A RISK-BASED APPROACH TO ENVIRONMENTAL SAFETY CONTROL OF THE REFINING VENTURE

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ABSTRACT

The article deals with the place and role of the risk-based approach in the processes of the environmental compliance at enterprises, the mechanism of risks assessment adding into the procedures and documentation of the ecological management is described, methods of risks parameters usage are unfolded during development and realization of programs and plans for refining ventures updating.
The topicality of the investigation is connected with the updating of the ecological management system of the PJSC "Orsknefteorgsintez" and with a planned applying of the risk-based approach into the oversight bodies including government environmental oversight bodies.
There is a goal to create approaches of the risk-based ecological management of the PJSC "Orsknefteorgsintez" on the ground of risks assessment for the population health damaged by the environmental pollution and on the ground of the received data interpretation and taking appropriate managerial decisions.
The investigations were held in two stages. During the first stage the levels of the risks for the population health caused by the open air pollution with the emissions from the PJSC" Orsknefteorgsintez" were defined. The results of hygienic analysis of the risks assessment for the population health because of the negative impact of the PJSC "Orsknefteorgsintez" are revealed, taking into account realization of the program of the business development midterm. The results of the comparative analysis of the levels of the population health risks before and after applying the reconstruction objects as a part of the industry development midterm program are represented. On the basis of the first stage investigation results the recommendations for the management of the population health risks, caused by the PJSC "Orsknefteorgsintez"production facilities (including control and monitoring) are developed.
The risk-based approach application improves the general system of the management of the quality of the environment in industries, optimizes the cooperation with the regulatory authorities, improves essentially the quality of the managerial decisions taking into account ecological demands and increases the investment efficiency.

KEY WORDS RISK-BASED APPROACH, SUSTAINABLE GROWTH, ECOLOGICAL RISKS, HEALTH RISK ASSESSMENT, ECOLOGICAL MANAGEMENT, OVERSIGHT ACTIVITIES.

TOPICALITY

We live in the world where the formed models and methods of the enterprise management lose torrentially efficiency due to the current changes, caused by the forth industrial revolution and constant increasing of the ecological risks. During the World Economic Forum in Davos (2018), it was brought out that the risks connected with the extreme weather events, natural disasters and environmental deterioration cause the biggest concern [The Global Risks Report , 2018]. The occurring problems are interrelated, they should be solved according to the complex approach (UNEP, 2015) taking into account the sustainable development conception. During the biggest Summit meeting in the history of the UNO devoted to the sustainable development issues "Rio+20" (Rio de Janeiro, 2012) the most of the countries of the world confirmed their committing to this main tendency of the development. Then it was also mentioned about the importance of the "green" modernization of the economy, formation of the common aims for the sustainable development.

The accepting of the aims of the sustainable development in September, 2015 (during the UNO Summit devoted to the sustainable development issues at the 70th anniversary session of the General Assembly of the UNO (New York)) laid the groundwork for providing goal-oriented and coordinated actions in the sustainable development field by the state, business and civil society.

For the manufacturing companies the appropriate business transaction can be economically advantageous and legal as a matter of law, and may have tremendous after-effects concerning the following of the ecological demands and society interests. Recognition of the existing contradictions reality in the development scenario contemplates that compromise solutions will be taken in the future.

Under conditions of risks increase companies should improve their viability. That's why nowadays practical instruments for the resilience increase on the ground of the complex systems science are actively developed. The processing complexity growth of the existing systems (power and water systems, etc) in the light of the climate changes will make the future world far more riskogenic than it is today.

Since 2012 transnational companies started cooperation in terms of the "Resilience Action Initiative"(Resilience Action Initiative, RAI) [The Resilience [s.a.]].

Corporate governance arrangements are invaded with the instruments of resilience increase.

In terms of the RAI an innovational resilience conception of the enterprises is suggested: "Turbulence: corporative prospect of cooperation in the resilience field". The instruments and conceptions for vulnerability reduction and sustainability increase under changing conditions are suggested in it. Depending on conceptual approaches to the risk decrease the three following categories of the viability proving are distinguished:

- Structural resilience describes the system dynamics inside the organization;
- Integral stability characterizes complex interrelations with outside world;
- Transformational stability presupposes transformations for reduction of some risks [The Resilience [s.a.]].

Generalization of work experience in terms of the RAI showed that the stable management of the companies in non-stable and quickly changing world is aimed to save their stability, predictability and high transparency in order to provide the trust of the investors, scientists and society in general. Besides, the management should become more flexible and adapting in order to provide the development of technologies themselves and to expand the spheres of their application [The resilience [s.a.].

