On the system of key indicators for monitoring the compliance with requirements of the Russia's Energy Security Doctrine in terms of reliable fuel and energy supply to domestic consumers of energy resources

Sergey Senderov^{1, 2,*}, Viktor Rabchuk¹

¹Melentiev Energy Systems Institute of Siberian Branch of the Russian Academy of Sciences, 130 Lermontov str., Irkutsk, Russia

²Federal State Budget Educational Institution of Higher Education «Irkutsk National Research Technical University», 83 Lermontov str., Irkutsk, Russia

Abstract. The paper is devoted to the problem of forming a system of indicators for monitoring the fulfilment of the requirements of the Russian Energy Security Doctrine, approved by the President of the Russian Federation in 2019, in terms of ensuring reliable fuel and power supply to energy consumers within the country. The main threats to energy security are described from the standpoint of ensuring the reliability of fuel and power supply to the regions of Russia and the country as a whole. Relevant indicators of federal and regional review levels are presented.

1 Introduction

Presidential Decree No. 216 of May 13, 2019 approved the text of the new Doctrine of the Energy Security of the Russian Federation (hereinafter referred to as the Doctrine) [1]. On November 29, 2018, a meeting of the Security Council of the Russian Federation was held, where the draft of this Doctrine was considered. At this meeting, the President of Russia noted that “unique reserves of all key energy sources today give us the opportunity to completely close domestic needs for energy resources, and impressive exports - including to the countries of the European Union, the Asia-Pacific region, the CIS - brings Russia not only tangible incomes but also allows it to be one of the main guarantors of world energy security” [2]. These words are certainly true today. At the same time, without taking radical decisions to overcome some of the negative trends in the energy security (ES) of the country and its regions, there are certain concerns about this role of Russia already for the medium term.

The new Doctrine was approved instead of the 2012 Doctrine [3]. In the 2012 Doctrine and in the relevant supporting materials [4, 5, etc.], significant problems in ensuring the ES of the country and its regions have already been noted. It was shown that the share of hard-to-recover reserves of natural gas and oil is growing; The wear and tear of the basic production assets of the fuel and energy complex (FEC) is unacceptably high, the pace of their renewal is low; the technical resource of a significant proportion of energy utilities, oil refining, electrical and heat generating equipment ends; The level of scientific and technical development in the Russian

FEC remains low. These problems are directly related to the increase in the frequency of emergency situations in the fuel and energy systems of the country and some regions. There are no major achievements in the field of energy conservation. Regional asymmetry is observed in the provision of the constituent entities of the Russian Federation with their own primary energy resources. The imperfection of pricing and tax policies persists, and the problems of efficiency and transparency of the activities of the fuel and energy complex organizations remain unresolved, all of which lead to a significant increase in energy prices for end users.

2 Energy Security Threats Analysis

In 2012 Doctrine, threats to energy security by the nature of occurrence and action were divided into internal (economic, socio-political, technological, natural) and external (foreign economic and foreign policy). The internal economic threats included: insufficient investment in the fuel and energy industries to upgrade production capacity, which in conditions of high equipment wear and its low technical level can lead to uncompensated retirement of production capacity of energy production facilities; the deterioration of the resource base of the fuel and energy sector and nuclear energy; the lack of the necessary diversification of the structure of the fuel and energy balance of the regions and the country as a whole; the shortage of energy resources and the breakdown of energy supply in some regions of Russia (the Far East and the Far North regions); high growth rates of prices (tariffs) for energy resources; high energy intensity of products; poor

* Corresponding author: ssm@isem.irk.ru

geological knowledge of the resources of the continental shelf of the Russian Federation; insufficient depth of hydrocarbon processing. Technogenic threats were directly related to economic ones: an increase in the share of obsolete and physically worn-out equipment in the fuel and energy complex due to insufficient investment; reduction of the technical level of energy facilities due to insufficient funding of research, development and technological works and poor implementation of their results; lack of highly qualified personnel, including in connection with the reduction in the training of specialists for the fuel and energy sector, while increasing the need for them; increasing the vulnerability of fuel and energy facilities associated with the complexity of systems and algorithms for managing these facilities.

Considerable attention was paid to the strategic threat of a high investment risk of developing gas fields in the Russian West Arctic Zone. In [6–8], it is shown that in the long term, with the rising cost of natural gas production in new hard-to-reach areas, the main volumes of Russian gas destined for export can be delivered to European markets with a cost price that is close to or even greater than the prices established by this time on gas. There may be a question about the effectiveness of such exports. But the question of refusing to export Russian gas in this situation is extremely complex: can a country without these foreign exchange earnings invest in the development of gas fields in the Western Arctic zone? But it is necessary to develop these new fields, because currently operating gas fields operate in a mode of falling production. At the same time, the share of gas in the balance of boiler-furnace fuel in the country exceeds 72%, and in a significant number of regions in the European part of Russia, this share is close to 90% and above.

