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# EXPERIENCE OF THE GEODETIC CONTROL FOR THE TECHNICAL CONDITION OF THE FUEL AND ENERGY COMPLEX OBJECTS

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**Statement of the problem.**

Different in design and purpose energetic and hydrotechnical constructions are the part of large fuel and energy systems, including thermal power plants.. They take a special place among engineering objects that require systematic and comprehensive monitoring to ensure their proper and trouble-free operation. This is due to technical difficulties of the design and construction of such facilities, because of their large size, diversity of soils in the area of construction, the influence of climatic factors of the environment, fluctuations in pressure on the foundation and the building in general under conditions of direct contact with water.

In general, these studies together occupy an important place geodetic deformation monitoring of engineering objects , the feature of which is the need to achieve high accuracy of measurement results , but usually in adverse environmental conditions or existing process equipment.

To achieve the objective and required accuracy [7] of geodetic control under conditions of exploitation of constructions and functioning equipment it should be well investigated the mode of their operation under the influence of various factors (technological, geodynamic, environment), accessibility of industrial area, traffic and then as a result the most appropriate and practice methods of observations should be chosen.

**Relationship with important scientific and practical tasks**.

Implementation of works on deformation monitoring and control for the technical condition of the fuel and energy complexes has important economic and nature-conservative value. In general complex of such studies, the geodetic deformation monitoring of engineering objects occupies an important place. The peculiarity is the need to achieve high accuracy of measurement results, but usually in adverse environmental conditions or functioning equipment.

**The main material**

On Dobrotvir thermal power plants, which operated since 1955, the systematic geodetic monitoring of following constructions is performed: the main production building, crushing building, coastal pumping station, chimneys, supports of boilers and galleries of fuel supply boilers, turbines foundations and crushing equipment, overflow dam of reservoir-cooler. In addition to that for overflow dam the horizontal and vertical displacements were determined, for hoods – rolling, for other objects - vertical displacements.

Horizontal displacement of concrete blocks of overflow dam are determined since 1984 [2] by alignment method using a fixed mark. As the line of sight between the extreme points of alignment is absent, there were need to set the separate alignment from each bank and to determine position of control marks on the continuation of the corresponding alignment. In addition, since the alignment points are on the ground part of the dam near the water and overflow dam, their positions were monitored from the control points by linear- angular intersection, and later - directly by GPS receivers. Almost horizontal shift of control marks were determined by the combined method [1, 2]. Beginning since 2009, the modification of this method was used, which is to simplify finding the displacements of control marks by not the graph- analytical method but solving direct and inverse geodetic problems [5].

Since 2006 geodetic works on monitoring horizontal displacements of ceiling panel of overflow dam started. They applied the electronic total station for determination of coordinates of control marks which placed down at the bottom and top panels near weir outlets that inexplicably began to close [3].

Vertical displacements of the overflow dam are determined by precision geometric leveling of second class of control marks in the concrete blocks of the dam.

Today 89 cycles of observing horizontal displacements and 50 cycles of observations of vertical displacements of concrete blocks, and 5 cycles of observations of the horizontal displacements of the dam ceiling panel are completed.

The results of these studies at the time helped to develop and implement measures to strengthen the right part of the overflow dam on the site of the upper pond, close the movement of all vehicles on it and set the size, direction and speed of displacement of ceiling panel.

To determine the technical condition of the building of coastal pumping station number 2 of Dobrotvir thermal power plants that during long time was in the area of ground excavation to extend underwater

channel, for today, since 1991, 5 cycles of observations of vertical displacements had been completed. The results of geodetic measurements showed that the Coast Pump Station #2 is deposited at an average annual rate of 1 mm, so its position should be periodically monitored.

