Prospects of modernization of maritime radio communication in the Arctic region of the Russian Federation.

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Zusammenfassung

In the report the modern condition, plans for development and offers on perfection and modernizations of systems of a maritime radio communication with vessels and sea oil platforms in the Arctic areas of the Russian Federation are considered.

It is shown, that for new areas of radio-navigational warnings in Arctic regions of the Russian Federation for the organization of work of the automated system of distant identification (LRIT) of vessels at Arctic ocean it is necessary to apply system of a meteoric radio communication because except for a meteoric radio communication there is no another enough cheap and reliable alternative for LRIT.

For maritime safety information (MSI) it is necessary to apply data transmission to distribution of the information on HF-channels of the World digital radio (DRM).

In modern conditions the economy of Russia cannot do without unique resources, first of all the hydrocarbons extracted in areas of the North and its Arctic zone. The continental shelf of the Arctic seas of Russia (total area = 2,9 million km2) contains over 75 billion t hydrocarbons (in an oil equivalent). In Arctic regions production providing reception about 11 % of the national income of Russia (is made at a dale of the population equal 1 %) and a component of 22 % of volume of the Russian export.

Last years IMO, and also the countries of the Arctic coast, including Russia, considerable attention give to development in these areas of means GMDSS, LRIT (Long range identification and tracking), AIS. The communication facility and navigation of these systems carrying out of urgent saving, underwater and other diving works, to liquidation of emergency floods of oil, oil

products and other harmful chemical substances in the sea are necessary for rendering assistance for people and the courts suffering disaster on the sea.

One of the major components of system of navigation-hydrographic maintenance is information support of seafarers, and in the first place transfer MSI. In 91-99 years of XX century the system of a radio communication with the courts, based on radio stations and land channels, has undergone the most serious negative changes and to navigation 1999 г, has actually ceased to function.

Presence of modern equipment of GMDSS on courts and modernisation of the coastal radio centres (radio stations) allows to create completely automated system of data transmission, facsimile, telephone and cable communication. The combination of some functions of equipment of GMDSS with modern digital technologies gives the chance to automate the radio centres not taken out of service.

The analysis of existing modern systems of digital communication systems shows that for maintenance of a steady and effective radio communication with objects at Arctic ocean and at the Arctic coast Russian Federation above 70° N on occasion it is possible to use means of Inmarsat, but it is connected with high cost of the traffic and to influence of hindrances on satellite communication.

At modernisation of a communication system of courts of the limited swimming with coastal radio stations the existing equipment of communication established both on courts, and on coastal radio stations as much as possible should be used. Besides, considering that on courts of the limited swimming for the purpose of economy of means, number of crew is minimum and, accordingly, on them there is no the radio expert, the modernised system should be extremely simple and accessible to operation to any expert who received average technical education and has passed 2-3 day courses on operation of system of a radio communication. Simultaneously modernised system of a radio communication should use modern digital technologies of communication, such as the Internet, a fax communication, a digital selective call, a radio telex and automatic telecommunication. Similar technologies are easy-to-work and give a high-quality telecommunication service.

In existing system of a radio communication almost all vessels making flights, both on sea, and on internal waterways of the Arctic coast of Russia, are equipped, at least, by two radio stations:

- Radio station of a metre wave band (156÷174 MHz) or a decimeter wave band (300÷330 MHz);
- Single-sideband radio station intermediate and short-wave (MF/HF) in the frequency band (1,5÷30 MHz).

Practically on each of the courts, making flights, both on sea, and on internal waterways there is the personal computer used for preparation and conducting of the ship documentation and calculation of stability of a vessel.

On the basis of modernisation of coastal and available ship means of a radio communication, and also the ship personal computer it is possible to receive considerable improvement of quality and increase of economic efficiency of system of a radio communication.

Therefore at revival of a network of radio stations at the Arctic coast and at creation of new radio stations at Arctic ocean for realisation of functions of transfer MSI/GMDSS; for work LRIT and AIS, it is necessary to apply modern digital radio stations short-wave (on HF-channels Digital Radio Mondiale - DRM) and meteoric radio communication systems, the short description of characteristics and which bases of functioning is resulted in the report.

In April, 2001 ITU recommended DRM as replacement of AM-radio by all ranges below 30 MHz, and in September of 2001 - European Telecommunications Standards Institute has included DRM in the catalogue of the European standards. In 2003 DRM the standard 62272-1 with the right to be called as the World standard [2-4].