Implementation of the risk-based approach to the practice of means of control and supervision activity is designed to further the creation of the institutional conditions for domestic enterprises functionality under conditions of the risks increase.

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In 2016 RF Government regulation was adopted, where development and confirmation of "… criteria for referring of legal bodies and individual entrepreneurs activity and (or) production facilities used by them to risks category definition are prescribed…for the state monitoring in the field of atmospheric air protection, for the state monitoring in the field of using and protection of water bodies", "for regional government environmental oversight" [Regulation 2016]. This gives a special value to the procedure of ecological risks and population health risks control. Realization of the risk-based approach in the system of enterprises management is established under the last international standards editions and provisions of the appropriate normative legal acts [GOST R ISO 9001-2015, 2015; GOST R ISO 14001-2016, 2016; GOST R ISO 31000:2010, 2010].

THE STATUS OF THE RESEARCH TOPIC

In Russia a special attention is given to the estimation and analysis of the territories, which are referred to hazard areas, i.e. territories with the critical possible pollution. This issue is one of the priority measures of the state policy streamed for the ecological development [The Strategy-2020, 2013]. Together with other risks especially "under conditions of development riskogenics increase while migrating to new economics" health risks are considered as a sensitive reagent of the population vital activity. The role of the risks receives much deeper sense during "definition of the target-oriented priorities structure of the environmental compliance…"[Fomenko G.A. 2016; Borodkin A.E. 2014; 2016]. In the Russian Federation quite a huge experience is accumulated concerning the population health risks assessment. Addressing the issue of theoretical questions concerning the risk assessment, harmonization of the foreign approaches to assessment and control of the population health risk caused by chemical substances, were performed by S.L.Avaliani, S.M.Novikov, A.V.Kiselev, N.V.Zaitseva, I.V. Mai, P.Z. Shur, B.A. Revich and others. The research results show a high predictive capability of the risk indexes, which give an opportunity to develop and justify managerial mechanisms. The biggest part of these works were mainly oriented for justifying the dimensions of the calculated border of the sanitary protected area and didn't deal with the issues concerning the environment safety control of the industrial organizations [Rakhmanin Y.A., Novikov S.M., Avaliani S.L. and others, 2015].

For years in the Russian Federation preparation of the legislative acts has been performed in order to put the risk-based approach into work of oversight bodies including the government environmental oversight bodies and to implement risk modeling. The greatest result were achieved by the oversight activity of Rospotrebnadzor [Andreeva E.E.,2016]. The risk-based model contains assessment system of the potential hazard in objects which are liable for sanitary and epidemiological supervision and supervision in the field of consumer protection with account of risk criteria for injury [Zaitseva N.V., Mai. I.V., Shur P.Z., and others, 2014].

The application of the risk-based approach is studied in the literature during planning and organization of disease control efforts at public events [Efremenko D.V., Kuznetsova I.V., 2017]. Controlof the population health risks with the usage of the risk-based approach is considered to be the way of reduction of the industrial releases and comes with economic analysis. A comparative estimation of the efficiency of the environmental measures was performed taking into account the highest possible economical efficiency and the highest possible reduction of the health risks levels [Avaliani S.L., Novikov S.M., Shashina T.A., and others, 2018].

Application of the indexes of acceptability of health risk in the quality control of the environmental conditions presented great results, but still there exists a major disconnection with the world systems of ecological and sanitary demands and standards.

In foreign literature mechanisms of ecological and economical interrelations in procedures of contamination control of environmental conditions are revealed in details [Leeves G.D., Herbert R.D., 2002], the approaches about how administrative barriers can be reduced and how verification efficiency with usage of risk acceptability criteria can be increased [Hampton p., 2017].

The principles of the risk-based oversight "…formed the basis for the range of documents, a sort of Regulators Compliance Code and Regulatory Enforcement and Sanction Act, which appeared to be basic in the sphere of regulation of oversight over business and management reform…" [Goryaev D.V., 2018].

