Assessment of the importance of environmental aspects in the construction of oil and gas facilities

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Abstract. One of the solutions for assessing the impact on the components of the natural environment and effective management at the present stage is the introduction of environmental management in the organization. The authors analyzed modern scientific approaches to the problem of greening the activities of enterprises and substantiated the expediency of using environmental control in the practice of environmental management. The paper substantiates the need to rank the elements of the activities of construction organizations in the construction of oil refining complexes according to the importance of their impact on the environment. The issues of environmental protection during the construction of the oil and gas complex are considered, taking into account the specifics of construction work. Functional zones for individual production processes and various impacts on the environment, types of impacts inherent in a construction company are identified. For the projected oil and gas complex, the identification of environmental aspects was carried out, significant aspects were highlighted and a comparative characteristic was drawn up for each of them.

1. Introduction
During the construction of oil and gas facilities, it becomes necessary to provide for a set of measures to prevent or reduce the possible negative impact of the facility on the components of the environment and human health. In order to better manage the impact on the components of the natural environment, it is necessary to rank the environmental aspects by importance [1-3]. The environmental aspects of an organization's activities are understood as elements of an organization's activities, its products or services that can interact with the environment, and a significant environmental aspect can have a more significant environmental impact on the environment [4-5].

The assessment of the significance of environmental aspects concerns mainly the current production activities. The impact on the environment in case of emergency or emergency situations is assessed in the form of risks within the framework of the development and implementation of special action plans for the elimination and prevention of accidents in accordance with the legislation of the Russian Federation.

2. Materials and methods
The identification of environmental aspects is carried out by an organization using one or more criteria [6-7]. To effectively manage the impact on the components of the natural environment, it is necessary to rank the environmental aspects and focus on the more significant ones. At the same time, it is necessary for organizations to determine at an early stage those indicators that characterize the amount of pollutant emitted during production, the nature of its distribution and impact, the volume of...
resource consumption, the amount of physical and chemical impacts. The calculation of the hazard of exposure is made in points [8].

The significance of environmental aspects is calculated according to the following criteria [9-14]:

- The magnitude of the impact on the atmospheric air, natural objects, water bodies (mass of emissions, discharges, boundaries and size of damaged lands);
- The nature of the impact;
- Toxicity of exposure (classification of pollutants by hazard classes);
- The state of the natural environment in the zone of negative impact;
- Ensuring compliance with regulatory and legal requirements;
- The position of stakeholders in the planning, construction and operation of oil and gas complexes (opinion of public preferences, authorities, etc.).

Impact Index ($I_i$) is a comprehensive indicator that takes into account the impact of negative factors on the state of the ecological system and allows you to compare the environmental impact of various production processes. Calculated by the formula

$$I_i = K \cdot P \cdot B$$

(1)

where $K$ is the amount of impact (volume or mass of the emitted pollutant or the volume of resource consumption); $P$ is the spread of impact, an indicator depending on the localization of impact during the construction of various facilities (may be global, regional or local); $B$ - exposure hazard (takes into account the possibility of restoring a damaged natural object or environment, and also takes into account the economic and environmental value of the object). When taking into account the indicators, a point estimate from 1 to 3 is used, where 1 is the minimum impact, 3 is the maximum.

The index of the significance of each environmental aspect is calculated taking into account the increasing or decreasing coefficients according to the formula:

$$I_s = I_i \cdot k_1 \cdot k_2 \cdot k_3$$

(2)

where $I_s$ is the index of the significance of the environmental aspect; $I_i$ - impact index; $k_1$ - coefficient of the state of the environment; $k_2$ is the coefficient of compliance with the requirements of standards and legislation; $k_3$ is the coefficient of taking into account the opinions of stakeholders. In the absence of a normatively established criterion that determines the significance of the impact, the coefficients are taken equal to 1.

The coefficient of the state of the environment ($k_1$) includes the state of atmospheric air, soil, land, and water resources by levels of background pollution. Climatic, geological, hydrological, landscape, socio-economic conditions on the territory of the planned construction are taken into account.

The coefficient $k_2$, taking into account the compliance of environmental aspects with ensuring compliance with the requirements of standards and legislation, is determined by the formula

$$k_2 = k_1^1 \cdot k_2^2 \cdot k_3^3$$

(3)

where $k_1^1$ is the coefficient of compliance with exposure standards. Determined by the annual volume of emissions, discharges, waste disposal, level of physical impact; $k_2^2$ - coefficient of elimination of violations according to the instructions of state and departmental bodies of environmental supervision for the evaluated aspect of the object; $k_3^3$ is the coefficient of environmental restrictions in the impact zone of the object.

