EXPERIMENTAL RESULTS CONCERNING THE MONITORING OF THE MACHINES' DRIVES IN CARBON EXPLOITATIONS

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Abstract: This paper presents the materialization of a monitoring system of the high power machines distributed on a large area in carbon exploitations, revealing the system's architecture with the component elements: The Subsystem designed for data acquisition represented by the data collecting equipment (ECD), which is assembled on each monitored machine and The Operator subsystem which takes over, processes and monitors data from ECD equipments, and revealing also the central monitoring software structure and the specific programs of the local equipment ECD.
Through the communication server, the system takes data from all the equipments from the carbon exploitation and allows the visualization of the synoptic scheme of the technological flux on all computers, having this right, connected in the same network with the server. The used programs allow the obtaining of some reports referring at the machine's functioning (individually or on technological lines), cumulated or journal type through the interrogation of the central database server and records data in one of the database's tables regarding the information referring at the appearance of some events.

Key words: monitoring system, data collecting equipment (ECD), microcontroller

1. PRESENTATION OF THE MONITORING SYSTEM

The functions of the monitoring system for machine's drives (fig.1), are:
►the taking over of the measures, which characterize the functioning of the supervised machines: supply voltage of the machine, current absorbed by drive motors of the machines, status of relay contacts, elastic force of the carpet for transportation bands, elastic force for lifting up & down cables of excavator arm, temperatures in the reducer's champs for the driving of transportation bands, temperatures in wheel's with coupe reducer camps of the excavator, the instantaneous debit for the excavated material and optional the active and reactive power for each machine;
►permanent and in real time visualization of the measures taken over from the machine's drive systems;
►visualized and sound alarm in case of overdue the normal level of functioning for monitored measures;
►storing information into a database, assuring in this way the possibility to process it any time if it is necessary such option;
►statistic analysis of data for issuing the prognosis and strategy on medium and long time.

The information collecting components are represented by transducers of electrical and non electrical measures which together with conditioning circuits have the act to translate the measured measure in to unified signal.

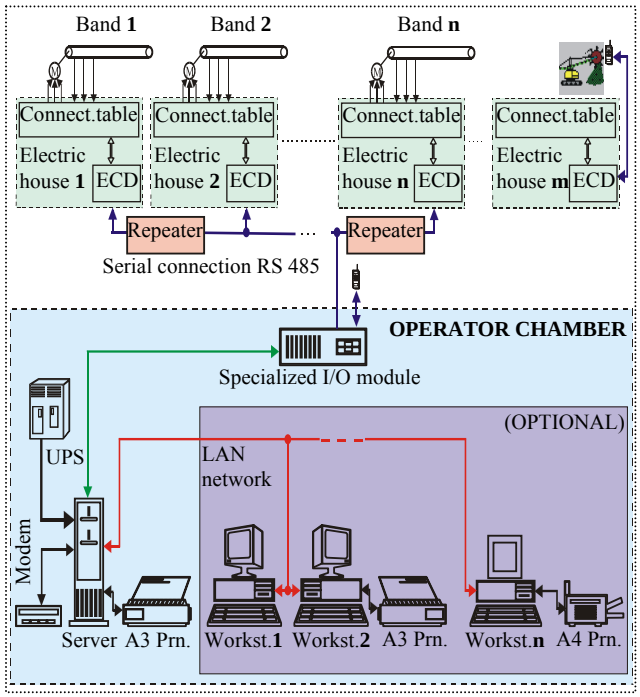

Fig.1. The diagram of the monitoring machines' drive system

The subsystem designed for data acquisition is represented by data collecting equipments (ECD) which achieve:
►taking over all measures (currents, voltages, contact status, elastic forces, temperatures) form the monitored driving systems;
►primary processing of acquisitioned data from drives;

►information transfer from the local equipment level to the superior level (operator) through a data communication bus or a radio modem.

The operator subsystem which main functions are:

►visualization of technological flux at the level of processes from the quarry;

►supervision of a set of electrical measures for each machine which is the base of damage diagnosis of the machine;

►supervision of the causes of machines' stopping;

►selection of one desired machine and also of some of the electrical or mechanical desired measures;

►obtaining of specific, momentary or on determined periods of time reports;

►supervision of electrical power consumption for each machine (optional).

