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managing of railway control devices, maintenance process

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### MANAGING OF RAILWAY CONTROL DEVICES MAINTENANCE PROCESS

High availability of the railway control systems can be reached by introducing adequate maintenance, taking into account technical and economical aspect. Data about real events are collected and processed by Information System with computer database. Maintenance strategy parameters are calculated on the base of processing and studding of collected data. This allows generating useful standards.

### KIEROWANIE PROCESEM OBSŁUGIWANIA URZĄDZEŃ STEROWANIA RUCHEM KOLEJOWYM

Referat dotyczy zagadnienia utrzymania urządzeń sterowania ruchem kolejowym w wymaganym stanie technicznym. Wzrastająca złożoność systemów sterowania ruchem i konieczność spełniania rosnących wymagań dotyczących ich niezawodności i gotowości sprawiają, że problem właściwego doboru metod obsługiwania urządzeń srk nabiera coraz większego znaczenia. Zaproponowano wdrożenie nowej, elastycznej strategii obsługiwania uwzględniającej rzeczywiste warunki eksploatacji urządzeń. Omówiono zbiór informacji istotnych dla sprawnego kierowania procesem obsługiwania. Przedstawiono System Informacyjny służący zbieraniu i przetwarzaniu informacji o przebiegu procesu eksploatacji. Zaprezentowano koncepcję struktury organizacyjnej systemu kierowania procesem obsługiwania. Opisano elementy systemu i realizowane funkcje.

### 1. INTRODUCTION

An increasing complexity of traffic management systems and a requirement to fulfill the requirements of reliability and availability result in the fact that the issue of selection of adequate maintenance of srk (railway traffic control) devices takes a new important meaning. There is an urgent need to introduce new, flexible strategies of maintenance, taking into account real operating conditions of each device. Efficient management of maintenance process becomes also an increasingly difficult and complex task. The management system should feature follow-up and adaptation ability i.e. ability to follow up changes of demand for maintenance, as well as ability to react to these changes as well as occurring external and internal disturbances.

In order to implement a new and flexible strategy of maintenance and new management methods it is necessary to have knowledge of observation, analysis and quick assessment of phenomena occurring in the operation system. Necessary are also tools making easier taking of rational decisions during maintenance process management.

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### 2. RAILWAY CONTROL DEVICES MAINTENANCE PROCESS

Operation process is described by [7] as a total of the processes concerning devices remaining in the stage of operation i.e. in-between the moment of their manufacturing and the one of realization of the decision about their closing.

The process of railway traffic control equipment operation includes collections of controlled processes, characterized by purposeful actions, and uncontrolled, destructive ones. Among the controlled processes, including among others pre-operating, operating and closing processes we will emphasize the ones ensuring suitability of the railway traffic control system equipment.

In accordance with the principle of finite durability [2] the nondestructive things do not exist. In order to support the useful properties of a thing in its operation system it has to be subject to maintenance operations enabling either conservation or restoration of useful properties in devices.

Using the idea of action chain used in praxeology, we may say that a device is:

being used when there exist an action chain where it is an intermediary of action,

- being a subject to maintenance, when in an action chain it is the subject matter of action.

Thus, there occurs a periodical change of role fulfilled by the railway traffic control device in the operation system. From an action intermediary it becomes an action subject, and subsequently – upon restoration of its operational potential – it becomes again an action intermediary.

Railway traffic control systems have to comply with always growing requirements concerning their reliability. Operation of these systems consists in realization of strictly determined partial tasks. Withdrawal of devices from the operation resulting from their loss of suitability or a necessity to perform preventive maintenance may cause material losses or enforce realization of the task using a replacement method. In case of the railway traffic control devices disturbance in the process of their operation may cause difficulties in the operation of the railway transport system in the area of the passengers and cargo transport, as well as impaired efficiency of operation of this system and safety of vehicle traffic.

The range of devices operated in the railway traffic control systems is broad and differentiated: from mechanical and electromechanical and electrical devices to the electronic ones, involving a great number of devices within the PKP network. This results in high outlays for maintenance of these devices in a proper technical condition. At the same time, technical condition of these devices and their failure rate influence considerably the operating costs of the railway infrastructure sector.

The railway traffic control system devices maintenance processes include actions aimed at maintaining these devices in adequate condition enabling satisfactory realization of their assigned functions. The PKP railways use a simple periodic strategy of cyclic maintenance. It covers all types of systems and their elements, as well as all other maintenance types. Maintenance cycles, different for various devices, are fixed for the entire length of their operation, and periods of time between maintenance have been determined in a subjective way, based on experience of operating staff.

Whereas the actual labor consumption and scope of maintenance task realization are closely related with condition of devices, their age, intensity of destructive processes etc. and the application of rational preventive maintenance requires knowledge of many features, characteristic for the devices under consideration and for the system to operate them. Practical requirements contribute to establishing new models of maintenance and implementation of new, more effective maintenance strategies, taking into consideration more of existing conditions of device operation.

A new approach to the issue of maintenance of railway traffic control system devices was proposed [3], formulating a proposal of changes in the existing strategy. [4] assumed a successive transition from the fixed cycle strategy to more efficient flexible one consisting in a dynamical determination of the moment of next maintenance [1]. Implementation of the new railway traffic control devices maintenance organization methods, taking into account their reliability, technical condition, intensity of use, operating costs [6] and occurring disturbances and restrictions, requires application of tools making easier to the maintenance process manager to make more rational decisions. The skills of observation, analysis and quick assessment of phenomena occurring in the operation system are needed.

