

The main occupational health risks under the work in the Arctic region

Nina.B.Rubtsova
scientific coordination department
 FSBSI "RIOH"
 Moscow, Russia
 rubtsovanb@yandex.ru

Igor.V.Bukhtiyarov
director
 FSBSI "RIOH"
 Moscow, Russia
 ivbukhtiyarov@mail.ru

Abstract—Workers morbidity and occupational and work related diseases development risks as result of adverse occupational and environmental factors exposure effects decrease is an actual task. Brief analysis of main occupational factors and principal ways of main problems decision are presented taking into account domestic and foreign experience. Workers health occupational risks assessment and management system development will allow flexible use the arsenal of measures to prevent health problems of workers in extreme climatic conditions of the Arctic region, thus increase the efficiency of labor, reduce economic losses, reduce morbidity, disability, mortality, extend labor longevity.

Keywords—occupational, environmental factors, Arctic, health risk, work longevity

I. INTRODUCTION

Strategy of scientific and technological development (STD) the Russian Federation, approved December 1, 2016, by the decree of the President of the Russian Federation, science and technology identified as one of the tools in the sustainable development of the country based on risks and possible dangers to human health assessment. The labor Code provides for the assessment and management of occupational risk (art. 209).

Workers health under work in Arctic is very important problem. Arctic region workers have high morbidity and mortality, difficult working and living conditions. Therefore, identification, assessment and management of professional risks related to work in order to develop and implement technologies for workforce saving, ensuring the solution of strategic and tactical tasks for personnel safety and economic development of these regions is a highly urgent task.

Arctic region effective socio-economic development requires the development of the of labor resources medical support of these regions concept based on personalized medicine system. Statistical data show that morbidity and mortality rates among workers in the Arctic are among the highest in Russia. The average biological age of employees exceeds the passport age, which indicates a pronounced personnel health adverse effect of labor and life factors complex in the Northern and Arctic regions as well as the presence of unresolved medical and social problems.

System for workers in Arctic region occupational health risks assessment and management development necessary to implement the measures for prevention of their health disorders related to work under exposure of extreme

climate-geographical, meteorological and heliogeophysical factors and modes of work. This system will make the possibility of optimal decision the issues of morbidity, disability, mortality decrease, economic losses reduce, as well as service and work efficiency improvement.

II. WORKERS' HEALTH RISKS IN ARCTIC

The main factors of work and life in Arctic are:

- Climate and geophysical factors;
- Harmful and dangerous conditions of service and work;
- Factors of peculiarities of the method of work;
- Psychological threats;
- Factors of nutrition, water supply;
- Social, medical factors.

Far North Environmental factors have a pronounced negative effect on human physical and mental health, called polar stress syndrome. Human health is adversely affected: low temperatures in combination with strong winds, short cold summer, high humidity, peculiar periods of polar night and polar day, lack of solar radiation, geomagnetic activity, sudden changes in atmospheric pressure, especially nutrition, long stay in closed rooms, etc.

High-intensity professional loads, significantly exceeding the standard for normal working conditions, often accompany work in the Arctic region. At the same time, work in the Arctic are characterized by additional occupational factors associated with region characteristics (shift work, different shift schedules, the need for sustainable communication including). This creates the prerequisites for somatic disorders and wide range of neuropsychiatric and psychosomatic disorders development. These disorders may lead directly to accidents, transfer of highly qualified specialists to another job and workers' severe chronic diseases development.

Service and work in the open territory in the Arctic, especially during the cold period of the year need the protection against cooling in order to maintain health and promote wellbeing and workability. The most adequate protection means is special clothes, which is a set that includes items that protect almost the entire surface of the body from cooling. Special protective from cooling clothes is important measure for cooling risk decrease.

III. OCCUPATIONAL RISKS ASSESSMENT

What is occupational risk? This is a combination of the probability of occurrence in the course of employment of a dangerous event, the severity of injury or other damage to human health caused by this event.

The existing system of occupational risk assessment and management implementation is in accordance with a number of international and domestic legal documents.

International:

- Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work [1]
- WHO Workers' health: global plan of action 2008–2017.
- ILO 187 Convention concerning the promotional framework for occupational safety and health
- International standard CIS countries GOST 12.0.230-2007 Occupational safety standards system. Occupational safety and health management systems. General requirements.

