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Expert systems of multivariable predictive control of oil and gas facilities reliability

Zemenkov Yu.D.[a], Shalay V.V.[b], Zemenkova M.Yu.[a]*

[a] *Tyumen State Oil and Gas University, 38, Volodarskogo St., Tyumen 625000, Russian Federation*
[b] *Omsk State Technical University, 11, Mira Pr., Omsk 644050, Russian Federation*

Abstract

The authors conducted a set of studies concerning the development of methodological support of multivariate predictive control reliability system for oil and gas industry. The algorithms, the innovative methods of calculation and the mathematical models of reliability factors, compatible with the modern production technological maintenance system, the system of dispatcher data registration, non-destructive testing diagnostics, and automated process control systems are developed. The mathematical software is designed to meet the technological features of the specific facilities, with applying the theory of process analysis, theory of reliability and fluctuation analysis elements. The developed models of reliability factors provide the possibility of predicting the parameters of technical facilities in a real time mode or for a fixed period, the structural and factor analysis function of the system in order to plan its optimal maintenance.

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Keywords: reliability; safety; pipeline transport; reliability prediction

1. Introduction

Monitoring technologies of MPC (multivariable predictive control) meet modern economical, production, and safety requirements based on the special continuous control of quantitative and running values of various factors: controllable, regulated, (set-points) and performance ones [1, 2].

* Corresponding author. Tel.: +7-345-220-1931.
E-mail address: zemenkov@tsogu.ru

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For the prediction and assessment of the reliability of pipeline transportation and hydrocarbon storage facilities in real time, complex study of all the factors, phenomena and processes that determine various properties of the system reliability is necessary.

The analysis of existing studies indicates that, despite the urgency of the problem and a significant amount of research, existing techniques allow only a one-time assessment of reliability and are not focused on the use of immediate assessment and prediction in real time with the use of modern computer technologies [3- 6].

2. Study subject

The subject of the study is the technology of reliability prognostic control, which requires the development of algorithmic and mathematical set.

3. Methods

Based on the analysis of the operating experience of the industrial facilities, it seems advisable to divide the sequence of the basic processes of design, implementation, and monitoring systems operation into several stages (Fig. 1). Stages 1, 2, 5, 6, and 7 are based on the results of theoretical and industrial research, while stages 3 and 4 are undertaken by organizations, developing information systems, as well as involved directly in construction and operating of the hazardous facility.

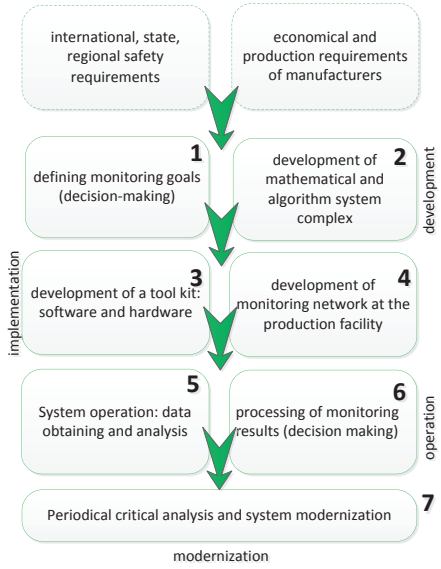

Fig. 1. Algorithm of developing the technological processes monitoring system

It is necessary to note, that possibilities and prospects of the implementation of the developed MPC system are not limited by only technological sphere of production: they are also focused on the scientific research and project institutes, regulatory authorities while evaluating the risk, choosing the complex of technological equipment for diagnostic and planned preventive maintenance, declaring organizations safety and so on.

Almost every system of technological or industrial monitoring and control contains information databank. The system of source data collection is constructed in such a way that can be generated at existing organizations using both current and new hardware.

For the analysis and control the system reliability, are formed structural and factor analysis algorithms, which, on a real-time basis, allow: