

ABSTRACT

of the dissertation work of Askarov Daulet Medgatuly on the topic: «Scientific and methodological approaches to a comprehensive assessment of the quality of the environment and public health in territories affected by launch vehicles» submitted for the degree of Doctor of Philosophy (PhD) in the specialty 8D10101 – «Public health»

Relevance of the topic:

Public health issues occupy a leading place in the social policy of any state, being a kind of barometer of social stability, economic well-being, and political balance in the country.

The laws of the Republic of Kazakhstan in the field of environmental safety are based on Article 31 of the Constitution of the Republic of Kazakhstan of 1995, which states that the State aims to protect the environment favorable for human life and health.

According to the Code of the Republic of Kazakhstan "On the Health of the People and the healthcare system" dated July 7, 2020, Article 4, the principle of the state policy in the field of healthcare is to ensure the sanitary and epidemiological well-being of the population, in which there is no harmful effect of environmental factors on a person and favorable conditions for his life are provided. A favorable environment, according to the Environmental Code of the Republic of Kazakhstan dated January 2, 2021, is an environment whose condition ensures environmental safety and public health, biodiversity conservation, pollution prevention, sustainable functioning of ecological systems, reproduction and rational use of natural resources, and environmental safety is a state of protection of vital interests and rights of the individual, society and the state from threats arising as a result of anthropogenic and natural impacts on the environment.

In the Republic of Kazakhstan, the landing of separable parts of the launch vehicles (LV) on technologically unprepared land areas for their fall, accidents during launch of launch vehicles, even in the absence of chemical pollution and other direct effects on the habitat, cause a sense of discomfort among residents of adjacent settlements, concern about the possible deterioration of the environmental situation, quality the environment and the state of their health, and, as a consequence, the occurrence of psychoemotional stress and the growth of psychosomatic diseases among the population.

The implementation of rocket and space activities, like any technological impact, is associated with a negative environmental impact. Launches of launch vehicles are occasionally accompanied by emergency falls. An emergency launch of a launch vehicle can lead to unplanned chemical and physical contamination of habitat objects with rocket fuel components exceeding the established regulatory values.

After 2 accidents of «Proton» launch vehicles in 1999, the recommendations of the Parliamentary hearings of 2002 noted the importance of a comprehensive

study of the impact of the activities of the Baikonur cosmodrome on the environment and public health to take the necessary measures to ensure the safety of the population, reduce the negative impact and compensate for damage from rocket and space activities.

Ensuring the safety of space activities is provided in Article 27 of the Law of the Republic of Kazakhstan "On Space Activities" dated 06.01.2012: "Space activities are carried out subject to ensuring the protection of human health and the environment, the protection of property of individuals and legal entities."

The system of ensuring the environmental safety of the activities of the Baikonur cosmodrome requires constant improvement, taking into account modern requirements. Therefore, the issues of harmonization of regulatory and methodological support with the legislative base of the republic in this area are acute.

The issues of strengthening the environmental safety of rocket and space activities, sanitary and epidemiological welfare of the population in the territories adjacent to the objects of the cosmodrome are constantly in the field of view of the state, repeatedly being the subject of discussion at the meetings of the Majilis of the Parliament of the Republic of Kazakhstan.

The purpose of the dissertation research:

To develop methodological approaches to a comprehensive assessment of the quality of environmental objects, the quality of life and health of the population in the territories of Kazakhstan affected by rocket and space activities.

Research objectives:

1. To assess the quality of environmental objects (atmospheric air, soil, water) in the territories adjacent to the falling areas of separable parts of launch vehicles and accident sites;

2. To study the main indicators of public health in the territories adjacent to the falling areas of separable parts of launch vehicles and accident sites;

3. To study the indicators of the quality of life in the territories adjacent to the falling areas of separable parts of launch vehicles and accident sites;

4. To develop methodological approaches to assessing the quality of the environment and the health of the population of the territories adjacent to the falling areas of separable parts of launch vehicles and accident sites at different stages of the post-accident period.

Research methods: hygienic, epidemiological, mathematical, statistical, informational and analytical.

Objects of research: Environment and public health.

The subject of the study: The environment and public health in the territories adjacent to the falling areas of separable parts of launch vehicles and accident sites.

The main provisions submitted for protection:

1. The chronology of hygienic and medical studies conducted in the areas of launch vehicle accidents in the territories of Kazakhstan, showed the untimeliness or lack of necessary studies of the habitat health status and quality of life of residents of nearby settlements.

2. The analysis of retrospective data and the literature data indicates the presence of psychoemotional tension among residents near functioning areas of the launch vehicle crash.

3. A step-by-step algorithm for assessing the quality of the environment and public health in the areas of launch vehicle accidents is not implemented in the practical guide.

4. The proposed scientifically based methodological approaches to a comprehensive assessment of the quality of the environment and the health of the population in the territories affected by rocket and space activities will make it possible to monitor more effectively.

Justification of scientific novelty:

1. For the first time in Kazakhstan, scientifically based methodological approaches have been developed for a comprehensive assessment of the results of hygienic and medical examinations in settlements in territories affected by rocket and space activities in normal and emergency situations, taking into account regional peculiarities.

2. On the basis of the conducted research, information on the assessment of the medical and environmental situation, public health and the conduct of preventive and health measures in the territories adjacent to the areas of accidents of space rockets has been systematized and unified.