Geodetic control of the chimney is to determine their basic geometric characteristics - rolling (deviation from the vertical axis of the structure). Difficulty of observing for chimney rolling is that they have their own oscillations, due to the influence of various environmental factors: wind load, solar radiation, humidity change, etc. - and the manmade factor : groundwater intake and lowering their level, inside heating the chimney during the production process, new construction near the chimney and so on. The accuracy of chimney rolling determination also depends on the method of observation, selection and application of which is determined by industrial site construction environment. In this context, to achieve objective results that are characterizing the current state of a structures is practically impossible. Therefore, the accuracy of the chimney rolling on the order of a few centimeters is sufficiently justified [4, 7].

Considering the advantages and disadvantages of the existing methods of observation, Dobrotvir thermal power plants industrial area and location of points of plane geodetic network, method of coordinates for determining chimney rolling and its dynamics is applied [6]. In order to control and obtain most reliable results, chimney rolling is also determined by direct angular intersection and targeting is carried out not only on the lower and upper sections, but also to intermediate and beyond the planned the extraordinary cycles were performed also.

At present on Dobrotvir thermal power plants 7 cycles of observation for rolling of three existing chimneys with height of 100 m, 100 m and 120 m and 14 cycles of observations for rolling of chimney with height 240 m had been implemented.

Maximum values of rolling, which observed on these four chimneys in all years of observations are respectively 40 cm, 31 cm , 43 cm and 76 cm, that in relative degree is equal to 0.0040 , 0.0031 , 0.0036 and 0.0032 when acceptable values are 0.0050 , 0.0050 , 0.0042 and 0.0021 [7]. It is clear that the rolling of the first three chimneys is on the limit of acceptable and for fourth chimney it exceeds the limit standard value.

The detailed analysis of the causes that could affect the verticality of the chimney with height 240 m showed that at one time there were two main factors that led to this - flooded pit for the construction of a new production building of the plant and construction of cleaner, located next to the chimney on the south east of it, i.e. in the same direction in which the chimney has rolling.

This state of all chimneys on Dobrotvir thermal power plants requires not only continuous monitoring, but also measures to strengthen them.

Operation of thermal power plant for nearly 60 years had a negative impact on the technical condition of the main building structures and technological equipment. Today, since 1969, 12 cycles of observations of the vertical displacement of the main building concrete columns, turbines foundations and metal towers of boilers carried out by high-precision geometric leveling by short rays. During this period (almost 45 years) a general trend towards settling of the above mentioned objects is observed, which reached a maximum value of 52 mm, which corresponds to the maximum speed of this process 1.2 mm / year and says that the settling of the main building structures and its technological equipment is not damped. Therefore, to prevent the events that can affect normal operation of technological plant equipment it is necessary to continue to perform geodetic control its technical condition and especially after the repair and demolition works.

As the fuel supply facilities of the station are concentrated in one place (on the north side of the main building), then to perform geodetic monitoring all of them are included in a single scheme of0 leveling. Since 1996 to 2009, 4 cycles of observations of the vertical displacement of body crushing building, crushing equipment foundations and pillars of galleries of fuel supply were completed. The results of geodetic monitoring of these objects show their settling with a maximum value of 4-6 mm, which points to the need for further geodetic control of these objects.

**In conclusion**

Experience of implementation of the geodetic monitoring of buildings and structures of fuel and energy sector allows us to conclude that the results of geodetic monitoring can not only give qualitative and quantitative characteristics of technical conditions of the objects of observation, but also to develop activities that contribute to their normal and accident-free operation. In this regard, it is necessary to establish a systematic and efficient geodetic monitoring of objects of fuel and energy complex, and to develop technical guidance materials with modern demands relating to frequency and accuracy of such works.

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**Experience of the geodetic control for the technical condition of the Fuel and Energy Complex objects**

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The methods and results of geodetic monitoring of buildings, structures and technological equipment of energetic complex (Dobrotvor TPP) are described. The conclusions prove that the results of such monitoring allow us to develop procedures which promote normal and accident-free operation of energetic complex objects. It is recommended to develop guiding technical materials with modern demands for regularity and precision of such works to ensure systematic and efficient geodetic monitoring of the fuel and energy complex.