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MONITORING COMPONENTS IN POWER PLANTS

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Abstract: This paper presents a practical application of technical diagnostics through monitoring in power plants. Application of technical diagnostics and condition monitoring systems is the result of years of research in the area of reliability of technical systems and the design of technical systems work in the energy industry. The function of preventive maintenance is increasingly represented in a new form known as proactive maintenance processes where monitoring systems play a key role. Monitoring of systems process in power plants includes periodic quality control of parts of the system, and its results represent a significant support for technical diagnostics. Automating the process of monitoring systems promotes preventive maintenance, and at the same time, technical diagnostics.
Keywords: condition monitoring, technical diagnostics, maintenance

1. INTRODUCTION

In this paper, we aim to describe a technique for determining the state of the system, ie. trying to answer the following questions:

- Is the system able to work and for how long?
- Whether it should be maintained, and how?
- Does it have cancelations where you should immediately shut down the system in order to eliminate failure?
- How long can system operate with failure and under which conditions?

To answer the above questions there has to be explored: what exactly is meant by condition and whether it can be measured.

Seeking for a clear definition of the status we see that all the questions above are related to how the system will be working until a certain event occurs, eg., failure, and this leads to the definition that the state of the object (plant) during which the plant operates in a specific mode, until the specified probability of failure in the allotted time is reached. If maintenance policy is applied, ie., replacements upon cancellation (without maintenance), then the probability will be equal to one, and if the system is maintained "by the state", then the probability of failure would be at a value that gives the best compromise between minimizing repairs and maintenance costs, and maximizes system capabilities [1].

It is believed that the definition in this form is the one which provides information leading directly to the planning of maintenance and repairs, and allows us to evaluate different operating strategies, and that they are of utmost importance for those who are responsible for the profitable operation of the power plant.

Increasing the safety and reliability of operation of plant and equipment in the production system, largely depends on timely detection of potential sources of failure of the equipment.

Solution to this important task contributes significantly to the application of methods and means of technical diagnostics.

2. TECHNICAL DIAGNOSTICS

Technical diagnostics (hereafter TD) is the science of identifying (recognizing) the operation of technical systems, with the aim of detecting a malfunction. It is based on the proven experimental methods and results, as well as the reciprocity of the functional dependence on the output of the measured diagnostic quantities (signals, parameters) of vehicles structured parameter, i.e., condition of the structure of technical diagnostics [1]. There are three levels of TD, as follows:

- monitoring and identifying deviations about diagnostical parameters and signals from their nominal value,
- analysis of the nature and cause of deviations diagnostic parameters and diagnostic signal from the nominal value, and
- forecast of possible work unit or units without delay.

At the power plants and processing facilities, the most important thing for good economical value of technical system is:

- availability of the property,
- operational safety, and
- lifespan of subsystems and their components.

Unplanned cancellations of process equipment (turbines, generators ...) have resulted in:
» accidents that cause property damage and endanger human lives,
» high costs for repairs and
» significant production losses.

In order to minimize failures in processing and power equipment and avoid damage, it is necessary to timely recognize changes in systems state, and that is possible with the supervision of employees (hearing, seeing, feeling) and the application of certain TD methods (Figure 1).

There should be distinguished two types of technical diagnostics:
» General TD – aims to determine the state of the object according to the general criteria: operating status and fault condition (often the diagnosis is called functional or express) and
» Local TD – aims to determine the technical condition of certain elements, and to determine the causes and characteristics of hidden faults.

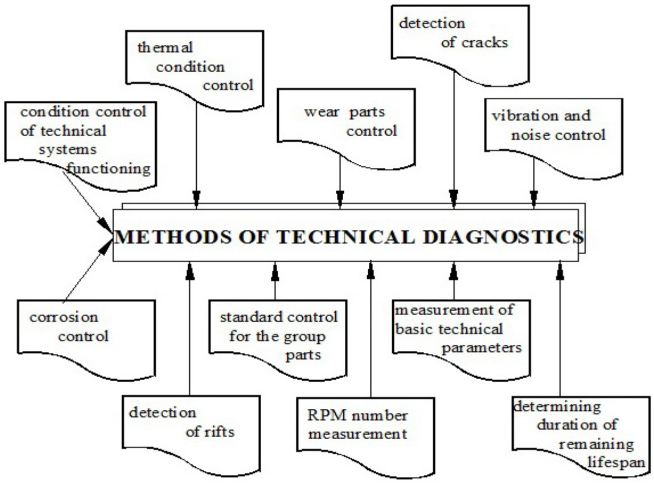

Figure 1. Basic methods of technical diagnostics

In the development and preparation of TD methods, it is necessary to solve three problems:
» define all possible (expected) occurrence of faults that need to be distinguished,
» select a set of parameters that will, as symptoms, through signals emitted by the equipment, give the informations about performance of the equipment and
» establishing a link between the failure or damage and symptoms (a defect corresponding to a symptom or vice versa, or the fault manifests itself through several symptoms).

