

Ukrainian competition for the best student research work
2014/2015 academic year

Cipher: "Soil"

TOPIC

"Increasing the safety of operation of shunt reactor POM 50000/500
taking into account the pressure of the structure on soil"

Section "Technical"

ВІДОМОСТІ

про автора та наукового керівника
конкурсної роботи під шифром: «грунт»

АВТОР:

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2. Ім'я Олег
3. По батькові Валерійович
4. Повна назва вищого навчального закладу, в якому навчається автор Запорізький національний технічний університет
5. Факультет електротехнічний
6. Курс 5 Номер групи Е-420
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Рішенням конкурсної комісії Запорізького національного технічного університету студент Барибін О.В. рекомендується для участі (прізвище, ініціали) у Всеукраїнському конкурсі студентських наукових робіт з

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М.П. _____ (підпис)

(посада, прізвище, ініціали)

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Abstract

Research work under the cipher: “soil”

Research work: 10 pages, 1 figure, 5 sources.

The analysis of possibility of installation and operation of shunt reactor POM 50000/500 at Zaporizhzhya nuclear electric power station on a sandy soil of medium size was carried out, that is topical for guaranteeing the stability of position of large structures.

The purpose of the work is to calculate pressure forces transmitted to sandy soils.

The scientific novelty of the work consists in the analysis of possibility of safe operation of the reactor according to its design and instability of the soil.

The practical importance of the work consists in providing of precise recommendations for location of massive equipment on unstable soils.

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1 Statement of the problem and purpose of the research

The subject of the research is shunting reactor POM 50000/500 with a rated voltage of 500 kV and capacity of 50000 kVA. The weight of the reactor is 54 254.2 kg, which affects the reliability of operation of the reactor significantly. It is connected with the necessity to install the reactor on sandy soil, which is predominant in the area of Zaporizhzhya nuclear electric power station at Enerhodar.

Shunt reactors is an important element of electrical systems. Shunt reactors are used for compensation of capacitive reactive power, which is generated by the extended weakly loaded transmission lines.

2 Description of shunt reactors POM 50000/500 and the field of its application

Shunt reactors are installed to stabilize the transmission of electricity or are switched on for voltage control in conditions of low load only. Shunt reactor reduces transmission outlays by combination of low maintenance expenses and high efficiency.

Shunt reactors are used to compensate capacitive VARs, generated by weakly loaded electrical transmission lines or underground cables. They are usually connected with transformer tertiary winding.

The reactor is equipped with modern protection, control-measuring equipment, lifting and transporting devices and monitoring system.

3 Operating conditions of the reactor

The reactor POM 50000/500 works in following conditions:

- the height above sea level less than 1000 m,
- nominal values of climatic factors in accordance with ГOCT 15150-69 and ГOCT 15543-70, I category of location;
- unexplosive environment without current-conductive dust, corrosive gases and vapors at concentrations, that ruins metals and insulation.

4 Structure peculiarities of the reactor

Cores of the reactor (fig. 1.1) have an external frame made of magnetic material. The external frame reduces magnetic resistance to main flow. In normal conditions of exploitation it effects similar to the action of lateral of five-rod transformer's core. This design has a significant advantage, because there is no connection between magnetic phases.



Figure 1.1 - Single-phase shunt reactor POM 50000/500

The active part of the reactor consists of winding, magnetic system, yoke girder, tightening-rod device, branches and main insulation.

5 Improving of technical characteristics of the reactor with the aim to reduce mass and dimension indices

Heating of the walls of the tank and a large mass are the main imperfections of basic structure of single-phase shunt reactor.

Vibrations and a large mass of the reactor create a problem to install it reactor in the area of Zaporizhzhya nuclear electric power station at Enerhodar, where sandy soil is predominant.

To improve technical characteristics and reduce mass and dimension indices cooling system with forced circulation of oil and blown would be used.

The type of magnetic system to armor-rod would be changed in structure. We can increase the reliability and reduce the weight and dimensions of the reactor with the help of armor-rod magnetic system with nonmagnetic gaps.

6 Calculation of permissible pressure forces on the soil at place of reactor's installation

Updated shunt reactor POM 50000/500 is designed for exploitation on the site of Zaporizhzhya nuclear nuclear electric power station at Enerhodar. According to the nature of soils near the Enerhodarcity it is necessary to check the possibility of establishing of the reactor for guaranteeing a safe operation during definite term of exploitation. With this purpose the calculation of the force acting on the basis taking into account the type of soil would be realized.

Input data:

The weight of updated reactor, $m_m = 54254,2$ kg;

The size of the basis for mounting of the reactor 455x455 cm;

Type of soil: sand of medium size;

Permissible normative pressure on soil $R = 3 \cdot 10^5$ Pa;

The coefficient of elastic uniform compression of soil $C = 50$ N / cm².

Permissible force pressure on the natural basis for a given soil is calculated as

$$N = S_0 \cdot C, \quad (3.1)$$

where S_0 – basis area, cm²;

C - The coefficient of elastic uniform compression of soil, N/cm².

Thus,

$$N = 455 \cdot 455 \cdot 50 = 10,351,250 \text{ N.}$$

The force transmitted to the foundation is calculated by the formula:

$$N_r = m \cdot g, \quad (3.2)$$

where m - mass of the reactor, kg;

g – acceleration of gravity, m/s².

The force transmitted to the foundation of the updated reactor is

$$N_r = 54254,2 \cdot 9,8 = 531\,691.16 \text{ N.}$$

7 Conclusions

Steady state of different structures depends largely on the type of soil and the possibility of its deformation. Three-dimensional deformation of homogeneous sandy soils to a considerable extent depends on elastic compression of particles. With increasing of load plastic it is explained by plastic destruction of contacts between them can take place, which can lead to loss of stability.

Calculations of pressure on sandy soil, which were carried out in work, showed the possibility of long-term and safe operation of shunt reactor of the model POM 50000/500 during a specified term of exploitation with preserving the stability of the state.

Literature

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