PROVIDING INDUSTRIAL SAFETY OF UNDERGROUND GAS STORAGE FACILITIES IN JSC GAZPROM

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ABSTRACT

The unified system of the industrial safety examination and diagnostics of the UGS facilities has been created and performs successfully in JSC GAZPROM; the system represents one of the challenges of GAZPROM’s strategy aimed at winning the leading position on the basis of cost reduction by means of the improvement in production capital funds utilization under binding obligation to meet the safety requirements for the gas industry facilities.

Development and implementation of the industrial safety examination and diagnostic system at the JSC GAZPROM UGS facilities provides for:

- safety (both for humans, environment and utilities) and efficiency of the UGS facilities’ operation;
- reduction of all the risks, reliable and efficient natural gas supply to the customers;
- high quality of examination of industrial safety and technical diagnostics of the UGS facilities;
- service life extension of the UGS facilities by way of reasonable prolongation of the facilities’ safe operation term;
- optimization of the repair and maintenance costs by means of undertaking them in accordance with the facilities’ actual technical condition;
- reduction of operational cost.
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1. THE ISSUE OF THE UGS FACILITIES’ INDUSTRIAL SAFETY

JSC GAZPROM is the owner of the major underground gas storage (UGS) facilities.

Currently the UGS system of JSC GAZPROM plays an outstanding role in securing reliable gas supply in the Russian Federation and export gas deliveries. The following functions are assigned to the UGS system (Fig. 1).

- shaving seasonal fluctuations in gas consumption in the RF;
- delivery of additional gas volumes to the consumers in extremely low temperatures both in several days occasions and in extra cold winter by way of building up corresponding additional gas reserves;
- securing reliable export gas deliveries;
- creating of the emergency long-term reserves;
- making gas reserves for the short-term failures in the gas supply system.

Based on the above the most important aspect in the underground gas storage system development in Russia is keeping its performance at a reliable, safe and stable level.

A number of laws regulating industrial safety at dangerous production facilities have been adopted in the recent years, including new national-wide and industrial normative documents aimed at provision of their secure operation.

The processes of physical ageing and wear-out of the UGS capital goods (Fig. 2), modern stringent HS&E requirements, necessity to optimize the cost of backing-up the required level of safe and secure performance were the reasons which led to development and deployment of the system of industrial safety examination and diagnostics of the technical facilities which is considered in JSC GAZPROM as the UGS facilities’ industrial safety management component.
The above system’s operation is carried out in accordance with the Federal Legislation requirements, rules, provisions and standards of the Russian Federation as well as international agreements in the field of industrial safety and is backed up by the front-line scientific and technical developments and ideas.

In line with the “Basic Principles of the Russian Federation State Policy in the Field of Industrial Safety at Hazardous Production Facilities”, adopted by the Russian Federation, the primary objective of GAZPROM’s efforts to foster industrial safety in the underground gas storage is the reduction of probable accident risks at the UGS facilities down to socially acceptable value in conjunction with introduction of new hazard-free technologies.

This has caused necessity to determine the key principles, priority goals and areas of GAZPROM’s activity in the field of development and systematic implementation of the industrial safety system and the quality of the UGS facilities’ diagnostics which makes a part of the industrial safety management system.

Obviously, the utmost efficiency of the performance of any system securing industrial safety and the quality of the UGS facilities’ diagnostics may be achieved through integrated approach to the planning and execution of examination and diagnostics activity.

Availability of experienced personnel, self-consistent regulatory and procedural documents and a set of modern technologies and tools of technical control, diagnostics and industrial safety management, the UGS facilities’ service certificates are prerequisites for efficient and high-quality examination and diagnostics operations.

In situation when there is deficiency in material and financial resources a priorities ranking is a corner-stone for examination and diagnostics of the UGS technical facilities. The priorities ranking should be based on the analysis and integrated evaluation of engineering and financial risks of the UGS facilities’ operation under different modes of technical maintenance.
2. OBJECTIVES AND PRINCIPLES OF EXAMINATION AND DIAGNOSTICS SERVICING OF THE UGS FACILITIES IN JSC GAZPROM

The industrial safety and diagnostics quality assurance system developed under the auspices of the GAZPROM’s Underground Gas Storage Direction is aimed at:

