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Continuous Monitoring and Diagnostic Systems

Sebastian Ristea*, Marius Gabriel Petrescu**

* Al - Bilad S & Clough Ltd., Clough - Zuhair Fayez Partnership (CZFP), Dhahran 31942, Saudi Arabia, e-mail: Sebastian.Ristea@czfp.com
** Petroleum-Gas University of Ploieşti, România

Abstract

To maintain the equipments' functional characteristics and the functioning in the most appropriate conditions to the initial ones, required to organize a production/process equipment maintaining and repairing system. From the analysis of the equipments behavior during the physical wear process it may be noticed that the wear in time of the different components takes place in a different way. This fact imposes to take ample measures of maintaining and repairing of these components in order to avoid the equipment premature out of service.
The application of certain modern equipment maintaining and repairing methods became an obvious necessity in the conditions of certain major changes during the last years on the international and national plan.

***Keyword*:** Continuous monitoring, production/process equipment, monitoring and diagnosis

Introduction

The transition supposes the structural change at the macroeconomic level and at the organizational management, necessary to be based on knowledge, information and on an innovative organizational attitude, proactive - preventive in the **technical management (production, maintenance, risk)** and has a primordial role. The application of certain modern equipments maintaining and repairing methods became an objective necessity in the conditions of certain major changes during the last years on the international and national plan.

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Aspects concerning the maintenance activities

A maintenance system/maintaining and repairing system consists in the total amount of the revisions, control and repairing activities in order to maintain an equipment in a functioning state during many, many years.

The maintenance has four components:

- Technical one: interventions with technical character;
- Organizational one: correlation of the different activities involved in the technical intervention;
- Auxiliary one: implications concerning the work legislation, social aspects, ecological ones etc.;
- Economic one: financing, evaluation of the maintaining activity efficiency and profitableness.

Regarding the economic aspect we can to mention that the expenses afferent to the maintaining activity may be divided in two categories:

- ***Direct expenses***, that are composed at their round by expenses with the personnel, spare parts, materials, tools and afferent devices,
- ***Indirect expenses***, that are the consequences of the equipments inappropriate functioning. In general the indirect expenses represent about 80-90% from the total amount of the maintaining expense.

Regarding the technical and organizational aspects we can to distinguish two types of maintenance, respectively:

- ***Corrective maintenance,*** that consists mainly on the elimination of the creeps / failures.
- ***Preventive maintenance,*** consisting in the actions that are taken in order to prevent the possible (estimated) failures.

The maintenance based on the machine condition or the preventive maintenance is an efficient strategy for the protection against the risks of unplanned equipment failures. The success of this strategy depends directly on a condition monitoring programme applied in a professional way. The prevention of a catastrophic failure will avoid the production losses and will reduce the direct and the indirect costs associated to the unplanned stationing time. Thus a monitoring programme of the machine condition will reduce the total cost of the maintenance, will ameliorate the safety in exploitation, will increase the company availability and will increase also the products quality.

Systems monitoring and diagnosis

Continuous monitoring of the processes in the operating systems has always been considered as one of the most efficient methods for system condition assessment. The implementation of a modern maintenance system supposes to pass through different obligatory stages starting from the change of the organizational structure and the management way of the maintenance sector till the acquisition of specific devices for the functioning surveillance and the equipment repairing.

Using the specific device, it may be pursue continuously and periodically the functioning state of all equipments. In this way it may be find out the incipient failures that may be solved in a given time in order to avoid the stop of the technological line in inappropriate moments. More than that, using performed devices and technical personnel special trained, it may be diagnosed the cause of the failure, thus its repairing will consists in the replacement of the components that caused the failure and it will not be a reparation or a replacement of the entire wear parts. Thus, it may be done important economies by reducing the manual labor and the spare parts quantity. More than that, by anticipating the reparation, it will be known the spare parts necessary and in this way it may be decreased the stock till liquidation.

A full continuous maintaining system and a systems diagnosis will take over tasks that have as objectives:

- the production operative ordering (the production process leading by dispatcher);
- the resources utilization monitoring;
- the monitoring of the devices functioning;
- the formation of the information referring to the production.

A thus system proves to be functional if it will assure a stable work for a considerable number of users, with a general content of information located on a server. In the figure 1 it is presented the architecture of such system as it was proposed by ISystems Automation company.