Hardware components offer support for processing, stocking, input, graphics displaying and data printing, using different equipments, the act of each being well determined. Due to safety considerations, there is optional the possibility to double some elements for preventing data loss or functionality interruptions.

Software components offer on one hand support for processing (operating systems, program execution and development environments), and on the other hand provide means of surveillance, visualization and data processing. It should also be mentioned here the communication programs, which beside electronic communication support assure the connections between different elements of the system. One of the most important components of the monitoring system is the database administration system, necessary for recording momentary values, which assure support for some processing in real time on one hand, and on the other hand, these data will be recorded for ulterior analysis in conventional database.

The monitoring system uses specialized software, formed from many components which run under Windows operating system, installed on a compatible IBM PC computer.

Communication components assure the connection means between different components, which can be radio but taking in consideration the complexity and cost, is resorted to physical connection channels. In the central processing system, formed from interconnected equipments through a local network (LAN - Local Area Network), in which case these are disposed in the central premise, and the connection between the central processing system and distant placed elements (measurement components, local decisional equipments) will be through other communication means: serial communication lines type RS 485 or radio modems.

2. RESOULTS OBTAINED WITH THE MONITORING SYSTEM

The tables and the graphics obtained with the monitoring system ECD, are:

►**the synoptic scheme of the technological flux** (fig.2) - allows the visualization and the detailing of the received/sent measures from the respective machine;

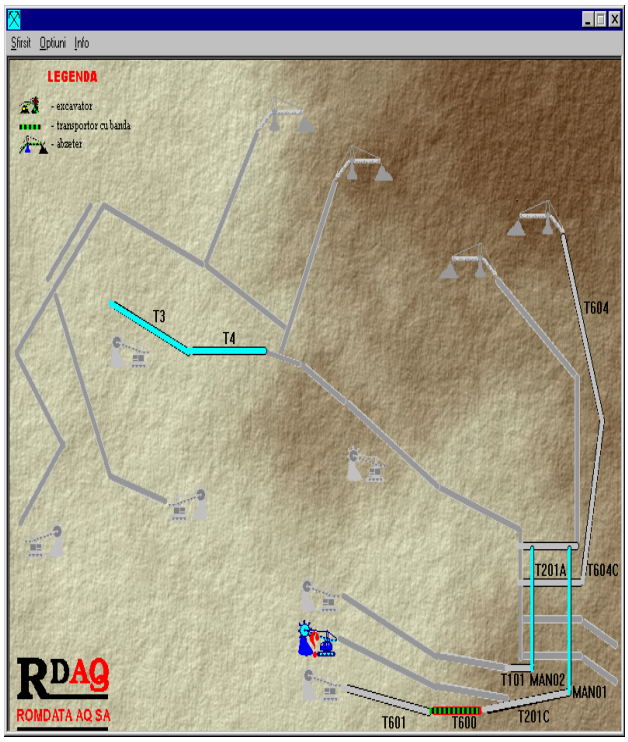

Fig.2. Synoptic scheme of the technological flux from a carbon exploitations

A click on a *Machine* **(**fig.2), allows the visualization of the collected/transmitted measures from the respective machine and the state of those **(**fig.3) and one on *Detail*, allows the detailing of the transmitted measures **(**fig.4).

On the supervised machines shown in the synoptic scheme, are mounted data collecting equipments (ECD) and the real time data transmission, which can be done through cable or radio modem.