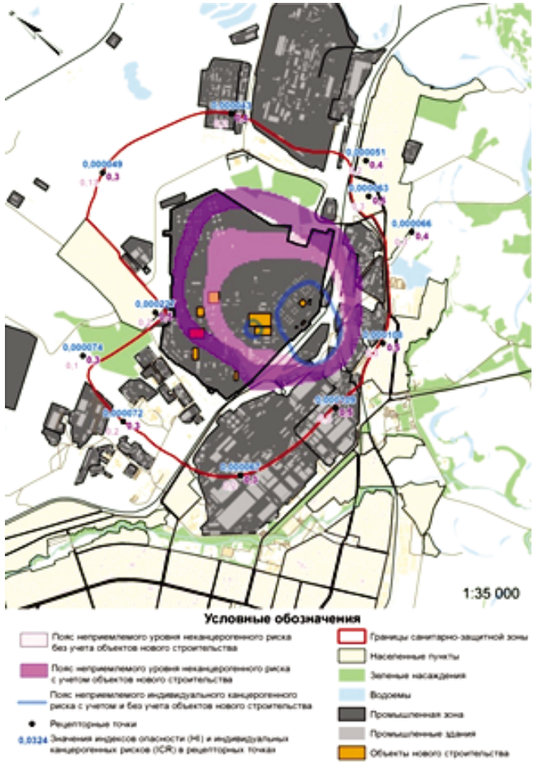
The most interesting methodological approaches to economical risk assessment are those where the cost of risk in the assessment system "cost-benefit" is considered as criterion of environmental measures economical efficiency [Golub A., Brody M., 2017].

The main instrument of the risk-based approach to the enterprise management is actual estimate of ecological risks and population health risks. The necessity to correct the established practice of the enterprise management with account of risk assessment is obvious, but the appropriate developments are not numerous and often not tied to the practice of the enterprise development planning and environmental protection activity. Upon an initiative of the PJSC "Orsknefteorgsintez"[1] and Research and production association "Institute Cadastre"[2] the investigations were made in order to estimate the population health risks caused by air pollution. On this ground the suggestions were made about how the risk-based approach can be implemented into the system of the environmental protection control of the PJSC "Orsknefteorgsintez".

RESEARCH MATERIALS AND METHODS

The following methods were used: ecological and geographical investigation, procedure of the assessment of the population health risk caused by the releases of the PJSC "Orsknefteorgsintez" (hazard identification, exposure assessment, assessment of "dose-response" relationship, risks characteristics, risk management). Mathematical simulation of dispersal of the highest possible one-time and average annual concentrations was done by means of Program Complex Unified Program of air pollution estimation "Ecologist", version 4.5, calculation box "Average" (LLC "Company "Integral"", St. Petersburg). Calculations of the cancerogenic risk (the value of the individual cancerogenic risk, ICR) and non-cancerogenic risk (hazard quotient (HQ) and index coefficient (IC)) for the population health were performed with the usage of MS Excel 2017 and calculation box "Risks", actualizing [P 2.1.10.1920-04, 2004]. Cartographical works were completed by means of computer geological information system (Arc Gis 10.1). As the main initial data for the mathematical simulation the current volumes of "Maximum Permitted Emission", the chapters of "The List of the Environmental protection Measures" and sanitary protection zone project were used, knowledge of the program of the PJSC "Orsknefteorgsintez" development midterm in 2012-2020 yrs., information about climate and weather features of the territory under research were given by FSBI "Russia's Weather service".

Picture 1. Geographical distribution: health risks evolution in 2012-2020 yrs.



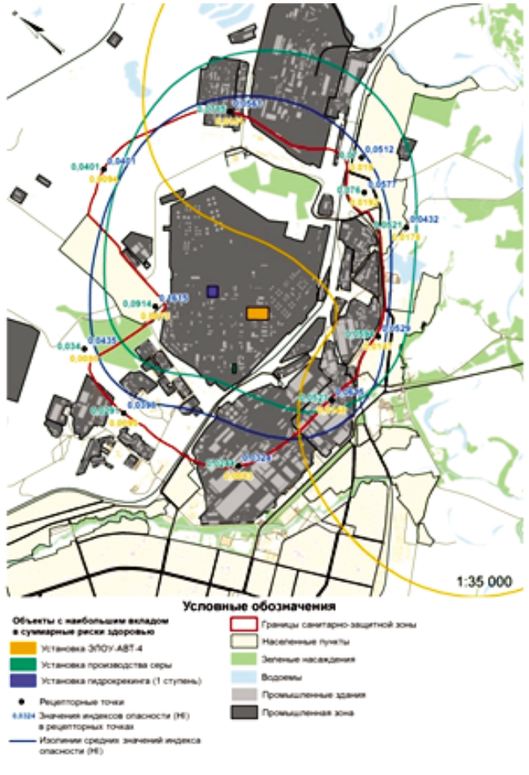
RESEARCH RESULTS

Implementation of the risk-based approach into the system of the environmental protection control of the PJSC "Orsknefteorgsintez" is planned to be performed in two stages:

- hazard identification and analysis of health risks caused by the emissions of the chemical substances of the PJSC "Orsknefteorgsintez" with account of the program realization of its development midterm (2012-2020 yrs.);
- development and actualizing of measures for management of the population health risks created by the enterprise production facilities.

