Geoecological aspects of rationing when creating energy facilities in Russia

Valery Belyaev[1*]

[1]NRU Moscow State Building University, Yaroslavl Highway, 26, 129337, Moscow, Russia

Abstract. The object of the research underlying this article is the geoecological issues of the creation of energy facilities in Russia, and such issues are considered in the aspect of rationing. These issues have not been studied enough, while their relevance is associated with the large-scale negative impact of energy facilities on the natural environment, as well as with the designation of state rationing as one of the leading areas of research within the scientific specialty "Geoecology". The purpose of the work was to identify the features of "geoecological rationing" in Russia by the example of the creation of energy facilities. To achieve it, the current situation concerning the geoecological aspects of rationing when creating energy facilities is considered. The stages and main problems of the formation of geoecology as a science in Russia are described (the national uniqueness of this phenomenon is emphasized). The directions of geoecological research that are relevant from the point of view of creating energy facilities, including the justification of state rationing, are highlighted. The main documents on standardization, the subject area of which affects the considered sphere of urban planning activity, are analyzed. The conclusion is made about the insufficient effectiveness of the considered documents in the geoecological aspect. The main problems of environmental regulation and standardization in the field of higher professional education in the field of "geoecology" are also identified. To rectify the situation, options are offered for performing systematic scientific studies, the results of which will be used, among other things, to update the documents under consideration.Keywords: geoecology, standardization document, rationing, energy facilities

1 Introduction

In Russia, geoecology is positioned as a new complex science. Its origins are usually associated with the works of Karl Troll, who understood it as a kind of unification of ecological and geographical research, equating "geoecology" with "landscape ecology" [1]. At the national level, the term "geoecology" began to gain popularity from the beginning of the 70s of the last century also thanks to the research of geographers (V. B. Sochava et al. [2]) with the subsequent formation of an appropriate scientific direction.

However, this term has not received a clear and generally accepted definition, and the subject and tasks of geoecology are still formulated differently. In the narrow sense of the

* Corresponding author: vbelyaev2011@mail.ru

word, everything boils down to the study of negative anthropogenic impacts on the natural environment, but most often "geoecology" is considered more broadly. Then the range of its tasks includes many, and a wide variety of scientific and practical directions and problems. At the same time, there is also a different interpretation of the subject, object and content of "geoecology", the range of research issues is blurred, there is no unified, generally recognized methodology and ontological elaboration (note that within the framework of the process-environment approach, the object of geoecology research is usually the environment, and the subject is various geoecological processes).

In such a situation, scientific discussions around "geoecology" do not subside, and the search for its content continues [3, 4, etc.]. Sometimes the very appearance of a new science is criticized. In particular, M.I. Bogdanov notes that geoecology as a science exists only in the post-Soviet space, which is generally true [5] (available reviews of foreign publications on this topic indicate that geoecology really does not officially stand out as an independent science and is usually considered as the study of multifaceted relationships existing between the substrate (climate, soils, geology, relief, landscape, etc.) and biota [6]). At the same time, they point out that it is incorrect to propose new scientific directions by trying to capture research areas from other, already established scientific directions. The search for truth in approaches to geoecology is conducted by representatives of different scientific schools. Professor V.T. Trofimov, in particular, has been doing this for several decades. Recognizing the noted and other "paradoxes of geoecology" and starting from them, he consistently developed this topic [7]. In its current author's interpretation, the content of the concept of "geoecology" is revealed as an interdisciplinary science that studies the ecological functions of the abiotic spheres of the Earth (ecosystem ecotope), the patterns of their formation and spatio-temporal changes under the influence of modern natural and anthropogenic influences in connection with the life and activity of biota, including humans – (ecosystem biocenosis). At the same time, the object of its study are ecosystems of various hierarchical levels, the ecological functions of their abiotic environments – components of the ecotope formed by natural processes of past epochs and transformed by modern natural and anthropogenic influences that ensure or complicate the functioning of the ecosystem biocenosis.