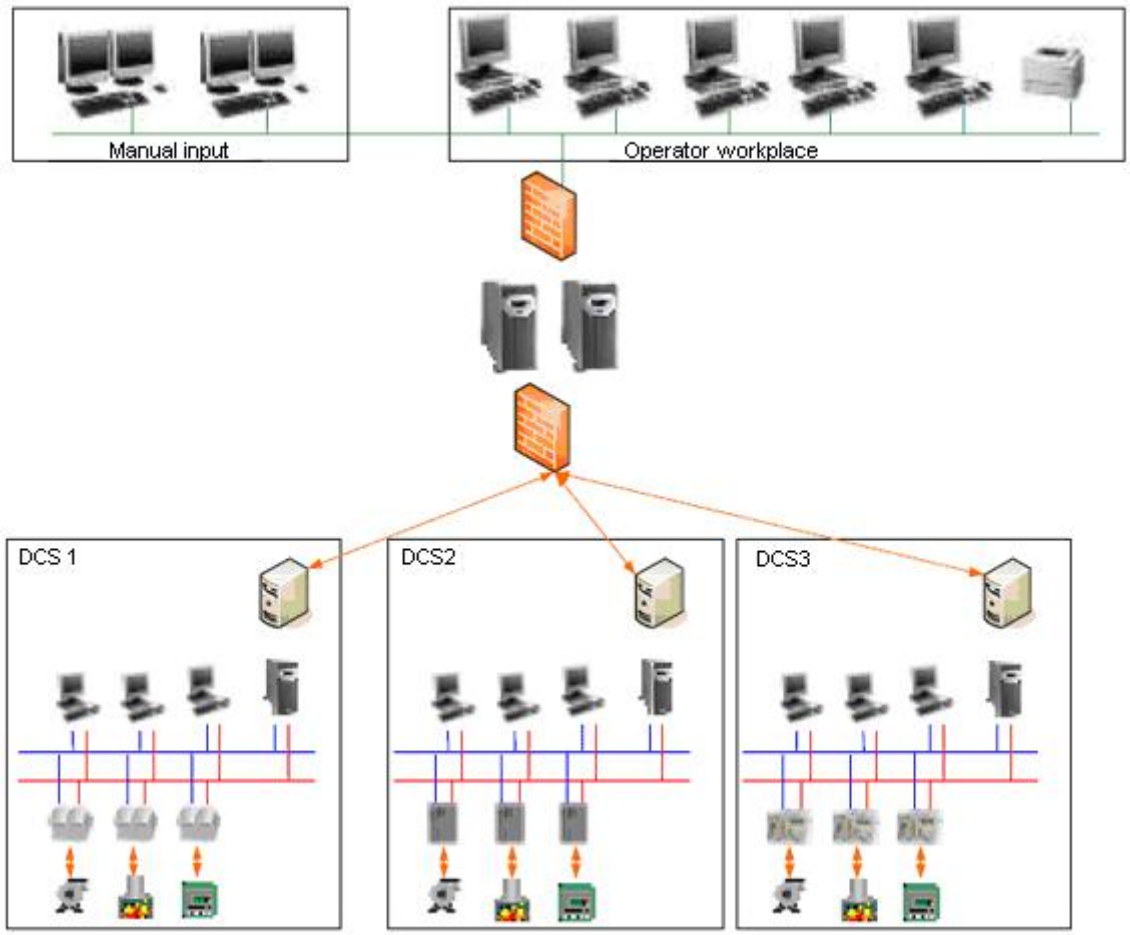

Figure 1. Structure scheme ISystems Automation [4]

The server creates a unique informative space of the company, that makes the production process to be transparent at any data presentation level, realizing the "any information, at any time, in any place" principle.

In function of the automatic level of the different zones of the industrial system, the monitoring may offer the solution of the following applications:

- the dynamic evidence of input of the raw material;
- the dynamic evidence of the direction, of the input flux of the raw materials and semi - product goods;

- the dynamic evidence of the raw material quantity, of the semi - product goods from the fabrication flux;
- the presentation of the information concerning the presence of the products in the fabrication process;
- the evidence of the moment or in dynamic energetic consumptions.

The results of the production system monitoring, in the hypothesis of stocking and statistic processing may be used successfully in order to optimize and make efficient all the activities that influence the fabrication activities.