The first stage. The levels of the population health risks caused by the air pollution from the PJSC "Orsknefteorgsintez" activities are defined, with the account of realization of the program of the development mid-term before and after putting into operation reconstruction objects within this program. 27 chemical toxicant with non-cancerogenic effect were identified as well as seven substances were defined as cancerogenic ones. It was decided to examine 11 priority toxicants including four of cancerogenic effect. Non-cancerogenic hazard is mainly formed by dioxide of sulfur (38%), cancerogenic hazard is formed by benzole (98%)[3].

Picture 2. Distribution of average values of risks from Greenfield development projects with the biggest input into the total population health risk.



[1] PJSC "Orsknefteorgsintez" is the largest refining venture of the Orenburg Region/The company releases competitive products of petroleum refining (diesel oil fluel, aviation kerosene, autopetrol etc.), actualizes huge investment projects. One of the main streams of the enterprise development is providing ecological safety in terms of air and water basins protection, hazardous waste management ((http://www.ornpz.ru).

[2] Research and production association "Institute "Cadastre"" performs researches and project developments in the environmental protection sphere, including risk assessment. Center for Population Health Assessment Services has been successfully functioning since 2008. The "Institute "Cadastre"" obtained a certificate for the risk assessment performing in the appropriate sphere (certificate № SDS 050 dtd the 6th of April, 2017, issued by Central Voluntary Certification Board of Risk Assessment Bodies FBHI "Hygienic and Epidepiological Center of the RF Rospotrebnadzor"; http://nipik.ru).

[3] To the toxicants with the defined cancerogenic effect (group 1 according to classification of International Agency for Research on Cancer) the following substances are referred: benzol, carbon (carbon black); to the probable chemical cancerogenics for humans (group 2A) benzapyrene is referred; to possible ones (group 2B po) ethyl benzene is referred.

For exposure assessment of the average annual concentrations receptor points (points of reaction) on the border of the sanitary protection zone and residential constructions in the immediate vicinity from the enterprise were established.

The exposure assessment of the toxicants showed an acceptable level of the average annual concentration.

Analysis of the toxicological features of the non-cancerogenic toxicants gave an opportunity to find that substances enter the human organism through the respiratory system, consequently, the main target organs are respiratory ones. Toxic action of the pollution agents appears by way of a wide range of the biological effects- starting from the increase of the tussis frequency and other symptoms of the upper and lower breathing passages to rough organic changes in respiratory organs.

Besides, hemotoxic effects are possible (blood affect), in a smaller extent influence on the central nervous system, heart vascular system, reproductive system is possible as well as on the immune system, hepatic and red marrow.

The levels of population health risk caused by the environmental pollution on the border of the sanitary protection zone (SPZ) of the enterprise we defined. The acceptable values will not be exceeded in the current position and in prospect, with account of the greenfield development project according to the program of the enterprise development midterm.

According to the more detailed analysis of the risk-laden situation dynamics (new objects building) (picture 1), even in case when zone configuration, "belt" of circulation of non-cancerogenic risks (ellipse focused on north-westward) are saved, risks distribution area is expanded with the new objects deployment. In these conditions the "belt" of the non-acceptable individual cancerogenic risk doesn't face great changes. Received results of the geographical orientation of the hazard grounds, located within the border of the SPZ and in whole referred to the plant master plan (in terms of facility accommodation of constructions), nevertheless show that in comparison with the other areas in the northwest part of the working site and SPZ territory it is prohibited to locate new industrial facilities.

The Greenfield development projects are ranked in order of contribution into general rates of cancerogenic and non-cancerogenic risks with the aim of finding the most riskogenic ones. The first place according to the risk priority is given to hydro cracking (input – 14.5%), the second place is given to sulfur regeneration unit (input- 13.8%), approximately on the same level are: oil distillation installation CDU / VDU-4 (input – 3.2%), automatic installation of on-spot loading of light oils with vapor recovery box (input – 2.6%), and asphaltum oil visbreaker unit (input – 2.1%). As for the other Greenfield development projects, inputs into the total health risk make up less than 2% (picture 2).

The second stage. On basis of the obtained results the measures are developed about how to control population health risks, caused by enterprise production facilities. Optimization of program of production control and monitoring refer to such measures. In terms of choosing and substantiation of efficiency of managerial decisions risk assessment procedure gave an opportunity to develop mechanisms and strategy of various regulatory measures on risk reduction.