Despite the noted objective difficulties inherent, including the initial period of its formation ("growth diseases"), the incompleteness of theoretical approaches, as well as the rigid and largely fair position of opponents, geoecology is officially recognized as a scientific direction in the group of scientific specialties "Earth and Environmental Sciences". Passport of scientific specialty 1.6.21. "Geoecology", corrected and approved recently https://vak.minobrnauki.gov.ru/searching#tab=_tab:materials ~. The multidimensional nature of geoecology is preserved in it and is illustrated in particular by the fact of listing fifteen related scientific specialties. At the same time, the new edition of the passport is built more harmoniously and logically. For example, it abolished the differentiation of research areas within geoecology by industry, although the range of research areas included in geoecology still remains unreasonably wide and heterogeneous. It should be noted that the research areas include such a direction as "scientific justification of state regulation (standardization) in the field of geoecological aspects of environmental management, as well as the scientific foundations of state geoecological expertise and control". This circumstance underlines the relevance of the issue we are investigating.

With regard to the considered aspect of rationing the creation of energy facilities, other areas of development are also significant, such as:

- scientific foundations of rational use and protection of water, air, land and energy resources;
- geoecological aspects of sustainable development of regions, functioning of natural and technical systems with optimization of interaction of natural and man-made subsystems;
- theory, methodology and methods of complex ES for geoecological characteristics of

the natural and man-made environment;

- mechanisms and patterns of development of dangerous natural, natural-man-made and man-made processes, predictive assessment of the danger and risk of their manifestation with appropriate engineering protection of territories, buildings and structures;
- geoecological aspects of water management design (the impact of hydraulic engineering, justification of the choice of location for the construction of reservoirs and reducing their negative impact on aquatic ecosystems);
- scientific foundations of the organization of geoecological monitoring of natural and technical systems and ensuring their environmental safety, development of environmental monitoring tools.
- modeling of geoecological processes and consequences of economic activity (mapping, GIS technologies and information systems in geoecology);
- resource conservation, rehabilitation and recultivation of land, disposal of production and consumption waste, including those resulting from the processing of minerals, construction, economic activity and operation of housing and communal complex, as well as geoecological justification for the safe placement, storage and disposal of toxic, radioactive and other waste;
- scientific and methodological foundations and principles of geoecological education.

Accordingly, there are a number of dissertation councils in the country that consider dissertations for the degree of doctor or candidate of sciences in the scientific specialty 1.6.21. "Geoecology". The niche of geoecology is also indicated in the segment of fundamental (academic) science. This is mainly due to the organization in 1996 of the Institute of Geoecology of the Russian Academy of Sciences, https://www.geoenv.ru/ru /. A number of universities (Moscow, Voronezh and other cities) have organized training in this discipline (see also below).

In the context we are investigating, it is important to understand that the establishment of state standards and other norms is an integral element of public administration. At the same time, it was found out that geoecology is not taken into account as a type of economic activity in the classification system of such types, https://www.consultant.ru/document/cons_doc_LAW_163320 /?ysclid=lda4w8owuy465949133. There is also no basic (special) legislative act regulating geoecological relations.

In the situation described above, it can be assumed (as a working hypothesis) that the system of state "geoecological" rationing as a derivative of the system of legal regulation is not perfect, especially in terms of creating energy facilities that are extremely potentially dangerous from the point of view of impact on the natural environment. The purpose of the study in this regard was to illustrate the national features of the geoecological aspect of rationing when creating energy facilities. Tasks facing the work: identification of the designated features (primarily in relation to technical (construction) rationing systems) with an appropriate overview of the situation in the field of environmental rationing and in the field of standardization of higher professional education, as well as the formulation of recommendations for the elimination of identified defects.