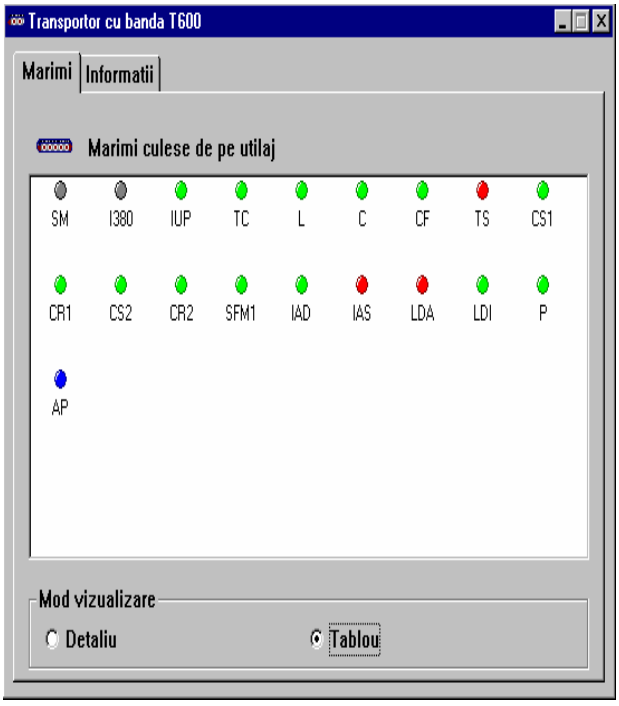

Fig. 3. Dialog window with the measures collected from the belt conveyor T600 and the state of those

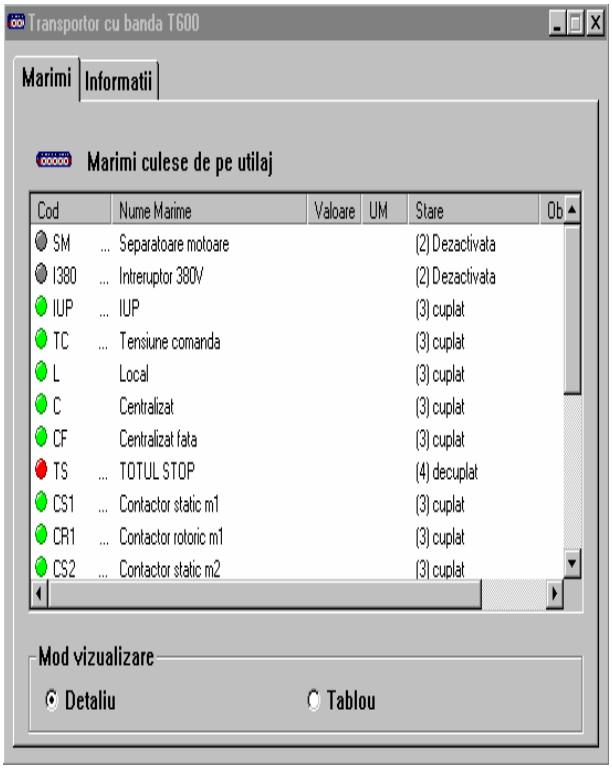

Fig. 4. Dialog window with the detailing of the transmitted measures from the belt conveyor T600

►**machines report** (fig.5) - allows obtaining of some activity reports of the monitored machines from the data base, through a dialog box with the following sections:

- ***Evolution*** (the chronological evolution of the selected machine in the Data Start - Data Stop period);
- ***State detail*** (groups the machine's evolution in state categories in the Data Start - Data Stop period);
- ***States total*** (the total states in the selected period);

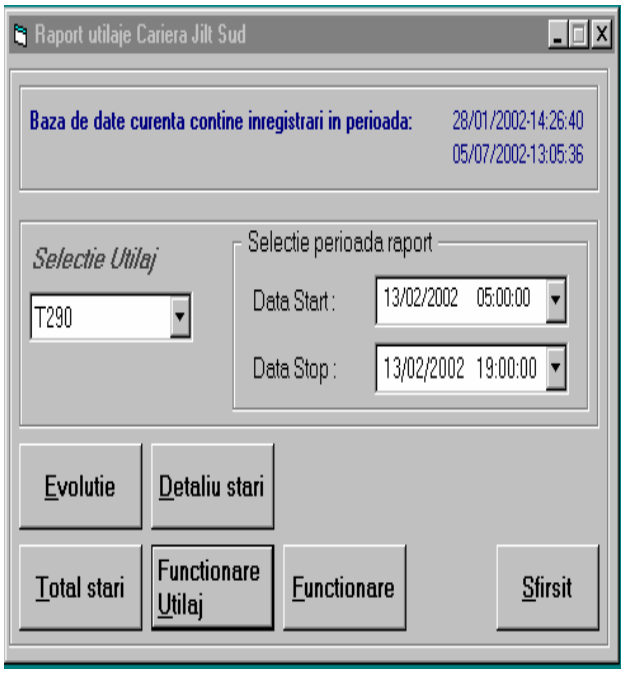

Fig. 5. Dialog window for the obtaining of the activity reports for the selected machine