Analysis of priorities of the enterprise ecological safety showed that to the main priorities of the ecological safety the following items refer:

- sanitary significant receptor points and working sites with the highest possible pressure (points on the SPZ border and residential area towards the south and north-east part of the working site) (geographical aspect);
- Priority industrial facilities and process units which create a high exposure and risk pressure (Greenfield development projects: hydro cracking, sulfur production, the existing projects are: installation 35–11/300–2, complex facility L-24-T-6, installation L-24-200-86(technological aspect);
- The most hazardous chemical toxicants with non-cancerogenic and cancerogenic effect (non-cancerogenic:sulphur dioxide, nitrogen dioxide, hydrogen sulphide, kerosene, nitrogen oxides, vanadium pentoxide, xylene, benzole, black carbon (carbon char), benzapyrene, ethyl benzene; cancerogenic: benzol, carbon (black carbon), ethyl benzene, benzapyrene (toxicological aspect).

To define the basic provisions of the risk based ecological management the mechanism of implementation of ecological risks into the ecological control system which is an integral piece of the general strategy of enterprise development were established. For the elaboration of mechanism standards of environmental managerial system were used [GOST R ISO 14004–2017, 2017]. General guidelines on implementation". Implementing mechanism of population health risk assessment into the system of the enterprise ecological management can efficiently involve assessment indexes of population health risks and ecological risks, caused by production activity of enterprise objects with regard of geographical risk distribution, the most significant toxicants, and priority riskogenic production facilities. A comprehensive picture of risks distribution is useful during production development planning, investments, actualization of the current ecological management, cooperation with the controlling authorities.

For the purpose of updating the control and monitoring system of the air pollution status with regard of assessment of the population health risk the suggestion of changing the programs of industrial ecological control and monitoring of the air basin were represented, including on the border of SPZ.

Practical importance of these suggestions lies in the fact that it is possible to prove the stable reaching of the acceptable level of technogenic influence close to the sources of pollutant emissions including the territory of the SPZ.

The lists of the recommended for control and monitoring pollutants are made on basis of relative hazard index. Non-cancerogenic pollutants are those substances for which the relative non-cancerogenic hazard index is 97% from the total amount of this index in the list of priority pollutants. The control and monitoring of the three main pollutants (sulphur dioxide, nitrogen dioxide, nitrogen oxide) and five specific for the enterprise pollutants (kerosene, hydrogen sulphide, vanadium pentoxide, xylene, benzole) were established. It was recommended to provide control and monitoring for the cancerogenic pollutants with the total index of the relative cancerogenic hazard 99.9% from the general total index of the related cancerogenic hazard. The control and monitoring were applied for benzole and carbon (black carbon). The posts of samples collection were decided to be allocated according to the priority receptor points (impact points), where the largest exposure pressure is created and the highest levels of population health risks appear.

Consequently, taking into account the results of the assessment of the population health risks, the controlled pollutants were recommended, the sampling points were specified and the monitoring mode was updated. This all is suggested to be involved into the program of the industrial ecological control and monitoring of the enterprise air basin conditions.

CONCLUSIONS

Within the conditions of risks increase all over the world a cautious attitude to the health risks and ecological risks becomes the important factor of the stable strategic development of the enterprises. That's why they should be studied more thoroughly and taken into account in the practice of risk-management, on the stage of spatial planning of the cities and habitations (during establishment of SPZ of enterprises and industrial hubs), during plant master plans (for choosing the optimal allocation of the industrial facilities with regard of the forming ecological risks), in the process of the current management of the enterprise ecological safety.

The actualization of the risk-based ecological management of the PJSC "Orsknefteorgsintez" clearly demonstrates a real opportunity, practical importance, and radical ways and methods for increasing of the enterprise management efficiency by way of correction of the processes of environmental quality control and taking substantiated ecological decisions in accordance with the modern approaches of ecological and economical analysis. The results of the health risk assessment and ecological risk assessment pay a great role when the following actions are taken:

- Taking decisions concerning the strategy of the technological development and enterprise investment policy;
- Making optimal planning spatial concepts from the point of ecology and economy for new production facilities allocation;
- Defining of the priority of the taking measures for production modernization;
- Development of the environment protecting plans, enterprise investment program and assessment of their efficiency;
- Technological regulations development;
- Economical analysis of the various variants of the enterprise development and defining of the appropriate ways of ecological risks control.

In general, application of the risk-based approach improves the whole system of environmental quality control, primarily by means of economic resources concentration for work with the most hazardous objects, consequently the investments into environmental protection are optimized. Reduction of ecological risks and health risks improves enterprises public image in terms of corporate responsibility.

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