2 Materials and Methods

Based on a review of selected literature sources and existing standardization documents, an assessment of the state of affairs in the field of "geoecological" rationing in relation to the creation of the main types of energy facilities is given. For this purpose, a selection of subject codes of rules was carried out with an assessment of their compliance with individual requirements of federal legislation and with an overall assessment of their quality level. A preliminary assessment of the effectiveness of environmental regulation in this area,

standardization in the field of labor relations and in the field of higher professional education is also given. According to the results of the assessment, appropriate recommendations are given to improve the standardization and standardization in the field under consideration. The formulation of the issue under study is fundamentally new, and the relevance of the study is related to the need to take into account the recommendations given to improve the efficiency of standardization and standardization in the field under consideration.

3 Results and Discussion

According to official reporting data (www.so-ups.ru) in September 2022, electricity production by power plants in Russia amounted to 84,592.8 million kWh. At the same time, the main share remains with thermal power plants (TPPs) – 45,488.1 million kWh. This is followed by the production volumes of hydroelectric power plants (HPPs), including hydro–accumulating HPPs - a total of 14,512.9 million kWh and nuclear power plants (NPP) – 18,418.3 million kWh. Renewable energy sources (geothermal, solar, wind, etc.) continue to be used insufficiently (about 0.2% of the total output).

Together with thermal power plants, large boiler houses act as energy sources in the centralized heat supply system, which together with thermal power plants produce more than 90% of thermal energy. In addition to natural gas, coal (23.9%), fuel oil (3%) and peat (0.1%) continue to be used as fuel for thermal power plants. Along with the use of a renewable source of electric energy (99% of generation in the country), hydropower provides: water supply, irrigation, protection of objects nearby to reservoirs from flooding, navigation. Nuclear power has a full range of technological processes (extraction, processing and enrichment of uranium ore, fuel production, construction of power units, processing and disposal of used nuclear fuel). From a geoecological point of view, the role of fuel energy as a branch of heavy industry engaged in the extraction, enrichment, processing and consumption of oil, gas, coal, peat and shale for their further consumption is important. In a broad sense, such facilities also refer to energy facilities.

In each of the activities, energy facilities have a technogenic effect on all elements of the natural environment (geo-shells). Such an influence is exerted on the atmosphere by means of harmful emissions, on the hydrosphere by discharges of polluted effluents. The impact on the lithosphere is associated with disturbance of landscapes, flooding of lands, processing of reservoir shores (hydroelectric power plants themselves, unlike reservoirs, affect the environment significantly less), storage of ash and slag waste with land withdrawal, etc. In addition, noise, thermal and electromagnetic pollution of the natural environment occurs. As a result of the activities of nuclear power plants (especially in emergency situations), an increase in the radioactive background of the natural environment may be observed.

In general, the greatest negative impact of energy occurs through the atmosphere, where a significant amount of pollutants that can spread over long distances and settle on water surfaces, soils and soils gets into. However, it is extremely important to understand the mechanisms of mutual influence of energy and geoecology. Such systemic studies in the ontological context have been carried out and reflected, for example, in [8]. It shows that anthropogenic factors created by the production process of the energy industry have a direct impact on the natural environment. This process includes several stages (extraction, transportation, fuel processing, its conversion into energy, energy transportation), the result of which are the main energy products with complex interrelations of the stages of fuel extraction and its transformation.

Turning directly to the topic of rationing in the field of geoecology, we note that the norm is usually understood as a legalized establishment, a recognized mandatory procedure, an established measure, an average value. The establishment of norms regarding the considered town-planning relations for the creation of energy facilities and relations arising in the field

of protection and rational use of natural resources is carried out at the state level. The main document regulating technical regulation in the construction industry is Federal Law No. 384-FL of December 30, 2009 "Technical Regulations on the Safety of Buildings and Structures" (further - 384-FL), and the Ministry of Construction of Russia (Ministry of Construction) is the authorized agency for this. At the same time, safety is ensured by complying with the requirements of 384-FL, which are detailed in the standards (further - GOST) and Codes of Practice (CP). In turn, documents of these formats are included in the Lists of regulatory and technical documents (further - RTDs), as a result of which compliance with the requirements of 384-FL is ensured, respectively, on a mandatory or voluntary basis. Moreover, the share of mandatory RTDs is steadily growing, and will obviously tend to zero, which is fundamentally different from the situation with the mandatory application of environmental and sanitary-epidemiological standards.