The coefficient $k_3$, which takes into account the views of stakeholders in the planning, construction and operation of oil and gas complexes (opinion of public preferences, authorities, etc.), is determined by the formula
where \( k_3 \) is the coefficient of accounting for environmental factors (priority of environmental authorities) at the location of sources of impact; \( k_3^1 \) - coefficient of taking into account public opinion, is determined depending on the number of complaints from the population, public organizations or other interested parties about environmental pollution by objects in the activities of public organizations or other interested parties.

3. Results

To carry out the procedure for assessing the impact on the environment of the planned activity, a preliminary plan of the main activities was developed, taking into account the information on public participation. The planned construction of the oil and gas complex envisages, in addition to the location of the main production facilities and office buildings, auxiliary facilities: maintenance facilities, off-site facilities, fire support, and a boiler room. According to the design data, the area of land plots required for the construction of the projected facilities is 99.65 hectares. Land reclamation area - 27.9 hectares.

In order to identify environmental aspects, the authors have identified individual areas that differ in production processes and the nature of the impact on the environment. At the same time, water intake facilities, sewage treatment facilities, off-site communications - water conduits, sewer collectors, power lines and communications are referred to as design and construction objects taken into account when impacting the environment.

As a result of the analysis of the initial data, we obtain the values of the environmental aspect significance index (table 3)

According to the data obtained (table 3), the significance of environmental aspects during the construction period of the projected facilities is classified as slightly increased:

- On construction sites in terms of emissions of dimetibenzen (xylene) - due to a large amount of painting work;
- On the site of temporary buildings and structures - in terms of nitrogen dioxide emissions, the flow of which is associated with the operation of diesel power plants.

These aspects may require planning of mitigation measures with evidence of the level of impact.

**Table 1. Environmental Significance Index.**

| Functional area | Environmental aspect | Impact index | Significance coefficients |
|-----------------|----------------------|--------------|--------------------------|
|                 |                      | K \( k_1 \)  | \( P_1 k_2^1 \) \( k_2^2 \) \( k_2^3 \) \( k_3^1 \) \( k_3^2 \) \( I_s \) |
| Construction sites | Emissions of pollutants into the atmosphere | 2 3 2 12 | 0.8 0.8 1 1 1 1 7.68 |
|                  | Waste generation     | 3 2 1 6    | 0.8 0.8 1 1 1 1 3.84 |
|                  | Water consumption    | 2 2 2 8    | 0.8 0.8 1 1 1 1 5.12 |
|                  | Physical factors     | 3 1 2 6    | 0.8 0.8 1 1 1 1 3.84 |
|                  | Breaking soil cover  | 1 3 3 9    | 0.8 0.8 1 1 1 1 5.76 |
4. Discussion

Assessment of soil disturbance is carried out for lands disturbed during construction, repair and drilling operations, where the reclamation measures were not carried out in a timely manner in accordance with the project and the lease agreement for this area was not extended. The amount of impact \((K)\) is determined depending on the proportion of disturbed land to the land allotment area. The distribution of the impact \((P)\) depends on the degree of disturbance of the soil cover and can be regional or local. The hazard of exposure \((B)\) is determined by the possibility of restoring the soil cover and soil fertility.

During the construction period of auxiliary production facilities, the impact on the atmospheric air will be associated with the operation of noisy sources, which include road construction equipment, vehicles, block-boxes of emergency stationary diesel power plants DES-1000 and DES-1600 (with periodic starts of diesel engines).

During the construction of the oil and gas complex, production and consumption wastes are generated. The waste of consumption generated as a result of the vital activity of people employed in the construction of projected facilities includes:

- Unsorted waste from dwellings;
- Garbage from office and domestic premises of organizations;
- Unsorted food waste from kitchens and catering organizations.

Production wastes generated during construction and installation works are presented:

- Waste products and materials used in the construction of facilities;
- Wastes from drilling water wells and GAZ wells for electrical protection;
- Wood waste generated as a result of cutting down trees and vegetation on the territory allocated for the construction of facilities;
- Waste water treatment waste;
- Waste generated during the wear of overalls by construction workers.

To assess the significance, we take only those aspects for which the impact index \((I_i)\) is more than 6 points, as well as those for which the established standards were exceeded.

During the construction period of auxiliary production facilities, the atmospheric air will be exposed to emissions of pollutants from road construction equipment, welding units, painting areas, areas for unloading loose construction materials, sand and gravel mixture, fueling areas for road construction equipment, chainsaws, bitumen laying sites ... The impact on the atmospheric air will also be associated with the operation of noisy sources, which include road construction equipment, vehicles, block boxes of emergency stationary diesel power plants DES-1000 and DES-1600 (with periodic starts of diesel engines).