3 The groups of the indicative analysis in the ES Doctrine 2012

In order to form a monitoring system for the main indicators of ensuring energy security requirements in terms of reliable fuel and power supply to consumers in the Doctrine 2012, among others, were formulated the relevant groups of indicative analysis. First of all, it is:

- the ratio of the increase in the balance reserves of primary fuel and energy resources to the volumes of their production;
- the share of natural gas in the structure of the balance of primary fuel and energy resources;
- the level of internal prices for gas, petroleum products, coal and electricity (capacity);
- the volume of non-payments in the retail and wholesale electricity markets;
- the pace of implementation of investment programs by fuel and energy companies;
- relative decrease in the specific energy intensity of the gross domestic product;
- stability of end-user energy supply (including regional level);
- the level of physical deterioration of basic production assets for the fuel and energy sector and related industries;
- number of emergencies at fuel and energy facilities.

To analyze the situation for each of these groups, in terms of ensuring the energy security of the country, in due time a corresponding list of ES indicators was formulated. These indicators were divided into relevant groups, a system for forming an integral indicative assessment of the condition of each group from the standpoint of ensuring the requirements of the ES was created and the same system for forming the integral assessment of the ES in the country as a whole. The results of this work and the methodology itself are quite clearly shown in [9].

The analysis showed that the identified negative trends that form an insufficient level of provision of the ES of Russia and its regions are fairly stable. The result of the implementation of these trends in recent years has been either the stagnation of the situation on most problems, or its aggravation. Accordingly, the main problem points indicated in the text of the previous Doctrine are reflected in the text of the Doctrine approved in 2019.

4 ES threats and the groups of indicative analysis in terms of ensuring the reliability of fuel and power supply in ES Doctrine 2019.

Considerable attention in the new Doctrine is paid to foreign economic and foreign policy threats to Russia's energy security. This is an important component of the problem of ES ensuring, but in this article we will dwell in greater detail on internal threats of a different nature, the implementation of which is directly related to the issues of reliable fuel and power supply to consumers within the country. From the positions indicated here among the most important internal threats presented in the new Doctrine, it makes sense to consider the following:

- mismatch of fuel and energy facilities with the needs of the socio-economic development of the Russian Federation (energy shortage or excess energy and energy infrastructure);
- reduction in the quality of the mineral resource base of the fuel and energy complex (depletion of existing deposits, reduction in size and decrease in the quality of the discovered deposits);
- insufficient supply of FEC organizations with labor resources, especially highly qualified personnel.

The new Doctrine is not explicitly stated, but among the most important ES threats is the impressive depreciation of the main production assets of the FEC.

In addition to these internal threats, the so-called cross-border threats are also considered in the new Doctrine. From the standpoint of reliability of fuel and power supply, in their list the most actual are:

- terrorist and sabotage activities that damage infrastructure and fuel and energy facilities;
- illegal use of information and communication technologies, including implementation of computer attacks on information infrastructure facilities and communication networks used to organize their interaction, which could lead to disruptions in the functioning of infrastructure and fuel and energy facilities;
- adverse and dangerous natural phenomena, environmental changes that lead to disruption of normal functioning and destruction of the FEC infrastructure and facilities.

The new Doctrine states that, in general, the realization of these threats may lead to the following negative consequences (including other):

- disruption of the normal functioning of organizations, including FEC organizations and branches of the economy of the Russian Federation;
- a rise in prices (tariffs) for FEC products and energy services;
- decrease in financial stability and termination of activity of FEC organizations.

In addition to the negative consequences indicated in the Doctrine, the slowdown of the specific energy intensity of the economy can also be expressed, as well as the lag of the vocational education system from the existing and future needs of the fuel and energy complex in qualified personnel with a corresponding increase in the threat of imperfect control of the functioning and development of the energy industries.

Based on the analysis of the main threats and their potential consequences for ensuring the energy security of the country and its regions, the Doctrine declares that the regulatory level of the ES should be ensured by the achievement of an acceptable situation in the following analysis groups:

1. Reproduction of the mineral resource base of the FEC.
2. Reliability and sustainability of the provision of Russian consumers with standard-quality energy resources and energy services.
3. The formation of a stock of products of FEC organizations in the state material reserve and maintaining it at the required level.
4. Ensuring the technical accessibility of the FEC infrastructure to various groups of consumers and the possibility of providing them with energy services.
5. Price (tariffs) regulation for the products of FEC organizations and energy services.
6. Investment activities in the field of energy, protection of investors' rights, control over foreign investments in Russian FEC organizations, which are of strategic importance for the defense and security of the country.

7. The implementation of antitrust regulation and the development of competition, including the development of organized (exchange) trade in products of FEC organizations.
8. Ensure energy saving and energy efficiency.
9. Ensuring antiterrorist security and safety of FEC infrastructure and facilities, including in emergency situations.
10. Ensuring the security of the critical information infrastructure of FEC facilities.
11. Exporting of products, technologies and services of FEC organizations.
12. Limiting the negative impact on the environment and ensuring the environmental safety of economic activities of FEC organizations.
13. Protection of the population and territories from emergencies at FEC facilities.
14. Applications of Russian technologies, equipment, materials, software in the implementation of investment projects in the FEC industries in the Russian Federation.