The totality of federal laws related to the safety of buildings and structures, regulatory legal acts approved in their development, including sanitary norms and rules, and numerous RTDs is a complex system of legal and technical requirements, and insufficiently effective. In this regard, the Ministry of Construction proposes measures to improve this system, starting with the adjustment of the legal framework, https://www.minstroyrf.gov.ru/press/minstroy-rossii-prorabatyvaet-sozdanie-edinogo-perechnya-normativnykh-dokumentov-v-stroitelstve/.

The main format of the RTD in terms of requirements for the creation of construction facilities (evidence base 348-FL) continues to be a joint venture. Both in the current Register of joint Ventures (maintained by the Ministry of Construction subordinate institution) and in the new structure proposed by the Ministry of Construction, there is no special section on energy facilities, and individual subject joint ventures are included in various subsections. The main (special, basic) ones are highlighted below Joint venture for the design of significant energy facilities with their consideration from the standpoint of geoecology.

The basic CP 90.13330.2012 "Thermal power plants" establishes norms and rules for the design and reconstruction of large thermal power plants using organic fuels with steam turbine and gas turbine units. Separate requirements of a geoecological nature (in terms of environmental protection, engineering protection, etc.) are contained in the sections of CP 90 concerning the placement of thermal power plants, the design of water supply systems, ash removal. These requirements, as a rule, are generalized (an indication of the need to take into account environmental and environmental standards and requirements), while there are requirements for performing engineering surveys (ES) (with the exception of requirements for the planning stage of the territory). When developing some sections of TPP projects, it is necessary to take into account other joint ventures (for example, joint ventures for boiler installations, joint ventures for heating networks, etc.), as well as the requirements of the relevant GOST.

Special CP 58.13330.2019 "Hydraulic structures. In contrast to CP 90, in addition to general instructions, it contains a special subsection "Environmental protection" with a fairly complete disclosure of the relevant requirements (studying the initial state of the natural environment, making forecasts of its changes, establishing an acceptable level of anthropogenic interference, developing protective measures, as well as methods of monitoring the condition during the operation of structures and reservoirs, etc.). It is pointed out that it is necessary to take into account changes in natural conditions that can lead to the development and activation of a number of negative physico-geological, geodynamic processes, including, for example, processing of reservoir shores. However, specific technical requirements are not given (they are partially contained in regulatory and methodological documents of an industry nature, see below). Technical regulation of the creation of reservoirs in general, in our opinion, needs to be systematized and developed, especially since the legislation provides for the specifics of the composition of the project

documentation prepared for this. They are established by the Decree of the Government of the Russian Federation No. 87 dated 16.02.2008 "On the composition of sections of project documentation and requirements for their content", which also indicates the need to develop a section "Environmental protection measures" (a similar set of requirements is contained in relation to the design of nuclear facilities)

At the same time, it must be remembered that with such deficits of technical requirements, special technical conditions have to be developed for design purposes, which involves additional time and money.

Also, the requirements for the implementation of ES are omitted in CP 58. At the same time, it should be understood that the assessment and forecasting of changes in the natural environment as a result of the creation of hydraulic structures proposed in paragraph 4.29 of CP 58 should be carried out precisely within the framework of ES.

In the relevant parts of the Hydraulic structures (HS) projects, it is necessary to take into account other joint ventures (Joint venture 23 on the grounds for HS, joint venture 39 on the creation of dams from ground materials, joint venture 80 on the creation of river HS, joint venture 101 on the creation of fish-passing and fish-protecting HS, joint venture 102 "Hydraulic tunnels" and some other joint ventures, as well as relevant GOST). As a rule, geoecological requirements are either absent in these documents, or are also summarized.