- provision of accident free protection for the vital personal interests and those of JSC GAZPROM at the UGS technical facilities, protection against the accident consequences by means of prevention of emergency failures of engineering devices, equipment and installations, as well as reduction of the probability of breakdowns and incidents, especially those of them which may entail loss of life;
- ensuring safety and operational efficiency of the UGS engineering devices, equipment and installations;
- reduction of environmental damage from the JSC GAZPROM UGS operation, as well as economic losses caused by accident management;
- high quality examination of the industrial safety and diagnostics of the UGS engineering devices, equipment and installations;
- service life prolongation of the UGS engineering devices, equipment and installations through reasonable extension of their safe operation;
- repair and maintenance of the engineering devices, equipment and installations based on their actual technical condition;
- forecasting the technical condition of the engineering devices, equipment and installations and elaboration of well-grounded recommendations on their further operation;
- operation cost reduction;
- standardization and implementation of information, methodical and metrological support of the industrial safety examination and diagnostics system in JSC GAZPROM;
- improvement of the normative and regulatory base for the UGS facilities’ operation in JSC GAZPROM;
- providing substitution of imported hi-tech diagnostic equipment and nondestructive inspection aids by home produce;
- optimization of expenditures on examination and diagnostics of the industrial safety through the development of a multilevel package of examination and diagnostics activities;
- training and professional improvement of specialists in the field of industrial safety examination and diagnostics of the JSC GAZPROM UGS technological assets.

To secure efficient material, technical and financial resources management, examination of the industrial safety and technical diagnostics of the UGS facilities should be carried out on the basis of the following principles: complexity, systematic approach, efficiency, priorities ranking.

Complexity means development of a complex system for examination and diagnostic servicing of the JSC GAZPROM UGS facilities, the main components of which are (Fig. 3):

- planning, coordination and control of the examination and diagnostic operations carried out at the UGS facilities;
- information technologies and common database;
- regulatory and methodical support;
- instrument and hardware support;
- personnel staffing.

Planning ensures solution of the following tasks:

- determination of per annum level of financing of the examination and diagnostics activity at the UGS facilities;
- optimization of physical volumes of the examination and diagnostics at the UGS facilities and their rational distribution;
- development of time-schedule of the examination and diagnostics;
- on-line processing of the data concerning the volume of urgent remedial works determined by the examination and diagnostics and transfer of the information to customers.
Quality control covers the following issues:
- technical auditing of enterprises performing the examination and diagnostics;
- validation of the results of the work performed;
- statistical analysis of the results.

Coordination of execution of the examination and diagnostics provides for the following:
- maintaining the adopted schedule of examination and diagnostics and making timely arrangements for the schedule execution in due time;
- on-line informing GAZPROM's divisions of the detected defects and failures;
- prompt arrangement of remedial works in order to repair major defects and failures.

Information technologies and common data base provide for:
- accumulation of data on technical condition of the facilities;
- statistical analysis of the types, dates and causes of the defects;
- detection of tentative and regional trends in defect formation across the entire farm of engineering devices, equipment and installations of the UGS facilities;
- planning of the remedial works;
- emergency situations forecasting;
- data analysis aimed at the specified life span prolongation;
- quality control of the examination and diagnostics and remedial operations.

Regulatory and methodical support (regulations, standards, procedures, guidelines, and techniques) is developed on the basis of the Federal Legislation requirements, rules, provisions and standards of the Russian Federation as well as those of the international agreements in the field of industrial safety.
Instrument and hardware support. Within GAZPROM Group of companies a common approach is used to the problem of instrument and hardware support of examination and diagnostics; the approach is formed on the basis of requirements of the existing standards, procedures, techniques and recommendations.

Personnel staffing. Efficient performance of the system is provided by training, professional improvement and rating of personnel dealing with the examination of industrial safety and diagnostics of the UGS technical facilities.

Systematical approach is the next principle of the examination and diagnostics servicing of the UGS facilities. The said principle assumes that the industrial safety examination and engineering diagnostics of the UGS facilities is considered to be a component of the UGS industrial safety management system.

Management of the system should be directed by the Federal Legislation requirements, rules, provisions and standards of the Russian Federation as well as international agreements in the field of industrial safety, and should be based on the front-line scientific and technical developments and ideas.

Realization of the above principle may be granted by solution of the following tasks:
- development of a strategy of the UGS technical objects’ operation;
- selection of adequate operation patterns for individual elements of the UGS facilities, rules and criteria for their technical condition evaluation, emergency situation identification;
- coordination of the selected operation strategies and techniques of examination and diagnostics servicing.