#### 3. INFORMATION IN THE MAINTENANCE PROCESS MANAGEMENT

Application of a new flexible strategy of maintenance of the railway traffic control devices requires a continuous inflow of information about their condition, course of maintenance process and phenomena occurring in the operation system and its surroundings. Fig.1 represents a diagram of information flow between the railway traffic control devices operation system and the system supporting management of maintenance process.



Fig.1. The information flows

The information essential for the efficient maintenance management process and work organization in the execute unit include [5]:

- a) information about the structure of operated facility (data about the railway traffic control devices and their role in the traffic control system),
- b) information about the course of devices' operation (their technical condition, intensity and period of use, malfunctions and course of maintenance work realization),
- c) information about the present availability of resources in the maintenance system,
- d) information enabling control and assessment of effectiveness and adequacy of maintenance work realization,

- c) information necessary for scheduling the maintenance realization (with values of reliability indices, required moments of maintenance work realization and moments of relay legalization, dates of maintenance tasks already realized, assumed technology of work realization, resources necessary for their completion, expected time and cost of realization),
- f) information making casier administration and organization of work in the maintenance unit (personnel, its qualifications and participation in the task realization, consumption of consumables, use of renewable resources, costs of work realization),
- g) information expanding knowledge about the devices being operated and processes occurring during their use (amounts of consumption, form, causes and effects of malfunctions).

### 4. MANAGING THE RAILWAY TRAFFIC CONTROL DEVICES MAINTENANCE

Fig.2 presents the diagram of the Information System [5] that basic task consists in collection, putting into a database and processing the above described information necessary for an efficient process of maintenance of the devices.

The basic components of Information Systems enabling realization of the assumed tasks include:

- personnel with appropriate qualifications, measurement instruments, device condition monitoring systems,
- paper information carriers and operator introducing the collected information to the database or an electronic (computerized) data transmission system,
- computer system provided with database.

The collected information are stored and processed in the System database. They constitute basis for the reports containing collective information important for the correct organization of work and making easier decision-making in the process of maintenance management.

The Computerized Information System should constitute the basic component of the future information system supporting the maintenance management (Fig.1) that will enable a rational and efficient management of the railway traffic control device maintenance process.



Fig.2. Diagram of Information System

For the purpose of implementation and efficient application of new and flexible strategy of the railway traffic control device management it is possible to suggest a regional system of maintenance process management with the following organization structure (Fig.3).



Fig.3. Organization structure of maintenance system

Where:

SE- Operation Section

OCE- Regional Operation Center

OCM- Regional Monitoring (Supervision) Center

OCU- Regional Maintenance Center

SCE- Network Operating Center

SCN- Network Reliability Center

SCD- Network Diagnostics Center

The presented structure contains three levels of maintenance process organization.

The Operating Sections collect information about the course of operation process for each particular device used in the Section. Based on Section resources, current inspections, regulation and servicing of devices are performed.

The Regional Operation Center (OCE) contains the regional database of the Information System, where information about the structure of each Section are maintained together with the information about the course of railway traffic control devices operation as well as utilization of resources in the Sections subject to the Center. The structure of OCE includes a Regional Monitoring Center (OCM) and Regional Maintenance Center (OCU).

The purpose of OCM is to supervise and assess the technical condition of devices operated by the Sections (SE) belonging to this region. Information about the course of devices operation process is collected in the OCM where reports about their technical condition are also created.

The Maintenance Center (OCU) contains specialized workshops where the repairs of damaged devices are performed as well as inspections and adjustments that exceed the possibilities of Operation Sections. In the technically justified cases, the service activities realized in Maintenance Centers may be partially or in whole taken over by the specialized manufacturer's servicing teams.

The structure of Network Operating Center (SCE) contains a Network Reliability Center (SCN) where information from regional databases of Information System are transferred that are necessary for determination of reliability indexes for the devices as well as characteristics of wear-out elements. Also within SCE is operating the Network Diagnostic Center (SCD) provided with the knowledge base and experts system. SCD supports the Regional Monitoring Centers in their assessment of technical condition of equipment, forecasting of wear-out and malfunctions as well as determination of causes and results of the operating events that have occurred.

The database of Network Operating Center keeps the latest issues of documentation and instructions as well as diagrams, drawings and descriptions of devices and systems.

## 5. CONCLUSION

The Operation Sections and Regional Maintenance Centers constitute in the proposed system of maintenance process management these elements that contain the physical realization of maintenance works. The Network Operation Center with cooperation of Regional Monitoring Centers prepares knowledge necessary for the efficient maintenance management. Process management takes place in the Regional Operating Centers. Here decisions are taken concerning schedules and scope of realization of particular maintenance tasks as well as repairs and replacement of equipment.

Implementation of the new railway traffic control devices maintenance strategy as well as regional maintenance process management system will enable a flexible modification of parameters of this process and their adjustment to the real needs. This will lead to the reduction of equipment operating costs [4, 6], improved organization of work, rationalization of the material management as well as unification and limitation of number of operational documents.

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