In the system of state regulation of the creation of nuclear power plants, the emphasis is rightly placed on safety issues. In this regard, the functions of the federal authorized agency (Rosatom State Corporation) have been expanded both in terms of procedures (issuance of building permits, etc.) and in terms of standardization. All this is explained by the high level of responsibility of the objects. However, within the framework of technical construction rationing, there is no special unified document on standardization for the design of nuclear power plants. Therefore, the relevant JV and GOST of a local nature, standards of the Rosatom Corporation of large design organizations (for example, in relation to the creation of certain elements of nuclear power plants), safety standards, technological standards, etc. are used. At the same time, it is significant that a special CP 151.13330.2012 "Engineering surveys for the placement, design and construction of nuclear power plants (in 2 parts)" has been developed, containing a number of geoecological requirements.

It should be noted that the issues of ES implementation in general in the geoecological aspect occupy a special place, ensuring the adoption of rational and safe design and planning decisions [9]. The basic RTD is CP 47.13330.2016 "SNiP 11-02-96 Engineering surveys for construction. The main provisions", and a special one can be considered CP 502.1325800.2021 "Engineering and environmental surveys for construction. General rules of work". Engineering and environmental surveys in their content represent what should be understood by the so-called "geoecological studies". According to V.T. Trofimov, they are aimed at studying all three abiotic spheres of the Earth and the biosphere. In the relevant parts, it is necessary to take into account other CPs (CP 482 for engineering and hydrometeorological surveys, CP 420 for ES in areas of landslide development, CP 438 for ES when planning territories, etc.), as well as the corresponding GOST.

The requirements of the subject CP and GOST follow from the safety legislation and (or) the relevant technical regulations (in addition to FL-384, these are also Federal Laws dated 21.07.2011 No. 256-FL "On the safety of Fuel and Energy Complex Facilities", dated 21.07.1997 No. 117-FL "On the safety of Hydraulic structures", dated 21.07.1997 No. 116-Federal Law "On Industrial Safety of Hazardous Production Facilities", dated 09.01.1996 No. 3-FL "On Radiation safety of the population", etc.).

A separate problem is the lack of technical regulations on planning safety, which to a certain extent explains the gaps and other defects of the considered joint venture and GOST in terms of the requirements concerning decision-making at the level of urban planning (territorial planning and territory planning) [10]. Requirements of this nature (placement of

objects, etc.) in the considered joint ventures are either omitted (for example, Joint Venture 90), or do not fully comply with the Urban Planning Code of the Russian Federation, although, for example, in the same Joint venture 58, it is rightly noted that "the solution of environmental issues should begin at the earliest stages of the design of the object." In this situation, for the development of environmental protection measures (for example, they are part of the materials for the justification of the territory planning project), first of all, the requirements and recommendations of the "planning" RTDs should be taken into account, first of all, the main one of them is CP 42.13330.2016. "Urban planning. Planning and development of urban and rural settlements" (special section on environmental protection, sections on energy supply, engineering training and protection of the territory, etc. with separate recommendations of a geoecological nature). It is also advisable to take into account the relevant requirements of CP 18 (design of "master plans" of industrial enterprises), as well as CP 348 (industrial parks and industrial clusters), which also provide separate substantive recommendations.

A number of the considered RTDs contain requirements for the implementation of control and monitoring in areas related to geoecology. For example, CP 78 indicates the need to provide for constant instrumental and visual monitoring of the condition of the hydraulic structure and the enclosing rock mass, for natural and man-made impacts on them, as well as requirements for the development of an environmental monitoring program and industrial environmental control. In this and other similar cases, in our opinion, it is also advisable to be guided by CP 305, which normalizes the conduct of geotechnical monitoring.

The results of the performed analysis in relation to the main CP concerning the geoecological aspects of the creation of energy facilities are summarized in Table 1

Table 1. The results of the analysis of the main documents considered on standardization in terms of environmental requirements for the creation of energy facilities.