In the process of diagnosing, there are few significant TD procedures [7]:
» installation of sensors on the subject of diagnosis,
» stabilizing facilities working regime and diagnostic equipment,
» record diagnostic signals,
» registration and measurement of the diagnostic parameters,
» comparison of the values obtained with the calibrated values,
» obtaining diagnostic solutions and information about the current state of the constituent elements of the system, and
» generating conclusions.

For a fuller insight into the state of the system and its functions computers are used as example (Figure 2), which configuration is mechanized to completely replace a large number of workers, for permanent external monitoring of the system and determining its status.

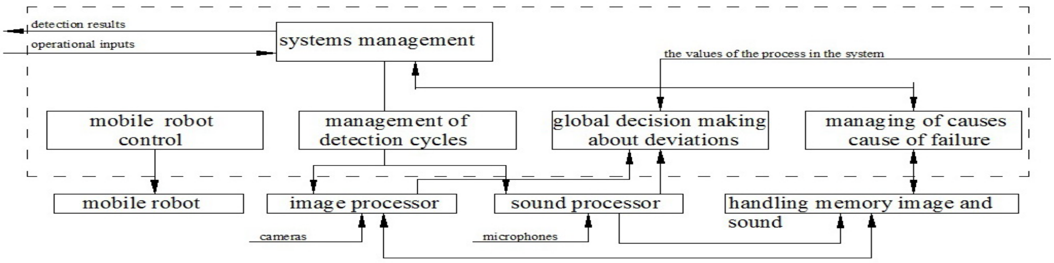

Figure 2. Functional system configuration

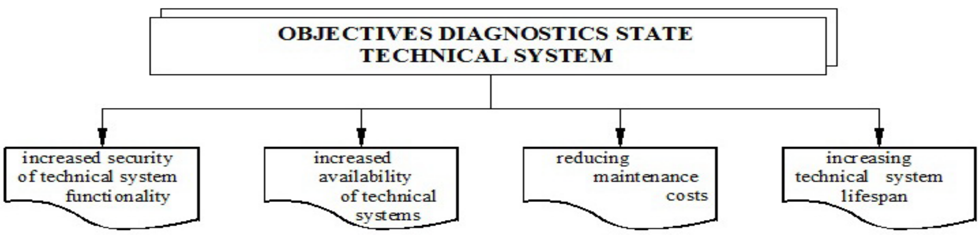

Figure 3. Technical and economic objectives of diagnosis

Diagnostics (permanent or temporary) of the state of the system (Figure 3), it is possible to improve the economics and security specifications of the system and to [4]:

» improve the safety of early detection of failure, so the faults could be reduced without greater consequences and protect operating personnel,
» increase the availability of plants constant supervision, in order to reduce the number of audits, inspections and unscheduled downtime,
» reducing the duration of the audit, repairs and rates, etc. ; diagnostics monitoring the state of the system during the drive, can determine what causes disturbance of the normal operation of the system and plan in advance the measures to be taken, when the drive stops, (by replacing damaged parts, procurement, other repairs...)
» extension of the life of the plant by optimizing the starting, stopping and transients and reducing adverse operating conditions.

3. MAINTENANCE

Maintenance, as well as a set of tasks with which system is able to function with predicted or expected performance, along with the existing conditions of operation system, is a complex technical science with a number of strategies, methods, techniques and organizational forms [2,4].

Here we will only mention the maintenance strategy in which the diagnosis has an important place, which is to "maintain the state" - CBM (Condition Based Maintenance).

This methodology maintenance includes three main phases [3]:
» history of changes to the state in the past - what is it,
» Technical diagnostics of the system - what is now,
» Weather conditions in the future - what will be.

Experiences in operation have shown that the majority of working funds do not lose their functional characteristics at once, but it is a continuous process. Indications of damage, failures and breakdowns occur earlier.

The introduction of diagnostics and organizations in the maintenance of the state (Figure 4) is a process (and condition) that determine state (health) of each part of the technical system, that could be measured and whose behavior we can control with certain parameters.