During the construction of the oil and gas complex, production and consumption wastes are generated. The waste of consumption generated as a result of the vital activity of people employed in the construction of projected facilities includes:

- Unsorted waste from dwellings;
- Garbage from office and domestic premises of organizations;
- Unsorted food waste from kitchens and catering organizations.

Production wastes generated during construction and installation works are presented:

- Waste products and materials used in the construction of facilities;
- Wastes from drilling water and gas wells;
- Wood waste generated as a result of cutting down trees and vegetation on the territory allocated for the construction of facilities;
- Waste water treatment waste;
• Waste generated during the wear of overalls by construction workers.

To assess the significance, we take only those aspects for which the impact index \( I_i \) is more than 6 points, as well as those for which the established standards were exceeded.

5. Conclusion
When identifying environmental aspects during the construction of oil and gas enterprises, it is necessary to follow the following algorithm of actions:

• To define the characteristics of each factor by which the significance of environmental aspects is assessed;
• Assess the impact of the factor on the environment;
• Analyze the potential risk of pollution and harm to the natural environment;
• To develop a list of measures to reduce the impact of a negative factor on the environment, including the restoration of damaged natural objects.

According to the data obtained, the significance of environmental aspects during the construction period of the projected auxiliary production facilities is classified as slightly increased:

On construction sites:
• In terms of emissions of demytylbenzene (Xylene) - due to the large volume of painting works in the second and third years of construction.
• In terms of the impact on flora and fauna - due to the removal of habitats

On the site of temporary buildings and structures of the contractor:
• In terms of nitrogen dioxide emissions, the flow of which is associated with the operation of diesel power plants that provide power to facilities.

References
[1] Rudneva E Yu, Kuzmenko A N and Dyachenko V R 2017 Management of Environmental Aspects in the Enterprise Eco-Trolling System. Current Trends of Development and Prospects for the Introduction of Innovative Technologies in Engineering, Education and Economics 1 (2) 24-29
[2] Volchik O V 2015 Identification and assessment of the significance of environmental aspects at the enterprise of the gas industry. Territory "NEFTEGAZ" 11 144–151
[3] Vorobyova Yu A, Nacharova Yu A and Kunchenko V A 2019 Identification of environmental aspects in the construction of oil and gas complexes. Housing and communal infrastructure 3 (10) 87-94
[4] Zherlykina M N, Vorob'eva Y A and Jaremienko S A 2019 Forecasting the Environmental Risk and the Outcome of the Impact of a Chemical Accident on the Environment. IOP Conference Series: Earth and Environmental Science 272 022027.
[5] Razumovskaya I V 2017 Planning the process of greening the gas-producing industry. Economy and ecology of territorial entities 2 86-89
[6] Shoba V A, Snegirev V A 2017 Designing the Environmental Management System of the Enterprise in Accordance With the New Version Of ISO 14001: Business. Education. Right 1 (38) 136-142
[7] Morozova O I, Ignashin M E 2017 Management of Environmental Aspects of the Enterprise in the Framework of the Implementation of the State Strategy "Green Economy". Materials of the XIII International Scientific and Practical Conference 301-306
[8] Konyaev S V 2012 Environmental management at enterprises of the oil and gas complex. Environmental protection in the oil and gas complex 9 24–30
[9] Kolosov A, Yaremienko S, Garmonov K. and Sklyarov K 2019 Influence of Gas Stations on the Ecology of the Urban Environment. E3S Web of Conferences. Topical Problems of Green
Architecture, Civil and Environmental Engineering 07031

[10] Garmonov K V, Shchukina T V, Zherlykina M N, Kukina O B and Pokromovich Yu R 2017 Research of Environmental Pollution from Emissions of Hazardous Substances of Industrial Enterprises Taking Into Account the Climatic Features of the Region. Housing and communal infrastructure 3(2) 84-92.

[11] Kopytina M Yu, Kitaev D N, Shchukina T V and Apoikova E A 2017 Diagnostics of Environmental Pollution and an Integrated Approach to its Protection. Ecology and industry of Russia 21(4) 59-63

[12] Markin S V, Belousova E E, Lykov O P, Nedre A Yu and Dedov A G 2010 Environmental Justification and Strategy of Environmental Activities in the Oil and Gas Complex. Proceedings of the Russian State University of Oil and Gas. THEM. Gubkin 3 (260) 116-124

[13] Mikhaylov A, Moiseev N, Aleshin K and Burkhardt T 2020 Global climate change and greenhouse effect. Entrepreneurship and Sustainability Issues 7(4) 2897-2913

[14] Mikhaylov A 2020 Lichens as indicators of atmospheric pollution in urban ecosystems. Israel Journal of Ecology & Evolution 10016 1-9