№	Regulatory and technical document	Completeness of subject ("geoecological") requirements/availability of a special section	Requirements for the implementation of engineering and environmental surveys	The possibility of using the document for the purposes under consideration		Directions for improving the document
				At the planning level	At the local level	
1	CP 90	Insufficient /missing	None (contains requirements for performing engineering surveys in general)	Limited	Limited (possible only in universal order)	Changes and additions based on a systematic scientific approach (see for example [11]), an addition in terms of taking into account planning aspects in accordance with the norms of urban

№	Regulatory and technical document	Completeness of subject ("geoecological") requirements/availability of a special section	Requirements for the implementation of engineering and environmental surveys	The possibility of using the document for the purposes under consideration		Directions for improving the document
				At the planning level	At the local level	
						planning legislation [10]
2	CP 58	Available (general requirements) /missing	Missing	Limited	Limited (possible only in universal order)	Addition of specific requirements of a geoecological nature (including for the creation of reservoirs), as well as requirements for the placement of objects in accordance with the norms of urban planning legislation[10]
3	CP 42	Available (general requirements) /available in the sections "Engineering training and protection of the territory" and "Environmental protection" (with numerous references to relevant sanitary and environmental standards, as well as state standards)	Missing	Have	Limited	In general, the document has exhausted the potential of its further development [10]

As for the creation of NPP facilities (they are not considered in Table 1), we consider it appropriate to create a special document on standardization in terms of design in the format of a set of rules with adequate inclusion of geoecological requirements in it (for the transition period, the format of the preliminary national standard provided for by Federal Law No. 162 of 29.06.2015-"On Standardization in Of the Russian Federation"). Ideally, such a document, in particular, should exclude the vicious practice of placing NPP sites in areas of intensive development of hazardous geological processes [12].

Many technological design standards (STP), usually approved at the industry level and

mostly in need of updating, are also focused on legal requirements for safety. Unfortunately, the system of technological design during the years of political perestroika and the economic crisis was essentially destroyed, therefore, individual subject-specific STPs require serious revision (for example, the STPs of thermal power plants were approved back in 1981). Appropriate technological regulations for operation are also adopted (for example, for nuclear power plants).

Regulation in the field of environmental protection is carried out in accordance with Chapter 5 of Federal Law No. 7-FL of 10.01.2002 "On Environmental Protection". It includes the development and application of a series of standards: environmental quality, permissible physical and other impacts on it, permissible and temporarily permitted emissions and discharges, technological standards and technical standards, standards for the generation of production and consumption waste, permissible anthropogenic load, permissible removal of components of the natural environment and other standards in the field of environmental protection including regulatory documents, federal norms and rules in this area. The main document justifying the environmental safety of the construction of the energy facilities under consideration at the planning stages is the environmental impact assessment materials (environmental impact assessment, EIA). As part of such materials, proposals for the implementation of environmental protection measures and engineering solutions for environmental protection should be justified [13, etc.]. The legislation also establishes the adoption of norms on the best available technologies, comprehensive environmental permits, environmental certification and licensing of certain types of activities and on the declaration of environmental impact.

According to the figurative expression of leading lawyers, environmental rationing literally "permeates" all spheres of activity. At the same time, it is obvious that the isolation of the geoecological component in it is the subject of a separate study. At the same time, one cannot but agree that in the current political and economic situation, the risk of foreign regulatory expansion in general in environmental regulation increases sharply [14]. In our opinion, this circumstance should also be taken into account when developing a rationing system in the field of environmental protection and in particular in its geoecological segment.

If we touch upon standardization in the field of higher professional education, then, in one way or another, the problems noted above were reflected in it (the lack of special legal regulation, the consolidation of geoecology as an activity, the blurring of its subject as a scientific direction, etc.). Therefore, contrary to the established requirements, training in this discipline (see above) is carried out in the absence of special professional standards and relevant federal educational standards in geoecology. At the same time, as is well known, federal educational standards should be based on the requirements of professional standards [11] (it is also significant that the draft of such an educational standard was developed back in 1999, but was never approved).