- ***Machine functioning*** (the functional states of a selected machine, total functioning time and the medium charge in the selected period);
- ***Functioning*** (the functioning states of all the machines and the total functioning time for each machine in the selected period);

All the reports show the selected *machine* for which the *evolution*, the selected *period* for the report, the *date* are visualized.

In the superior part the corresponding period of time of the available recordings from the database is marked. This period can be configured from the program according to the necessities and the number of recordings from the database. The usual periods are 1-2 weeks.

►**technological lines report** (fig.6) - allows obtaining of some reports regarding the belonging of a machine to a technological line, through a dialog box with the following sections:

- ***Flaws*** (reports the machines' states list which have the interrupting code completed, for example the functioning state does not have the interrupting code completed);
- ***Functioning*** (reports the list of the states of normal functioning or functioning with flaws for machines from the regarded line);
- ***Complete*** (reports the list of all machines' states which belong to the regarded line);

All reports show *the technological line* selected for which the *evolution*, the selected *period* for the report, the *date* are visualized.

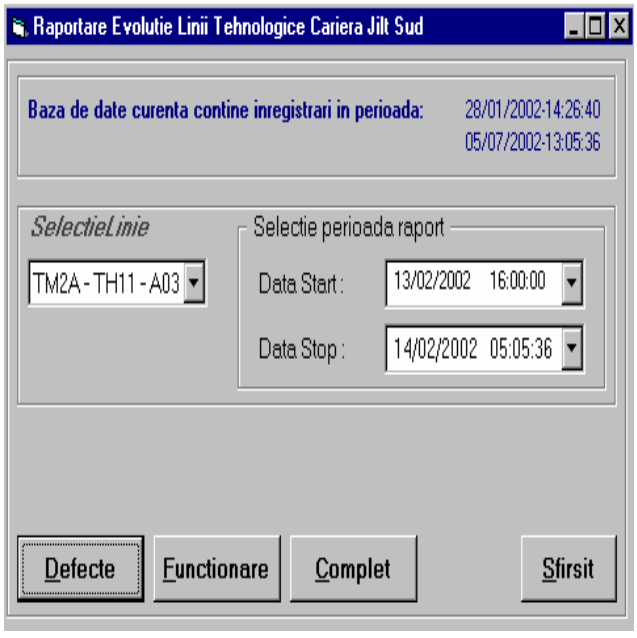

Fig. 6. Dialog window for the obtaining of the belonging of a machine to a technological line

►**flaws' recording** (fig.7) - allows the actualization and visualization of the flaws which appear in the production process, by the administrator, through a dialog box with the sections:

- ***Selection of actualization flaws period; Machine selection for which are inputted flaws; Editing; Sorting;***

