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IMPROVEMENT OF DRILLING RIG ELECTRICAL EQUIPMENT

Abstract. The article describes the electrical complex of a modern electric drilling rig. The structure of electrical complexes is caused by a wide range of requirements for the drilling depth, purpose and operating conditions of the drilling rig. The issue of the direct use of the engine, namely, the conversion of various types of energy into mechanical energy, is also considered. Today, in leading industries, the ratio of the installed capacity of electric drives to the total installed capacity of drives with engines of all types (Thermal, hydraulic, pneumatic) is approaching 100%. This is determined by the fact that electric motors are manufactured for various capacities (from hundredths of a watt to tens of thousands of kilowatts) and rotational speeds.

Keywords: alternating current, direct current, electrical engineering complex.

Introduction

Automated electric drive is the main consumer of electricity. In industrialized countries, more than 60% of the electricity produced is converted into mechanical energy by electric drive. Since ancient times, people have tried to replace heavy physical labor, which was a source of mechanical energy. In modern drives, various motors are used as a source of mechanical energy. Solution of all, without exception, technological processes of well construction is provided by electric drive systems.

Formulation of the problem. The well construction process requires uninterrupted operation of the drilling rigs, in particular engines and pumps. Interest is the well drilling on the electric drive, the sequence of start-up of all machines and mechanisms, as well as the layout of the DC and AC electrical equipment [1-6]. Therefore, the development and modernization of the electric drive contributes to productivity growth and increase production efficiency. Knowledge of the properties and capabilities of the drive allows the electrical engineer to ensure the rational use of the drive.

Basic material

The electrotechnical complex of a modern power-driven drilling rig is a collection of subsystems that provide for the generation (in the absence of centralized power supply), the distribution, transformation and use of electrical energy, as well as the control of all these subsystems, and includes:

- high voltage switchgear;
- power and transformer transformers;
- AC and DC electric machines;
- complete thyristor devices;
- complete devices for control, protection and distribution of low voltage electrical energy;
- cables and wires;
- electric light sources;
- mobile power plants.

Structures of electrotechnical complexes, despite the variety of schemes of drilling rigs, due to the wide range of requirements for drilling depths, purposes and conditions of operation, can be reduced to two typical schemes, the application of which on installations of different versions reduces the parameters of used electrical equipment.

A typical structure of an AC drive for plants with centralized power supply (Fig. 1) is focused on the use of partially adjustable actuators of the main mechanisms that allow to form the starting characteristic and to provide economic regulation of the speed of rotation in a limited range.

The typical structure of a direct current drive for plants with centralized and autonomous power supply (Fig. 2) is focused on the use of deeply adjustable actuators of the main mechanisms based on electric motors and power thyristor converters.

The power block in non-electrified areas represents a set of diesel-electric AC units, and in the electrified ones a set of cells of the complete switchgear and transformers that reduce the voltage to the required level.

Electrical equipment included in the electrotechnical complex are either products of a specific purpose, ie. Designed according to individual technical requirements and having one basic variant of application, or relates to products of general industrial purpose.

The catalog usually only provides information on the specific purpose electrical equipment

The set of electrotechnical means used on diesel-powered installations of the main mechanisms is fully included in the set of installations of the corresponding class with the electric drive and usually refers to products of general industrial purpose, so information about this electrical equipment is not given in the article.

To power the auxiliary drive mechanisms of a diesel-powered drilling rig, the latter is usually equipped with two 200-kW diesel-electric units each.