4 Conclusions

The conducted analytical review revealed a number of defects in the national system of "geoecological rationing" on the example of the creation of energy facilities. In many ways, they are connected with the imperfection of public administration in this area (insufficient scientific validity of "geoecology", vagueness of identification of geoecology as a type of economic activity, intersection with "ecology", etc., activities and sciences, corresponding duplication and gaps (ontology of terms, etc.) in the field of legal regulation of geoecological relations).

The main RTDs in the field of creating energy facilities do not contain the completeness and specificity of the subject ("geoecological") requirements and special sections about it. They also do not include requirements for the results of engineering and environmental

surveys as a key type of AI that ensures the adoption of an effective geoecological decision. The RTD data demonstrate disregard for modern norms of urban planning legislation (the above-discussed CP 42 on the scope of application in this case is not substantive). Thus, the possibility of using the considered joint ventures for geoecological purposes is limited, and at the planning level is essentially absent. The situation is somewhat better in the field of standardization of ES execution. A special document in this regard is CP 502. on engineering and environmental surveys.

The trend of departmental standardization in the creation of nuclear power plants does not correspond to the strategic line to strengthen the role of the Ministry of Construction of Russia in this area (see the Decree of the Government of the Russian Federation dated 31.10.2022 N 3268-r "On approval of the Strategy for the development of the construction industry and housing and communal services of the Russian Federation for the period up to 2030 with a forecast up to 2035"). In addition, this increases the risks of leveling the disclosure of the geoecological aspect in the composition of industry standardization documents.

The situation is almost mirrored in the field of standardization of higher professional education, which requires the consistent creation of a professional standard and a federal educational standard for geoecology.

At the same time, at the beginning it is advisable to put an end to the disputes about the legitimacy of "geoecology" and its subject content as a science and as a type of economic activity. For these purposes, it is advisable to include relevant topics in the plans of both fundamental scientific research of the Russian Academy of Sciences (see above about the Institute of Geoecology of this Academy) and the Russian Academy of Architecture and Construction Sciences), and in the plans of applied scientific research (Ministry of Construction and other departments) of research. According to the results of the latter, appropriate changes and additions should be made to the structure and composition of the RTD in terms of geoecological justification for the creation of energy and other capital construction facilities.

The topic of environmental regulation also requires a separate scientific study, given its actualization in connection with the increasing risk of foreign regulatory expansion.

References

1. C. Troll, et al., Colloquium geogr **9** (1968)
2. I. E. Timashev, News of the Russian Geographical Society **143(1)**, 28-33 (2011)
3. L.L. Rozanov, Scientific dialogue **2(38)**, 21—40 (2015)
4. V.T. Trofimov, Bulletin of the Moscow University (Series 4: Geology) **4**, 3-13 (2009)
5. M.I. Bogdanov, Engineering geology **1**, 14-20 (2014)
6. N. Rajakaruna, R.S. Boyd, *Geoecology. Oxford Bibliographies in Ecology. Ed. David Gibson* (Oxford University Press, New York, 2014)
7. V.T. Trofimov, Bulletin of the Moscow University. (Series 4: Geology) **1(5)**, 3-12 (2021)
8. L.V. Massel, et al., Design Ontology **4(30)**, 550-561 (2018)
9. V.L. Belyaev, Ecology of urbanized territories **4**, 40-46 (2021)
10. V.L. Belyaev, Ecology of urbanized territories **2**, 67-73 (2022)
11. V.L. Shulman, Electric stations **5**, 29-34 (2006)
12. N.V. Tchaikovskay, et al., Mechanical engineering and life safety **3(17)**, 27-36 (2013)
13. F.F. Bryukhan, Moscow Economic Journal **8**, 134-137 (2020)

14. N.G. Zhavoronkova, Yu.G. Shpakovsky, Lex russica **74(6)**, 56–67 (2021)