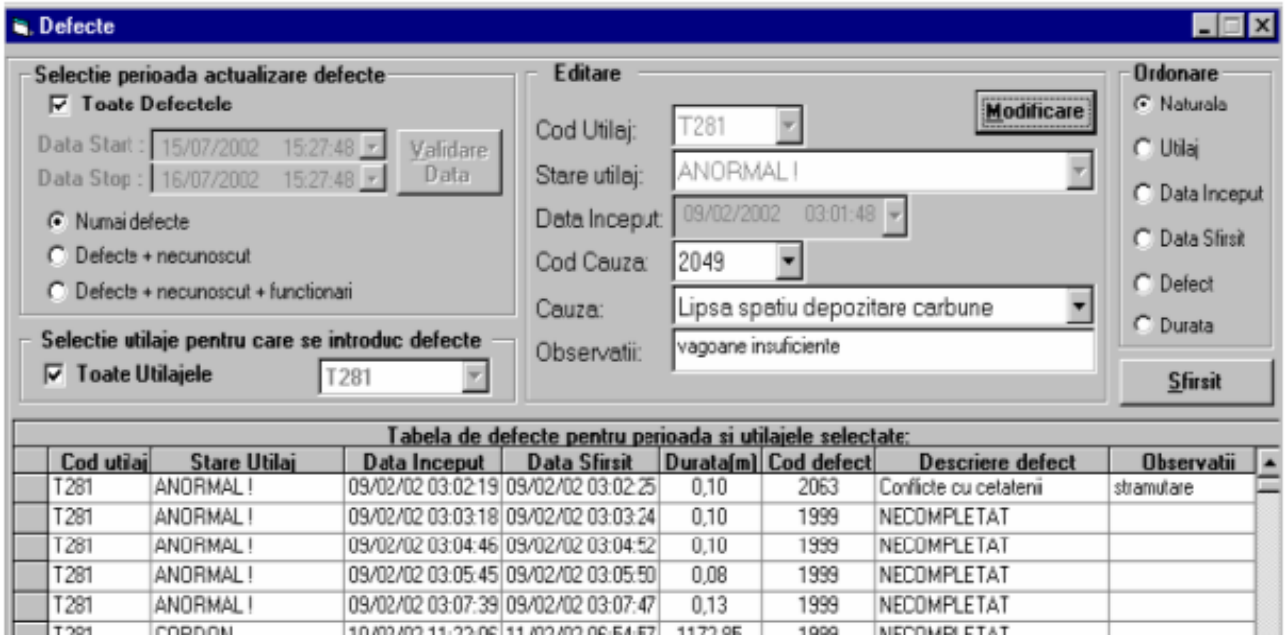

Fig. 7. Dialog window and table of recordings of flaws for the selected period and machine

3. CONCLUSIONS

►The data collecting equipment (ECD) presented in this paper is integrated into a complex surveillance (monitoring) of the machine's drives system in carbon exploitations - Gorj.

►The built monitoring system, having as infrastructure the local data acquisition equipments (ECD) offers owners a powerful work instrument which allows taking over of operative decisions in minimum time and maximum efficiency to machine's surveillance and driving from the technological process.

►The system offers possibility of permanent machines' from the quarry status monitoring.

►Through extrapolating of the data base built based on process records, it can realize analysis regarding the activity of the supervised quarry, and based on these data it can realize statically data analysis regarding the prognoses and strategy on medium and long term.

►Through the possibilities that are offered, the system can work interconnected with other monitoring systems and also with other calculation systems in the network, allowing this way access to information, at diverse decisional levels.

4. BIBLIOGRAPHY

1. Areny R.P.,Webster J.G.; *Sensors and Signal Conditioning*; Wiley-Interscience Publication, John Wiley & Sons, Inc., USA, 1991.

2. Cottet F.; *Traitement des signaux et acquisition de données*; Editeur DUNOD, Paris, 1997.

3. Coulon F.; *Theorie et traitament des signaux*; Dunod, Paris, 1984.

4. Dobriceanu M., Pîrjan D.; *Senzori şi instrumentaţie*; Editura Sitech, Craiova, 2001.

5. Dobriceanu M.; *Sisteme de achiziţie şi microprocesoare*; Editura Universitaria Craiova, 2003.

6. Dobriceanu M.,Filiţă M., Săceanu V., Drăgancea M., Toader G. Contract *Dispecerizare cariera Jilţ Nord;* Nr.01/21.03.2000, S.C. ROMDATA AQ S.A. (executant) şi Exploatarea minieră cariera Jilţ (beneficiar).

7. Golovanov C., Albu M., ş.a; *Probleme moderne de măsurare în electroenergetică*; Ed. Tehnică., Bucureşti, 2001.

8. Paull Holland, Mike Fraser, Steve Lekas, Fred Schraff; *Signal Conditioning&PC- Based Data Acquisition,* Iotech Inc. – USA, 1997.

9. Rotar D.; *Sisteme de achiziţie şi teletransmisia datelor*; Reprografia Universitatea din Bacău, 1998.

10. Szekely I., Szabo W., Gerigan C.; *Sisteme de achiziţie şi prelucrare a datelor*; Rep. Universitatea din Braşov, 1997.