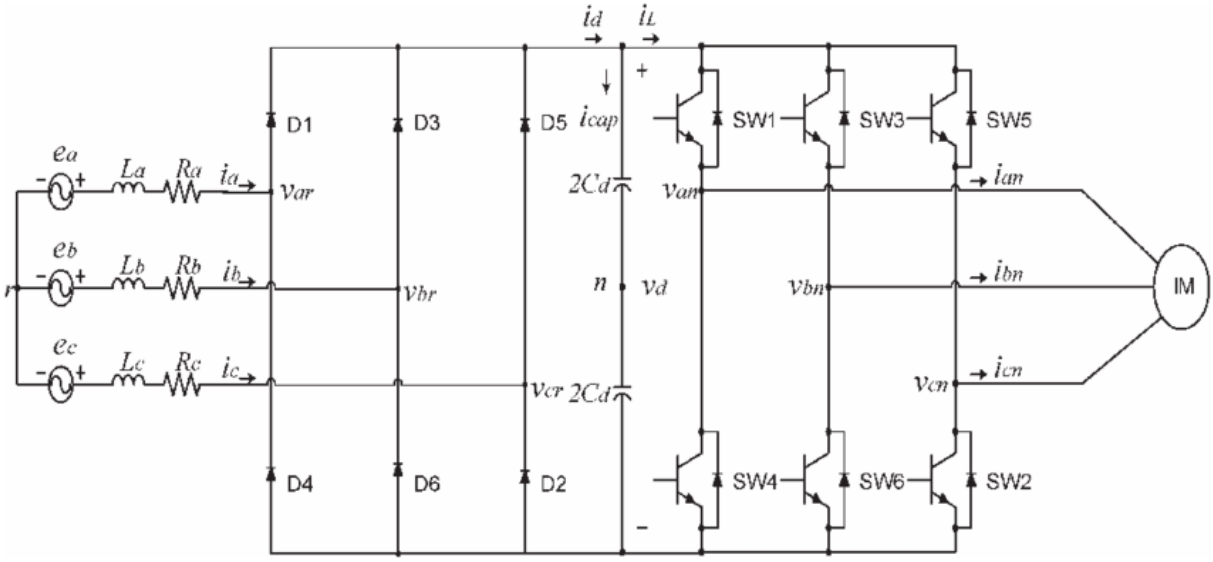

Fig. 1. A typical single-line diagram of an electrotechnical complex of an AC drilling rig: Ra - complete high-voltage switchgear; SW3,5,1 - power lowering transformers; D1, D2, D3, - electric motors respectively winches, drilling pumps, rotor, bit regulator; TRS - thyristor slider; TPD, TPP are power thyristor converters respectively of the rotor and the feed regulator; Lc - thyristor activators; A2 - control cabinets for auxiliary mechanisms

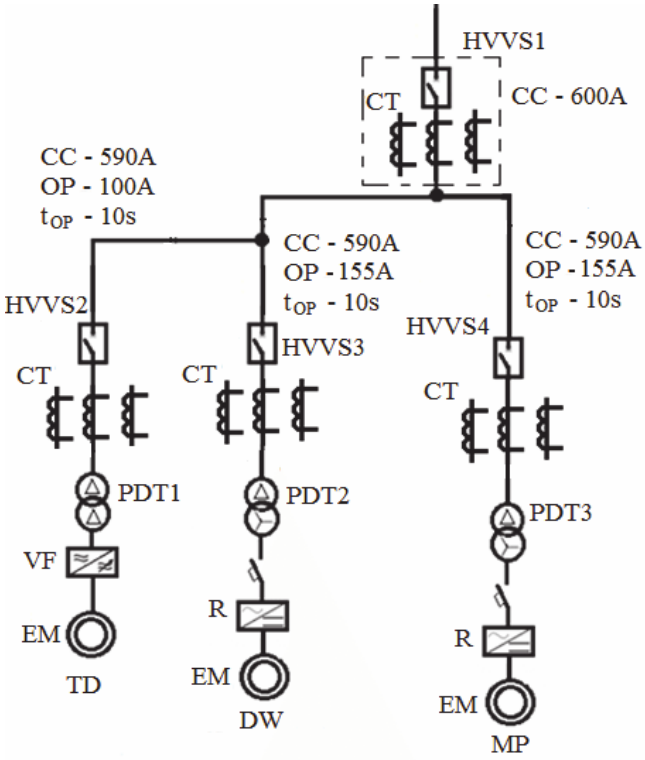

Fig. 2. A typical single-line diagram of an electrotechnical complex of a drilling rig with electric drive: The drill rig's power supply single-line diagram HVVS1…HVVS4 – high-voltage vacuum switches; PDT1…PDT3 – power dry transformers; CT – current transformers; VF – frequency converter; EM – electric motor; R – rectifier; CC – current cutoff; OP – overcurrent protection; TD – top drive; DW – drawwork; MP – mud pump.