Basic strategies of the UGS facilities operation are:
- operation until the end of specified life span of critical components securing the safety of an object;
- operation until failure or breakdown of equipment, some elements and engineering systems;
- operation until the moment just preceding the failure or breakdown of equipment, elements and engineering systems.

Efficiency. Efficiency assumes that implementation of the procedures of engineering diagnostics and examination of industrial safety should result in optimization of UGS facilities operational cost on the basis of a switchover to operation in accordance with the actual technical condition.

The main tasks of the principle implementation are as follows:
- cost-benefit analysis of the efficiency of the industrial safety examination and engineering diagnostics system;
- substantiation of required and sufficient level and frequency of the industrial safety examination and engineering diagnostics to ensure required reliability and acceptable operation risk level;
- optimization of expenditures on servicing and repairs of the UGS facilities;
- introduction of the resource-saving technologies and procedures;
- justification of action plans dealing with liability insurance of operators of the UGS facilities.

Diagnostic system might be considered cost effective and socially justifiable if it ensures cost optimization within the “safety – quality – price” scheme.

Priority principle provides for assessment of tendency in the examination and diagnostics servicing of the UGS facilities based on deployment of the potential of modern industrial safety examination techniques, procedures and tools of engineering diagnostics and monitoring of the technical condition of the UGS devices, equipment and structures.

Implementation of the principle implies solution of the following tasks:
- assessment of tendency in the field of ensuring industrial safety at the UGS facilities;
- justification of the need for investments in promotion of promising trends in the development of methods and techniques providing industrial safety at the UGS facilities, mainly deployment of stationary instrument monitoring system;
- consolidation of the resources of GAZPROM’s subsidiaries and the organizations involved with the aim of financing the advanced developments in the field of industrial safety promotion at the UGS facilities in case of the absence of centralized funding within the budget of JSC GAZPROM.

3. PRACTICAL IMPLEMENTATION OF THE APPROACHES DEVELOPED

To implement the above claimed objectives and goals JSC GAZPROM has developed the Provision (standard) in regulating implementation and operation of the unified system of the industrial safety examination and diagnostics of the UGS technical objects. The Provision defines the following:
- goals, facilities and organizational structure of the industrial safety examination and technical diagnostics system;
- planning phases, the order of work execution and performance record;
- JSC GAZPROM unified regulatory and procedural support required for examining the industrial safety and engineering diagnostics;
- general requirements to examination and diagnostic organizations, experts and specialists in engineering diagnostics.

Examination of industrial safety and engineering diagnostics activity is carried out at all the UGS facilities under operation in JSC GAZPROM in accordance with perspective plans and the Work Program approved annually.

The following types of the UGS engineering devices, equipment and installations are subject to industrial safety examination and diagnostics in JSC GAZPROM (Fig. 4):

- UGS wells of different classes;
- Christmas trees and casing heads;
- high pressure vessels (dust collectors, filter separators, separators, absorbers, etc.);
- above- and underground process pipelines (connecting pipelines, in-field and inter-field gathering lines, wellhead connections, pipelines of gas collecting and distribution stations, gas treatment plants);
- equipment of the gas treatment plants and gas collecting (distribution) stations;
- other technical devices (when required).

Development and deployment of the unified system of the UGS industrial safety examination and technical diagnostics in JSC GAZPROM has made it possible to:
- ensure safety (both for humans, environment and utilities) and efficiency of the UGS facilities’ operation;
- reduce all the risks, provide for reliable and efficient natural gas supply to the customers;
- secure high quality of work on examination of industrial safety and technical diagnostics of the UGS facilities;
- increase the service life of the UGS facilities by way of reasonable prolongation of the facilities’ safe operation term;
- optimize the repair and maintenance costs by means of their undertaking in accordance with the facilities’ actual technical condition;
- reduce the operation cost.

Thus the unified system of the industrial safety examination and diagnostics of the UGS facilities has been created and performs successfully in JSC GAZPROM. The system represents one of the challenges of GAZPROM’s strategy aimed at winning the leading position by cost reduction by means of the improvements in production capital funds utilization under binding obligation to meet the safety requirements for the gas industry facilities.
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Fig.1. Functions Assigned to the UGS System

Fig.2. UGS Facilities Commissioning

Fig.3. Structure of UGS Industrial Safety Examination & Technical Diagnostics System in JSC GAZPROM

Fig.4. Examination and Diagnostics Volume by Type of Work and Years