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The concept of developing monitoring system of technological equipment operating in the arctic zone and the far north

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Abstract

A large number of technological equipment is used in development, transport, storage and primary processing of hydrocarbons produced in the Far North. The telemetry and remote control systems development of this equipment has its own characteristics. The authors introduced the concept of developing such a system. The concept is based on the wireless collecting system of vibrodiagnostic data and developed a digital high-speed communications network of SV range navigation data already developed at Omsk State Technical University. The first is focused on collecting data from a of wireless sensors network within a radius of several hundred meters, the second is focused on transferring data over long distances in the range of medium waves.

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Keywords: telemetry; remote control; wireless data transmission; CB radio communication range.

1. Introduction

Development of the Arctic and the Far North has a large national and scientific importance. These areas hide vast reserves of minerals. There is an active development of minerals in recent years. In the development, initial processing and transportation of raw materials there is used a large number of process equipment, which often operates in automatic mode. Accordingly, there is the task of monitoring its condition, the transmission of telemetry data and remote control. The development of radio communication systems and, in particular, telemetry and remote control for the Arctic and the Far North areas has following features:

- extreme climatic conditions;
- long distances between objects;

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- a large number of monitored parameters at each facility;
- no possibility of data transmission via cellular networks due to lack of coverage from the mobile operators;
- low level industrial interference at all frequencies.

Satellite communications has the main disadvantage: its high price, which includes the cost of the deployment of space, and most important thing is incomplete cover areas, especially in northern latitudes. In addition, the high cost of the terminal equipment of the subscriber. All these factors motivate the developers to seek new technical and technological solutions in the development of such systems.

2. The choice of frequency bands for the development of the system

Recently, the development of data transmission systems has a tendency to increase operating frequency. This is due to the increase in the volume of information to be transmitted, a change in its nature. As a consequence, there is a need to increase the data rate, which is possible with the modulated frequency band extension. This, in turn, is possible by increasing the nominal carrier frequency. The communication range of subscribers on the ground (point - point) is in the range of VHF limited line of sight antennas, depending on the power of the transmitter it ranges from a few hundred meters to several kilometers. Advantages of VHF equipment are small dimensions, including antennas, low costs. There are a large number of highly integrated chips to develop such equipment. In addition, there are several frequency bands, with no need to obtain permission to use them and record radio-electronic means, subject to limitations on the power of the transmitter and the band of frequencies occupied. In particular, it ranges 433 MHz, 868 MHz and 2400 MHz. It should be noted that increasing the operating frequency increased the space attenuation for propagation. From this point of view, the most attractive range is of 433 MHz. The main drawback of this range is that it runs various household radio systems - from car alarms to amateur radio stations, which create a large amount of noise in the development of industrial communication systems in this range. However, in the Arctic and in the Far North the population density is very low and, as a consequence, in the range of 433 MHz interference environment is favorable.

HF traditionally are used to develop long-distance ionospheric (up to thousands of kilometers) and ultra-long range radio links (several thousand kilometers). Modern equipment has high consumer characteristics, widely represented in the market and is actively used. The main drawback of short wavelength is dependent propagation conditions on the state of the ionosphere. Application of HF is often difficult or impossible in the Arctic. This is due to changes in the structure of the ionosphere under the influence of the Sun and the proximity of the magnetic poles of the Earth. In periods of solar activity ionization of the D layer of the ionosphere increases sharply, and then reflection of radio waves from the ionosphere occurs in radio and HF becomes impossible.

The traditional use of MF range is broadcasting, maritime communications, driving beacons. In the daytime the ionosphere disturbance increases and MF range propagation is mainly due to the surface (of the earth) wave (Fig.1). At night, the waves reflected from the ionosphere can be taken over long distances.