Theoretical and practical significance of the study:

The developed systematized methodological approaches to hygienic and medical research in the Kazakh territories adjacent to the falling areas of separable parts of launch vehicles will help to assess the consequences of emergency situations in different time periods after accidents of space rockets in a timely manner. This will make it possible to develop recommendations for making management decisions in the field of health and environmental safety in the territories affected by rocket and space activities, taking into account regional peculiarities in the Republic of Kazakhstan.

Personal contribution of the doctoral student:

The personal contribution of the author is to participate in expedition trips for hygienic and medical research, analysis of scientific literature, collection of retrospective and prospective data on the state of habitat objects (atmospheric air, soil, drinking water), data from screening and in-depth medical examinations, a survey of residents on the quality of life in the territories adjacent to the areas of activity of the objects of the Baikonur cosmodrome.

The analysis, statistical processing, determination of reliability, and interpretation of the obtained results were carried out.

Based on the conducted research, methodological approaches to a comprehensive assessment of the quality of the environment and public health in Kazakhstan's territories affected by rocket and space activities have been developed.

Research results:

1. Soil analysis at the site of the emergency fall of the «Soyuz-FG» LV revealed: up to 294.7 times the increase in MPC for UDMH, up to 98136 times the

increase in MPC for NDMA, up to 2766 times the increase in MPC for nitrate ions and 816 times the increase in MPC for nitrite ions.

In the habitat objects of the settlements of the emergency fall of the «Soyuz-FG» LV, the following was detected: in soil - UDMH <0.05 mg/kg (MPC =0.1 mg/kg), NDMA <0.05 mg/kg (MPC=0.01 mg/kg); in water, UDMH <0.01 mg/dm³ (MPC=0.02 mg/dm³), NDMA <0.01 mg/dm³ (MPC=0.01 mg/dm³);

2. Higher rates of coronary heart disease (CHD) were observed in the territories adjacent to the falling areas of the separable parts of launch vehicles and the accident sites of the «Soyuz-FG» LV (OR 1.30; 95% CI: 0.70-2.39), arterial hypertension (OR 1.84; 95% CI: 1.11-3.03), endocrine diseases (diabetes mellitus, obesity) (OR 1.76; 95% CI: 1.12-2.79) and decrease in hemoglobin (OR 1.89; 95% CI: 1.17-3.07).

3. In the main group, in a locality closer to the area of the emergency falling of the «Soyuz-FG» LV, residents were dissatisfied with the quality of drinking water (1.6 points out of 5) and atmospheric air pollution (2.3 points out of 5). Almost all respondents noted concern about the presence of falling areas of separable parts of launch vehicles and consider LV launches detrimental to their health (98.1% and 97.7%).

4. Methodological approaches have been developed to assess the quality of the environment and the health of the population in the territories adjacent to the falling areas of separable parts of launch vehicles and accident sites at different stages of the post-accident period.

Conclusions of the study:

1. Multiple exceedances of MPC by components of rocket fuels and products of their transformation were found in the places of falling fragments of the LV (balloon cylinders, propulsion system). In the objects of the habitat of settlements, the excess of the MPC by the components of rocket fuel and the products of their transformation was not detected.

2. High rates of detected diseases at the accident sites of the «Soyuz-FG» LV, along with the signs of reactive anxiety of the population noted in the data of the literature review and retrospective studies in the vicinity of the falling areas of the separating parts of launch vehicles and accident sites, may be one of the factors of psychosomatic pathology, due to psychoemotional impact of the rocket and space activities on the residents of the region.

3. The presence of an active launch vehicle falling areas near settlements brings concern to local residents. The population of the region is experiencing nervous and mental stress from the effects of rocket and space activities.

4. The developed methodological approaches from a socio-hygienic point of view are important for a comprehensive assessment of the medical and environmental situation, public health and rehabilitation measures in the territories adjacent to the accident areas of the rocket and space activities.

Research recommendations:

1. Based on the results of screening and in-depth studies of the health status of the population in areas affected by rocket and space activities, registers of examined persons with established diagnoses, recommendations for treatment, and

rehabilitation have been compiled, which have been provided to local health authorities.

2. The developed methodological approaches for a comprehensive assessment of the quality of the environment and public health have been provided and recommended to the Aerospace Committee of the Ministry of Digital Development, Innovation and Aerospace Industry of the Republic of Kazakhstan for monitoring the quality of the habitat and public health, effective and targeted measures to eliminate the consequences of emergency situations at different stages of the post-accident period.

Approbation of research results:

The main results of the study were reported and discussed at the Scientific and Technical Council of the branch of the RSE "Infrakos" in Almaty, and at the cathedral meeting and the scientific committee "Public Health" of "KazNMU named after S.D. Asfendiyarov".

According to the results of the dissertation work published:

- 8 articles in scientific journals, including 2 articles indexed in the Scopus database (Q2, CiteScore 2021 - 4.3, percentile 74 and Q4, CiteScore 2021 - 0.9, percentile 23), and 3 articles in journals recommended by Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan;

- 1 thesis and 1 poster report at an international conference;

- monograph (Kozlovsky V.A., Pozdnyakova A.P., Amrin M.K., Askarov D.M. Comprehensive assessment of public health in the territories adjacent to the accident areas of the rocket and space activities / RSE "Scientific Research Center "Garysh-Ecology" Almaty 2020, ISBN 978-601-332-931-4. – 304 p.).

Volume and structure of the dissertation:

The dissertation work consists of an introduction, 5 chapters, and a conclusion. The volume of the dissertation: 145 pages, 31 tables, 30 figures, and 20 appendices. The list of references includes 120 sources of foreign, domestic sources and regulatory documents (standards, GOST-s, measurement methods, etc.).