In system DRM it is offered to apply more difficult modulation with simultaneous change at bearing amplitude and a phase (QAM - quadrature amplitude modulation) in a combination to frequency consolidation orthogonal bearing (OFDM - Orthogonal Frequency Division Modulation) with protective inserts between blocks. The similar kind of modulation is named as the coded frequency consolidation orthogonal bearing - Coded Orthogonal frequency-division multiplexing (COFDM) [6].

In the presence of multibeam distribution and frequency-selective fading in radio channels (it is characteristic for the Arctic radio lines) the part bearing, entering into an OFDM-signal, can be weakened or in general disappear. However applying technologies DRM, the information containing in such bearing, in many cases can be restored on remained intact bearing at the expense of noiseproof coding. In case of impossibility to restore the information in a symbol or a number of symbols masking of errors is applied. In system DRM apply QAM with number of values 4, 16 or 64, i.e. QAM-4 QAM-16 or QAM-64. The similar technology almost ideally uses communication channel capacity. According to Recommendation ITU-P BS.1514-1 DRM-radio station signals can occupy on air different strips of frequencies [5-10]. Efficiency of use of a spectrum at system DRM reaches 2,5 b/s/Hz - a fine indicator for HF- band. Transfer DRM of signals is steady against hindrances since in system the broadband signal consisting of hundreds independent narrow-band, is used is a little sensitive to distortions of the separate bearing.

System DRM allows multiplex to four diverse streams. Thus, the signal of one DRM-station with the general speed 24 kb/s can contain, for example, one stereochannel with speed of transfer 10 kb/s, two monochannels on 4 kb/s and one stream of data transmission or files for the speed 6 kb/s [2-6].

The idea of application of system DRM for information distribution on safety of navigation and for the notification about approaching natural cataclysms has been stated on subcommittee IMO COMSAR in February, 2006.

Other direction of reliable distribution of the information in the Arctic areas is use of means of meteoric communication. Meteorites, burning down, reserve in atmosphere a trace - the

meteoric channel, and its length can reach 15 km at width about 20 m. There is such stream - from 200 ms to 1 s [1,7-9].

The radio signal sent by a radio transmitter in atmosphere, "is reflected" from the meteoric channel and broadcast on the earth. And the signal can be received from the land station located on distance of many hundreds of kilometres from a point of reception. At first connection is established, and then figures are sent. Meteoric communication operates in a range of 30÷60 MHz, that is in that part of a spectrum from which it is possible to work worldwide. Moreover, quality of transfer is not influenced by weather conditions.

The system of meteoric communication can be used for definition of a site of trucks, remote monitoring (for example, courts, oil overpasses, objects of navigatsionno-hydrographic maintenance etc.), acknowledgement of authenticity of credit cards, and also in any other area where operative information interchange of small volume is necessary. Standard functions of system include an exchange of messages between control centre and mobile object, automatic transfer of reports on parametres of a site of mobile object. Messages can contain the text and big parametres of a condition and the information on the management, effectively coded for reliable transfer. Means of meteoric communication are easily integrated with means GPS and provide with the information on a site of mobile object with accuracy of an order of 5÷10 metres.

In the report possible variants of placing of the base meteoric radio stations considering all northern ways of navigation and a place of remote objects taking into account minimisation of quantity of base radio stations are considered.

Systems of meteoric communication provide speeds of information transfer in the channel from 4800 b/s to several tens kilobats, and capital investments much more low than at satellite communication systems. They do not demand payment of the traffic and are easy-to-work and highly reliable systems. The basic lack of systems of meteoric communication is some delay at information transfer which can reach to 1÷10 minutes However experience of long-term operation of systems of meteoric communication on Alaska, in Northern part of the USA and in Canada, shows that 90 % of the transferred information receive a delay less than one minute, and 99 % of the transferred information receive a delay less than three minutes. The radius of a covering of base station makes 2000÷2500 km.

Spent 2000 - 2003 Central Marine R&D Institute repeated natural tests including on limiting distances about 2000 km, have shown that for maintenance of monitoring of remote objects, gathering and information delivery the meteoric radio communication is the most effective and most reliable of all existing kinds of a radio communication for problems LRIT and AIS in Arctic regions [2].

The structure of base and user's radio stations of system of a meteoric radio communication, their basic characteristics and information interchange reports are defined by requirements ITU the River 843-1 both F.1113 and CEPT [1,7-9].

In the report data on function charts of modernisation of the typical coastal radio centre also are resulted, and the monitoring area is not limited as in system Inmarsat, 70 ° N, and can be carried out up to poles.

The basic conclusions of the report:

- For organisation LRIT and AIS at Arctic ocean it is necessary to apply system of a meteoric radio communication;
- To distribution MSI/GMDSS it is necessary to apply data transmission on HF- channels DRM.

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