National:

- Federal law No. 52-FZ of 30.03.99 "On Sanitary and epidemiological welfare of the population»
- Federal law No. 265-FZ of 04.10.2010 "On ratification of the Convention on the promotion of occupational safety and health (Convention No. 187)
- The Order of Ministry of Health and Social Development of RF from April 12, 2011 № 302n "On conducting preliminary and regular medical examinations of workers engaged in hazardous and harmful working environment";
- The Order of Ministry of Health and Social Development of RF from April 27, 2012 № 417n "About list of occupational diseases adoption";
- Guidance on occupational health risk assessment for workers. Organizational and methodological aspects, principles and evaluation criteria. P. 2.2.1766-03 [2];
- Guidelines for the hygienic assessment of working environment and work process factors. Criteria and classification of working conditions. P 2.2.2006-05 [3];
- GOST R ISO 17776-2010 Risk management. Guidelines on tools and techniques for hazard identification and risk assessment for petroleum and natural gas offshore production installations (the only one directly related to the work in the Arctic region).

According to [2] the occupational risk (OR) assessment and management system includes its risk analysis, which consists of risk assessment, risk management and risk information. Risk assessment includes hazard identification, exposure assessment and risk characterization. To OR assess the following criteria are used: hygienic preliminary criteria by [3], risk categorization by classes of working conditions; medical and biological indicators of workers' health (reproductive and offspring health including); workers' health disorders severity; risk categorization according to the degree of proof; the degree of health disorders relation with work by epidemiological data.

The results of OR assessment on the degree of proof (UN criteria) are divided by risk proof into following. Category 1A (proven occupational risk) – based on the results of working conditions hygienic assessment by [3], the data of periodic medical examinations, physiological, laboratory and experimental studies, as well as epidemiological data. Category 1B (presumed occupational risk) – based on the results of hygienic assessment of working conditions according [3] criteria, supplemented by specific clinical, physiological, laboratory, experimental data (including peer reviewed publication). Category 2 (suspected occupational risk) – based on the results of hygienic assessment of working conditions according to [3] criteria. The measure of risk proof is category - 1A (proven), 1B (presumed) or 2 (suspect). Preventive measures chose (risk management) in accordance with ILO recommendations the following priorities should: dangerous factor or risk elimination, control of dangerous risk factor at source, dangerous factor reduction safe work systems or introduction, personal protective equipment use while maintaining the residual risk.

The OR categorization is carried out preliminary by classes of working conditions (by results of the hygienic assessment) (Table 1) and finally by socially significant indicators of workers' health (Table 2).

TABLE 1. CLASSES OF WORKING CONDITIONS, OCCUPATIONAL RISK CATEGORIES

Class of working condition by [2]	Occupational disease index, I _{od}	Professional risk category	Urgency of action on risk decrease
Optimal – 1	–	Risk absence	Measures are not needed
Permissible – 2	<0.05	Negligible (tolerable) risk	No action is required, but vulnerable persons need additional protection
Hazardous – 3.1	0.05-0.11	Low (moderate) risk	Risk decrease measures are required
Hazardous – 3.2	0.12-0.24	Medium (significant) risk	Risk decrease measures are required in due time
Hazardous – 3.3	0.25-0.49	High (intolerable) risk	Immediate risk decrease measures are required
Hazardous – 3.4	0.5-1.0	Very high (intolerable) risk	Work cannot be started or continued until risk reduce
Dangerous (extreme)	>1.0	Ultra-high risk and risk to life inherent the profession	Work should be carried out under special regulations only

TABLE 2. BIOMEDICAL INDICATORS FOR RISK ASSESSMENT DEPENDING ON WORKING CONDITIONS CLASS*

Working condition class by Guideline [3] criteria	Health state indicators according to periodic medical examination data	Morbidity with temporary disability indicators	Biological and passport age comparison indicators	Indicators of mortality, lack longevity, disability, etc.	Reproductive health, offspring health disorders
1	-	-	-	-	-
2	-	-	-	-	-

3.1	+	-	-	-	+
3.2	++	+	+	-	+
3.3	++	++	+	+	++
3.4	++	++	+	++	++
4	++	++	+	++	++

*The analyses of occupational disease morbidity is obligatory
 Comments: - no required; + recommended; ++ be sure

The existing system of occupational risks is designed for working conditions in the enterprises of Central Russia and standardized work shifts. Intensive development of the Arctic territories necessitates an increasing use of various types of work related to the complex of new risks: climate, industrial, social, medical, information and psychological, which necessitates medical selection, adaptation and rehabilitation of workers or serving in the Arctic zone of the Russian Federation technologies improvement.