Equipment monitoring and diagnosis

Condition monitoring is useful for the purpose of evaluating the machine performance, therefore pointing out to the moment when the machine should undergo a maintenance repair. By periodically monitoring the equipment operating parameters, through the means of vibration analysis, lube oil analysis or thermography, malfunctions usually related to that specific equipment can be highlighted early enough in order to perform a preventive maintenance program instead corrective maintenance [3, 4].

Although condition monitoring principles are simple to understand, its technology is oftenly misunderstood, thus used incorrectly. In order to perform a proper diagnosis, it is first necessarily to monitor the relevant set of parameters, and secondly, to compare the readings against the typical machine malfunction expected output.

As a rule of the thumb, good practice when maintaining the equipment is to perform a thorough data analysis, taking into account the recommendation for corrective maintenance backed-up by a good technical judgement. The most traditional strategies of the predictive maintenance will form, in this context, a maintenance activity, maintained in time by an automatic process Proactive Maintenance (PRM), forming a continuous amelioration curl that supposes to pass through three stages [4]:

- the establishing of a predictive system (that includes activities as the analysis of the vibrations, of the lubricants, thermographs);
- the establishing of a system of diagnosis and analysis of the main causes that will determine the maintenance corrective measures;
- the identification of the performance key indicators for the measuring of the equipments functioning state amelioration.

The Proactive Maintenance, following a very well defined process that includes the best monitoring practical activities of the machines condition, the causes that generate the problems are identified, developing corrective actions in order to eliminate the reappearance. The PRM process establishes also the amelioration objectives, known as performance key indicators in order to reduce gradually the problems and to advance to the best practice in the world in the respective industrial segment.

The implementation and the support of the monitoring and diagnosis systems may benefit of the on-line and portable conditions. In the table 1, for example, there are presented equipments proposed by SKF Reliability Systems company, incorporating the successful software platform PRISM4 and the Machine Analyst recent technology.

A technology type Machine Analyst, using the data obtained during the monitoring, may integrate amelioration objectives of the specific reliability, adapted to the beneficiary particular demands and may include services as: the monitoring of the vibrations; the lubrication analysis; the advanced analysis and the diagnosis; the installation of the ball bearings and of the bearings; the precision alignment; the dynamic precision equilibration; the lubrication recommendations; the check of the sealing; the ball bearings upgrades etc. [3, 4, 5].

If the results of an equipment monitoring are preserved in a data base, it will accumulate a very useful information volume for a periodical analysis of the failures causes and it will be easier to take measures to avoid the appearance of further failures. Such an approach of the problems, named also ***proactive*** will lead on average and long term to other important economies.

Table 1. The SKF Reliability Systems equipments [4]

Accelerometers Proximity wells Vibration measuring systems	
Noise measuring instruments Pressure transducers	
Monitoring and more number of rotations protection systems	

Conclusions

Using a specific device, it may be made a continuous or periodical monitoring of the equipments functioning state of any technological installation. Thus, it may be detected incipient failures that may be solved in a given time in order to avoid the stop of the technological line in inappropriate moments. More than that, using performed devices and technical personnel special trained, it may be diagnosed the cause of the failure, thus its repairing will consists in the replacement of the components that caused the failure and it will not be a reparation or a replacement of the entire wear parts. Thus, it may be done important economies by reducing the manual labor and the spare parts quantity. More than that, by anticipating the reparation, it will be known the spare parts necessary and in this way it may be decreased the stock till liquidation [4, 5].

If the results of an equipment monitoring are preserved in a data base, it will accumulate a very useful information volume for a periodical analysis of the failures causes and it will be easier to take measures to avoid the appearance of further failures. Such an approach of the problems, named also ***proactive*** will lead on average and long term to other important economies.

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Sisteme pentru monitorizare continuă şi diagnoză

Rezumat

Pentru menţinerea caracteristicilor funcţionale ale utilajelor şi a funcţionării în condiţii cât mai apropiate de cele iniţiale, este necesară organizarea unui sistem de întreţinere şi reparare a echipamentelor de producţie/proces. Din analiza comportamentului utilajelor în procesul de uzură fizică se poate constata că uzarea în timp a diferitelor componente are loc în mod diferenţiat. Acest fapt impune luarea unor măsuri mai ample de întreţinere şi reparare a acestor componente, pentru a evita ieşirea prematură din funcţie a utilajului.
Aplicarea unor metode moderne de întretinere si reparare a utilajelor a devenit o necesitate obiectivã, în conditiile unor schimbãri majore petrecute în ultimii ani pe plan mondial si national.
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