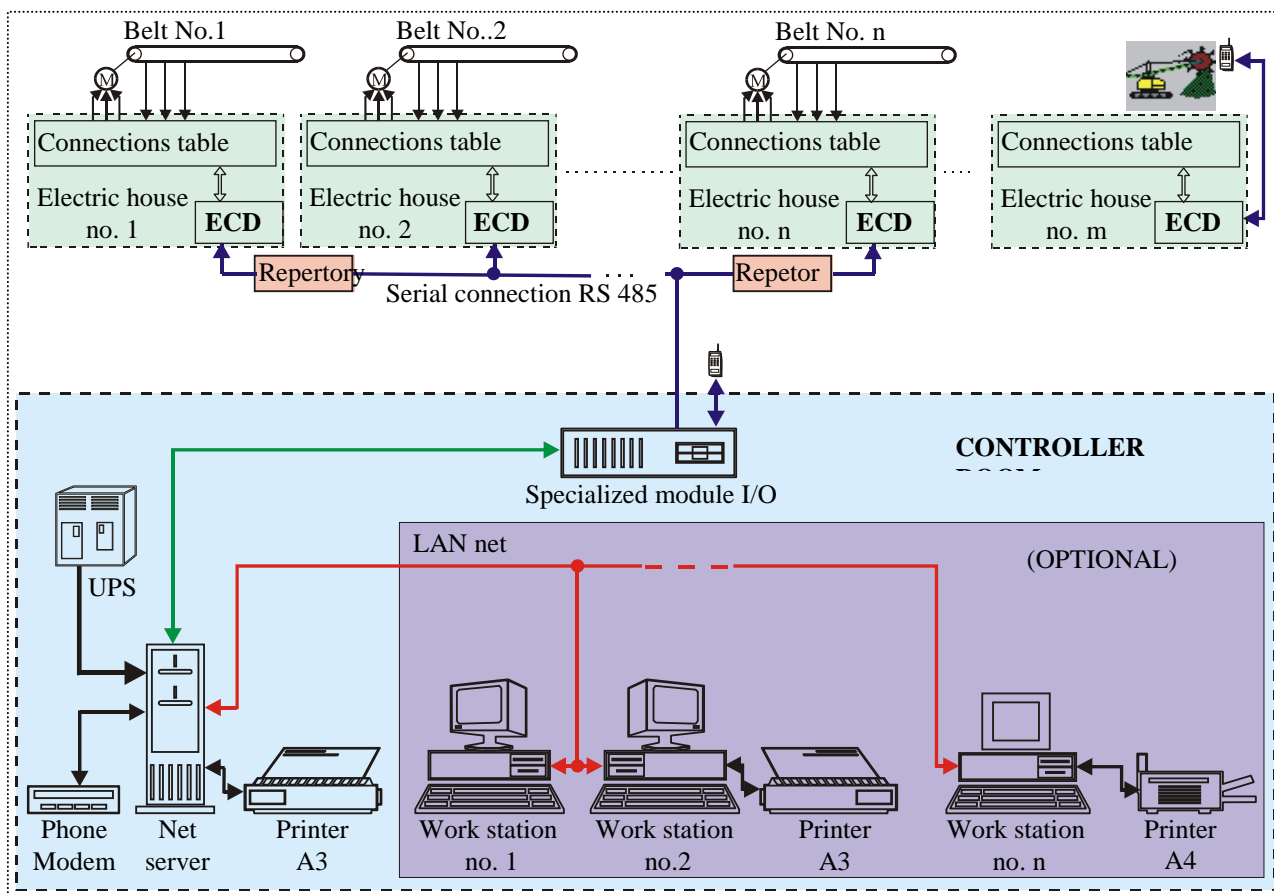
## 3. BASIC REQUIREMENTS FOR THE MONITORING SYSTEM

From the basic requirements of monitoring system we can mention:

*Opening* that consists in the possibility of cooperation with other systems as enterprise informatic system, the system of engineering programs, invoicing system for consumption, distribution and command system, management system, modeling system of processes, optimizing system, etc. and the possibility of functionality extension. The opening have to presented from hardware point of view (different hardware platforms), software (different operating systems) communications, (international standards), but also fro the point of view of data administration (standards respecting) and of applications (different possibilities for interface and the support offered for other programs).

*Adaptability* meaning the possibility to configure the components according to concrete requirements, even in the case when these requirements are changing during the system life, the possibility of connecting new equipments or programs to the existing system.

*Putting at disposal the necessary data in a useful time* is another important requirement, by which, can be taken useful



Picture 1 Scheme of the equipment monitoring system

measures and in time, for avoiding the eventual accidents or unpredicted situations.

*Security and safety of data* consists in preventing the entrance of unwanted information in the systems, which can lead to the revealing of highly confidential information. Also, is necessary the setting into functioning an archiving system, that will allow the consulting of data and the issuing of reports. Hence, the data that were archived can be erased and will be obtained a new space for the data system.

*The collected data will have to be necessary ones and most reduced possible*, by this way the system will not overloaded with useless data. In the same tome, the collected data will have to be able to offer a most complete image over the status and events from the system.

*The possibility of rapid identification of defects and also their most precisely localization*, that represents another requirement for the monitoring system. Also, have to be able to offer all the necessary data about the possible elements involved in the fixing of defect.

*Simple and comfortable interface* with operators, and the elements with similar functions or that are referring to similar thing to be grouped.

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