

TECHNICAL DIAGNOSTICS AND SERVICE OF GAS DISTRIBUTION NETWORKS

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ABSTRACT. The report examines and analyzes the main activities related to technical diagnostics and service of distribution networks. The main methods for detecting natural gas leaks from gas distribution networks are considered.

Keywords: gas pipelines, gas distribution networks, technical diagnostics

ТЕХНИЧЕСКА ДИАГНОСТИКА И СЕРВИЗ НА ГАЗОРАЗПРЕДЕЛИТЕЛНИ МРЕЖИ

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РЕЗЮМЕ. В доклада са разгледани и анализирани основните дейности свързани с техническа диагностика и сервиз на разпределителни мрежи. Разгледани са основните методи за откриване на утечки на природен газ от газоразпределителните мрежи.

Ключови думи: газопроводи, газоразпределителни мрежи, техническа диагностика

Introduction

The operation of the gas distribution networks is a technical and technological complex of activities aimed at ensuring continuous, safe and trouble-free operation of the network, in order to supply consumers reliably with natural gas in compliance with the quality requirements according to the current regulations in the country, to protect environment and citizens' health, life and property (Nikolov, 2007).

Maintenance, diagnostics and service of the gas distribution networks is a combination of methodological and technical means for assessing the condition of the controlled parameters; accumulation of professional experience and storage of data about them; their systematization; processing and analysis of results; selection of organizational and technical measures aimed at the practical implementation of the most efficient and rational form of service.

Maintenance is control over the technical condition, cleaning, readjustment and other operations without disassembly regarding the maintenance of the functionality and serviceability of the equipment in automatic gas control stations, gas control points and switchboards and in gas control and measuring points and switchboards;

Disassembly audit is a set of operations with disassembly, cleaning, inspection and replacement of rapidly wearing parts of the equipment in the facilities, as well as establishing the need to repair units and parts and restore normal functional operating conditions for the next operational period.

Repair is a complex of operations with replacement of parts and assemblies, after the implementation of which the serviceability and trouble-free operation of the equipment is guaranteed during the next period of operation.

For proper functioning of the various pieces of equipment installed in gas control points and switchboards and in gas control and measuring points and switchboards, the operating staff systematically visit them with a frequency depending on the type of equipment (gas consumption, frequency of filter contamination, age, conditions and mode of operation). The periodicity of these inspections is determined by the annual plan for the activity of maintenance diagnostics and service of the gas distribution network.

If necessary, the periods for these inspections are shortened by conducting an emergency, unscheduled inspection, appointed and performed depending on local operating conditions or for specific gas control points and switchboards or gas control and measuring points and switchboards (Boyadzhiev, 2014). These inspections do not replace the periodic scheduled inspection.

Maintenance of the gas distribution network

It is carried out in accordance with the specific operating conditions, gas pressure, duration of operation and condition of the gas distribution network, characteristics and corrosion activity of the soil, the presence of stray currents, the nature of the area and specific passages (through various obstacles), the organization and training of the service staff in the respective gas distribution company.

Inspecting the route of the gas pipelines is performed periodically as follows:

- the route of the newly built and put into operation gas pipelines - immediately on the day of their filling with gas and on the next day after the gasification;

- gas pipelines operated under normal conditions and in good technical condition are inspected on the following intervals:

- gas pipelines for pressure 0.4 MPa and higher on the territory of the settlement - not less than twice a month;
- the gas pipelines from GCS / AGCS to the settlement - not less than once a month;
- gas pipelines for pressure 0.1 (0.01) MPa - not less than once a month;
- gas pipelines located within a radius of 15 m from the place of construction works - daily, until the danger of damage is eliminated;

When inspecting the gas pipelines, the following is performed:

- inspection of the route and the linear crane units for gas leaks by external signs and instrumentation;
- checking the presence and condition of the benchmarks for marking the route;
- inspection of the area along the route of the gas pipeline in order to detect shrinkage, erosion;
- checking the presence and condition of the signs on the fence panels, cabinets, crane units, etc., the condition of the cabinet doors;
- inspection of the supports and obstacles on both sides of the above-ground sections of the gas pipelines;
- when crossing water obstacles - the erosion of the shores or the accumulation of materials;
- control of the activities over or near the gas pipelines by third parties without the written consent of the gas distribution company;
- inspection of the condition of the cast iron pots of the underground installed shut-off fittings made of polyethylene and cleaning of ice, snow, mud;
- checking the presence of clogging with mud, sand and other contaminants in the shafts of the underground cranes made of polyethylene, preventing the normal and trouble-free handling of the rotors and the leads to the shut-off fittings;
- immediate cleaning with appropriate shaft fittings if necessary;
- checking for gas contamination of the shaft in the siege pot with the help of a gas analyzer;
- checking the direction of the linear valve on the actuator cap, "open" and "closed", in relation to the direction of the axis of the gas pipeline (for ball valves, 1/4 revolution, type KHP);
- inspection (smoothly and carefully) of "closing" and "opening" of the shut-off valve once a year;
- The operating staff of the gas distribution company prepares numbered route maps (schemes) for inspecting the gas distribution network (GDN). The results of the performed inspections are recorded in the Operational Register of the GDN, and a report is prepared for the patrols (the detected faults and violations are entered) in the Register for the patrols - working document.

The checking of steel gas pipelines that are subject to scheduled repairs after technical inspection is carried out in accordance with the Instruction for control and diagnostics of the technical condition of the gas distribution network for natural gas leaks, as follows:

- in the built-up area of the settlement - not less than once a week;
- in the unbuilt area of the settlement - not less than twice a month.