The schematic diagram of the electrical equipment provides for the possibility of using the full power of each unit separately to power all electricity consumers, and also provides for the parallel operation of diesel generators. This ensures redundancy of power supply when necessary to stop one unit, as well as the distribution of load on two diesel generators when connecting additional consumers. One diesel-electric unit is installed for standby power supply of plants with centralized power supply.

The generated electricity from the generator is fed to the control panel and then transmitted to the control cabinets of the actuators of the auxiliary mechanisms. Power is supplied to the consumers through circuit breakers located in control cabinets.

The article does not consider the electrical equipment of individual production facilities for special drilling conditions (except for electric machines for offshore drilling rigs), as well as the equipment built into complete control devices and the electrical equipment of the drilling process control systems.

Electrotechnical products for surface drilling units are available in climatic versions B (for macro-climatic regions with temperate climates) and UHL (for macro-climatic regions with temperate and cold climates) with air temperature during operation (at placement categories 1, 2 and 3) from +40 to -45 C and from +40 to -60 ° C, respectively.

Height above sea level - up to 1000 m, relative humidity 80% at + 20C.

The environment should not contain explosive and fire hazardous, as well as a large amount of corrosive gases and vapors in concentrations that destroy metals, insulation, coatings.

Equipment placement categories (GOST 15150-69) include outdoor operation, in rooms where temperature and humidity fluctuations are not significantly different from outdoor or indoor or indoor fluctuations, with more natural ventilation without artificially controlled climatic conditions.

Table 1 shows the degree of protection, as well as some other features of the operating conditions and design.

Table 1 – **Degrees of protection and operation of equipment**

Indicators	**Category and type**			
	КРУ type	Trans-formers	Electric machines	
			АКБ	АОКБ
Altitude, m, no more.	1000	1000	1000	1000
Air temperature, C^0.				
The maximum	+40	+35	+40	+40
The minimum	-45	-60	-45	-60
The relative humidity of the air at a temperature of 20 C^0,%	80	80	80	100
Degree of protection (GOST 14254-80)	1P34*	1P21	1P23	1P44
Resistance to mechanical factors	M18	M25	M18	M18
Climate education and placement category	ХЛ1	У1(ХЛ1)**	У2	УХЛ2

To indicate the degree of protection are used Latin letters 1P and the following two digits (GOST 14254-80). The first figure indicates the degree of protection of personnel against contact with live parts and moving parts. Inside the shell, as well as the degree of protection against entry into solid foreign bodies. The second digit indicates the degree of protection against water ingress. The "dash" in table 1 means that this parameter is not regulated by the specifications.

Conclusions

This article deals with the issues of operation, selection and scheme of the drilling rig power engineering complex deep wells.

Determined the sequence and correctness of the connection of the main drives with AC and DC. Data on the degree of protection and operation of equipment in different climatic conditions.

A typical single-line diagram of an electrotechnical complex of a drilling rig with a direct-drive electric drive, as well as a typical single-line diagram of an electrotechnical complex of a drilling rig with an electric drive.

The connection sequence and the issue of redundancy of power supply in case of stopping of one unit are determined, as well as the distribution of load on two diesel generators when connecting additional consumers.

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Удосконалення електрообладнання бурових установок

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Анотація. В статті обписується електротехнічний комплекс сучасної бурової установки із електроприводом. Структура електротехнічних комплексів, що викликана широким спектром вимог до глибини буріння, призначення та умов експлуатації бурової установки. Також розглядається питання прямого призначення двигуна, а саме перетворення енергії різних видів у механічну енергію. Сьогодні у провідних галузях промисловості відношення встановленої потужності електроприводів до загальної встановленої потужності приводів із двигунами всіх видів (теплових ,гідравлічних, пневматичних) наближається до 100 % . Це визначається тим ,що електродвигуни виготовляються на різноманітні потужності (від сотих частин ват до десятків тисяч кіловат) та швидкості обертання.

Ключові слова: змінний струм, постійний струм, електротехнічний комплекс.