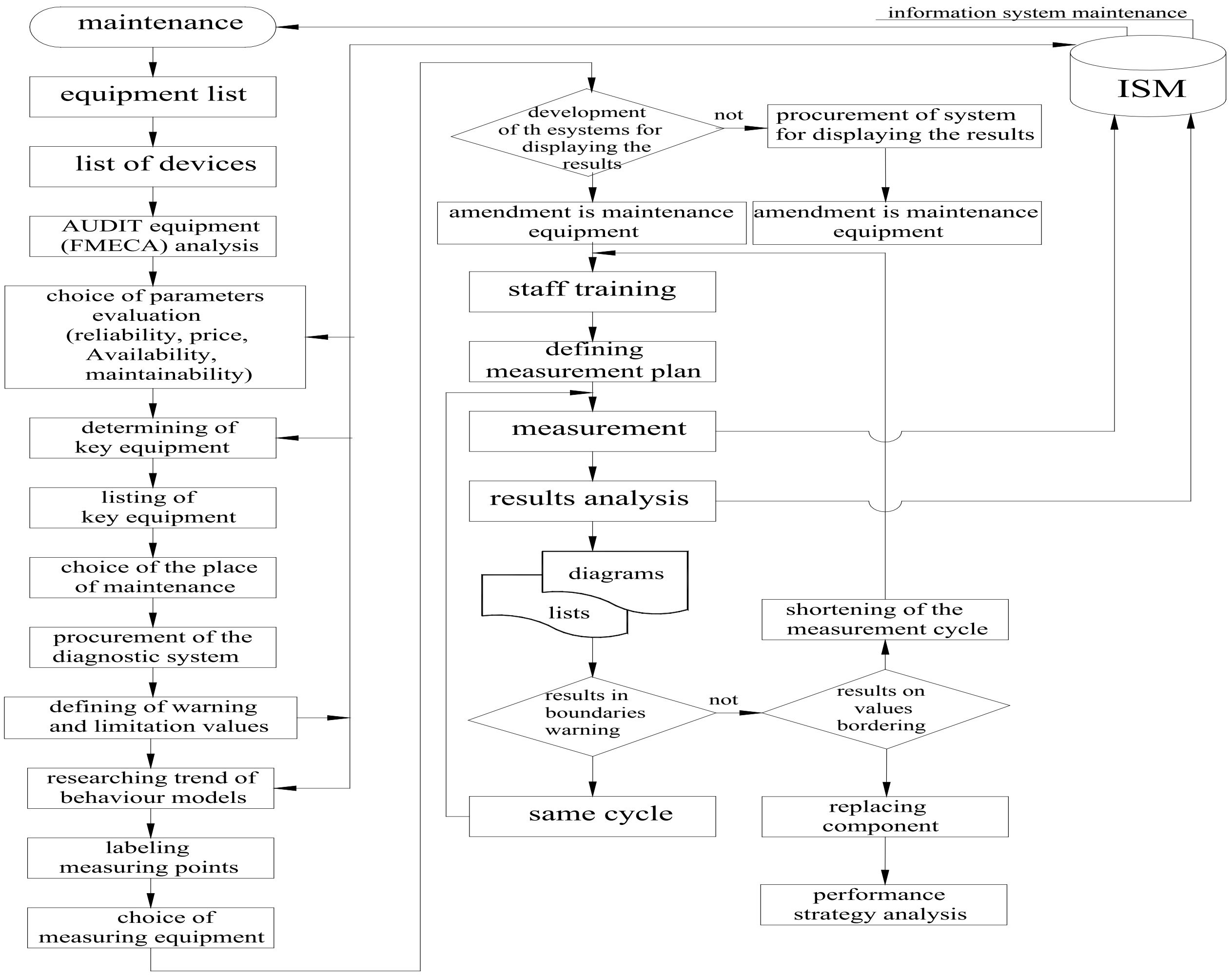

Figure 4. Algorythm of introducing diagnostic and maintenance "by the state"

Condition based maintenance is based on the results of the diagnostic process, which allows the determination of the state of each component involved in the diagnostic monitoring, on the basis of which is determined by the following test plan, inspection, replacement, repair, thus increasing the time of the effective work of the technical system, eliminating unnecessary downtime [5,6].

4. CONCLUSIONS

It is the great importance of the application of technical diagnostics, primarily because of the possibility of discovering failures in the early stages of their occurrence.

Ability to apply the technical diagnostics in predicting the future state of the equipment, is important in maintaining complex systems.

Preventive maintenance, by the state, with the use of diagnostic methods and techniques, i.e., with a diagnosis of the situation, gives conditions for the foreseeable maintenance.

Practice shows that the diagnostic condition monitoring is cost effective operation, because the investment costs are amortized through an unplanned downtime due to repairs.

New technical requirements diagnostics lead to the development of software and hardware modules to improve expert systems with large diagnostic assessment and confident forecasts.

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