- For the proper functioning of the equipment installed in the facilities, the operating staff of GDC systematically visits and monitors them with a frequency depending on the type of equipment and in accordance with the requirements of the Instruction for adjustment of gas control points and switchboards and Instruction for maintenance and repair.

- The results are entered in the Operational Register of the facility, and for the inspection of the facility an entry is made in the Operational Register of GDN.

- The control of the technological parameters of the gas in the GDN, equipped with remote control devices is carried out with the help of an automated SKADA system.

Maintenance of gas distribution network facilities

Gas filters

The contamination of the filter is checked with a differential manometer. If there is an indication of contamination, it is opened and cleaned or the filter element is replaced.

Stopcocks

The entrance is checked (smooth opening and closing) and the closing tightness of the shut-off valves in the equipment, too.

Gas pressure regulators and pilots

The setting of the regulators in the facility is carried out with a metrologically checked manometer and, if necessary, a readjustment is performed.

Periodic change of the main and reserve regulatory line.

The faults of the regulators causing an inadmissible increase or decrease of the working pressure above the limits of the pressure setting are eliminated immediately or the unit is replaced and the reasons for this are established.

The regulator, during operation, must not allow the outlet pressure to exceed the highest level of operating pressure (OP) according to BSS EN 12279 + A1: 2006.

The monitor must not allow the outlet pressure to exceed the temporary working pressure (TOP) according to BSS EN 12279 + A1: 2006.

Safety-discharge valves (SDV)

With a checked manometer, the setting in the facility is checked and, if necessary, a readjustment is performed.

These valves, including those built into the pressure regulators, are set to operate when the pressure after the regulator /monitor/ exceeds the temporary operating pressure (TOP) according to BSS EN 12279 + A1: 2006.

Safety shut-off valves (SSV)

With a checked manometer, the settings of the safety shut-off valves in the facility are checked and, if necessary, readjustments are made.

These valves are set to operate when the pressure after the regulator reaches the maximum accidental pressure (MAP) or falls by more than 30 percent of the maximum operating pressure (MOP) according to BSS EN 12279 + A1: 2006.

Manometers

They are declared and submitted for inspection to the State Agency for Metrology and Technical Supervision (BIM).

Flowmeters

They are declared and submitted for metrological inspection by an authorized laboratory. The frequency of inspections is determined by an order of the Chairman of the State Agency for Metrology and Technical Supervision (SAMTS).

Diagnosis of the technical conditions of distributive gas pipelines for natural gas leaks

The devices for measuring the natural gas content and, accordingly, for detecting leaks and gas leaks must be in accordance with the current European norms and standards. The control of gas distribution networks (GDN) in relation to gas leaks can be performed by means of mobile devices for footinspection or to use specially equipped vehicles. These devices can be used in collective gas pipelines of gas fields and in collective oil pipelines through which gas-oil emulsion is transported (Boyadzhiev, 2008; Georgiev, 2014).

Depending on the specific cases, the devices for detection and localization of natural gas leak work on a different principle and are equipped with different types of sensors. In many respects it is appropriate to use combined devices capable of measuring the gas concentration in different ranges;

Methods for search and localization of natural gas leak

Foot method

It is inspected by means of a mobile device equipped with a plain or bell-shaped probe, checking the air directly on the soil surface for the presence of gas. Care must be taken to place the probe tightly in order to maximally avoid influences, for example, from exhaust gases, wind, etc. Gas pipelines should be inspected as close as possible to the axis of their route, and if they are laid under a solid surface (asphalt, concrete, paving), the closest breaks or cracks should be checked. When using a plain probe, the test must be performed at a slow walking speed. The bell-shaped probe is placed along the route every 1-1.5 m, holding for sampling the soil air for about 5 seconds. The inspection of the building deviations is performed next to the wall of the house. Wet or frozen soil surfaces can become gas-tight. Therefore, routine control is not recommended in these circumstances. If unscheduled inspections cannot be avoided, the frozen cover should be ruptured and the soil air - checked.

The distribution of gas must be observed and taken into account, especially in the direction of buildings and cavities. All breakdown and leakage data are documented on drafts. The drafts are unambiguously marked with control numbers and documented. Note: the method of testing, the instruments used, the name of the inspector, the deep drillings and the number of breaches or leaks detected. The inspected sections, respectively routes are marked in the reports..

The equipment built in the road surface and sidewalks (shafts, canals, pots of underground cranes, etc.) is also checked for the presence of gas. When establishing the presence of gas, precautionary measures are taken

immediately and the companies operating the underground facilities are notified. Neighboring buildings should also be involved in the inspection and possible security work.

Acoustic method

This method is based on the detection of ultrasonic waves received from the movement of the gas in the pipeline. The waves are with a frequency of 40-45 kHz. In this method, the detection of leakage is based on the gas flow rate. The method is characterized by high sensitivity $1 \times 10^{-2} \text{ cm}^2 / \text{sec}$ (Nikolov 2007). Main disadvantage of the method is disturbances in the research equipment as a result of background noise.

Conclusion

The correct functioning of the various equipment installed in gas control points and switchboards and in gas control and measuring points and switchboards it is obligatory for the staff to inspect them regularly depending on the type of facilities (consumption of gas, frequency of filter contamination, age, conditions and mode of operation).

Devices for measuring the natural gas content and, accordingly, for detecting leaks and gas leaks from gas pipelines must be in accordance with the current European norms and standards. The control of the gas distribution networks (GDN) with regard to gas leaks is carried out on a large scale by means of mobile devices for inspection by foot method or by the use of specially equipped vehicles.

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