This problem is very important. In particular, the Northern Dimension Partnership in Public Health and Social Well-being Occupational Safety and Health Expert Group currently develops comprehensive programme to ensure safe and healthy working conditions in industries operating in the Arctic. Finland, Sweden, Norway, Canada, the United States and other countries are actively involved in this programme. The actions of this program include three priority thematic areas: human health, reduction/elimination of the problem solve imbalance, research aimed at sustainable development.

Research experience in the Russian Federation allowed to determine the criteria for classification of risk categories, perceived temperature (coefficient of weather sharpness), risk of frostbite and recommended limitations of work based on the negative temperatures exposure risk analysis (Table 3).

Based on the mathematical analysis of the relationship of indicators of thermal condition of the person and the severity of the physical work, the resulting equation indicating the close relationship of human body heat exchange with average skin temperature, changes in heat content and level energy casts. The analysis of the results showed a reduction in the temperature sensitivity to cold, a dependence of the type of adaptation from the constitutional features of the physique [4].

TABLE 3. RISK CATEGORIES CLASSIFICATION, THE PERCEIVED TEMPERATURE (WEATHER SHARPNESS INDEX), THE RISK OF FROSTBITE, WORK RESTRICTION RECOMMENDATIONS (MODIFIED FROM ISO 11079:2007)

Class of risk	Temperature sensation (°C)	Risk	Recommended work limits
0	>-9	Low risk, < 5% chance of frostbite for most people	Normal work; urgent work; planned work
1	from -10° to -24°	Low risk, < 5% chance of frostbite for most people. Uncomfortable conditions	Normal work (reduced shift time); urgent work
2	from -25° to -34°	Moderate risk, increased risk of frostbite for most people for 10-30 min. Quite cold	Normal work (reduced shift time); urgent work
3	from -35° to -59°	High risk, risk of frostbite for most people within 2-10 min. Very cold.	Urgent work only

4	-60° and lower	Extreme risk, risk of frostbite for most people within 2 minutes or less. Extremely cold.	Outdoor work forbidden
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IV. PRIORITY ACTIVITIES FOR WORK IN THE ARCTIC RISKS ASSESSMENT AND MANAGEMENT

The Russian Federation has developed strategic and operational plans for workers' health at the federal and sub-national level. Concept the implementation of State policy aimed at maintaining to worker's health of Russia for the period until 2020 and the further prospect has been developed as well as National Plan of Actions. However, the country has not yet established occupational risk management systems for the main groups of employees in the Arctic region. There is no single concept of taking into account the complex of unfavorable climate-geographic, as well as occupational factors at work in the Arctic with recommendations for taking into account the health individual characteristics, workers social and living conditions and heir personalized prevention, with information technology use including.

There are insufficiently developed:

- The Concept of works in the Arctic territories medical support taking into account the experience of Russian and foreign companies work in the Arctic region;
- Indicative hygienic criteria of regions with the most unfavorable working conditions identification for preventive measures priority directions determination;
- Work in the Arctic related diseases early diagnosis and prevention Criteria (taking into account the complex of occupational and labor process factors);
- Requirements for preliminary and regular medical examinations, pre-watch, pre-shift, pre-trip including on the basis of working conditions hygienic assessment data and occupational risk analysis;
- Medical and psychological support of workers training, acclimatization and adaptation to work in severe and extreme Arctic environments;
- Programs of working longevity in the Arctic territories prolongation technologies introduction with use the method of biological age assessment;
- Criteria for cold stress in the workplace assessment, taking into account the work physical loads severity, adaptation to cold, gender, as well as personal protective equipment use.

The solution of these problems will create a new comprehensive system of occupational health risk assessment and management workers in the Arctic zone, taking into account the work specifics under exposure of environmental, occupational labor process factors. Moreover, risk management system will include the system of extreme climate-geographic, meteorological, helio-geophysical, occupational factors and operation modes exposure effects assessment and management. This will

allow finding the optimal solution of morbidity, disability, mortality decrease, economic losses reduce, labor efficiency improving.

CONCLUSION

An adequate system of occupational risk assessment and management as well as medical support of work in the Arctic territories introduction will accelerate the development of hard-to-reach areas and reduce costs, ensure the equipment smooth operation and improve the labor resources efficiency. Its implementation will keep the health of personnel, reduce the rates of injuries, morbidity (including temporary disability) and mortality among workers, and extend longevity.

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