5 ES Indicators in terms of reliability of fuel and power supply to consumers for monitoring the requirements of ES Doctrine 2019

Considering that the monitoring of all these analysis groups is important for ensuring the ES of Russia and its regions, at least on the basis that they are highlighted in the text of the Doctrine, we will dwell in more detail on those that are directly related to ensuring the reliability of fuel and power supply to domestic consumers. In our opinion, groups 1, 2, 5, 6, 8 and 9 directly relate to such groups of analysis.

To monitor the situation with ensuring the requirements of the ES of Russia and its regions for the above groups, relevant indicators were formulated. At the same time, it makes sense to evaluate the values of some indicators only at the country level, and the values of others need to be assessed at the regional level. The values of the regional level indicators that signal a negative situation with the reliability of fuel and power supply to consumers in a particular region should be considered and taken into account when assessing the situation with the provision of ES in the country as a whole.

The table below shows the indicators of the federal and regional levels. The values of these indicators should be monitored when analyzing the situation with the state of a country's ES in terms of ensuring reliable fuel and power supply to consumers of final types of energy within the country. These indicators are grouped by the corresponding analysis groups (group numbers correspond to numbers from the above list of groups).

Table. ES indicators by groups of indicative analysis in terms of ensuring reliable fuel and power supply to consumers within the country (group numbers correspond to numbers from the above list of DL analysis groups)

<i>1. Reproduction of the mineral resource base of the FEC</i>	
<i>State level:</i> 1.1s. The ratio of the increase in the balance reserves of oil over a 5-year period to the total volume of oil production in the country for the same period, p.u. 1.2s. The ratio of the increase in the balance reserves of natural gas over a 5-year period to the total volume of natural gas production in the country for the same period, p.u. 1.3s. The ratio of the increase in the balance reserves of coal over a 5-year period to the total volume of coal production in the country for the same period, p.u. 1.4s. The ratio of the increase in the balance reserves of uranium over a 5-year period to the total volume of uranium concentrate production in the country for the same period, p.u.	
<i>2. Reliability and sustainability of the provision of domestic consumers with energy, energy and raw materials of the appropriate volume, range and quality, including the necessary reserve of capacity and reserves</i>	
<i>State level:</i> 2.1s. The share of natural gas in the structure of the balance of primary fuel and energy resources, %.	<i>Regional level:</i> 2.1r. The ratio of the sum of the available capacity of power plants and the capacity of the intersystem connections of the region with its neighbors to the maximum electrical load in its territory, p.u. 2.2r. Relative ability to meet the total demand for boiler and furnace fuel from the internal sources of the region, %. 2.3r. The share of the dominant resource in the total consumption of boiler and furnace fuel in the region, %.
2.2s–2.6s. Relative total undersupply of certain types of fuel and energy resources in the country as a whole for the analyzed year (gas, coal, fuel oil, light oil products as a whole, electricity), %. 2.7s–2.13s. Physical depreciation of basic production assets by FEC branches and related industries (FEC as a whole, the gas industry, the sphere of oil production and transportation, oil refining, the coal industry, electric power industry, power engineering), %.	2.4r. The share of the largest power station in the installed electric power of the region (for the regions electrically isolated and weakly connected with the UES), %. 2.5r–2.9r. Relative total undersupply of certain types of fuel and energy resources in the region for the analyzed year (gas, coal, fuel oil, light oil products as a whole, electricity), %. 2.10r. The level of potential endowment of the region with the furnace and boiler fuel during cold snap in the relevant federal district, %. 2.11r. The level of potential endowment of the regional electrical load during cold snap in the relevant federal district, %. 2.12r. The level of potential endowment of the region with thermal energy during cold snap in the relevant federal district, %. 2.13r. The risk of shortage of the main types of fuel and energy resources of the region during the implementation of natural emergencies that are typical for this region, %. 2.14r. The level of relative undersupply of the main types of fuel and energy resources in the region during emergency situations at critical energy facilities in the region or technologically related to it, %. 2.15r. The degree of depreciation of the basic production assets of the energy sector of the region, %. 2.16r. The ratio of the average annual input of installed capacity and the reconstruction of power plants in the region over the last 5-year period to the installed capacity of the region, p.u.
<i>5. The establishment of a predictable, diversified, depending on the quality of the goods or services and acceptable to producers and all groups of consumers of the level of tariffs and prices for energy resources, energy and energy services</i>	
<i>State level:</i> 5.1s.–5.6s. The relative growth of domestic prices for the main types of fuel and energy resources (gas, coal, fuel oil, light oil products in general, electricity, heat energy), %.	<i>Regional level:</i> 5.1r.–5.6r. The relative growth of prices in the region for the main types of fuel and energy resources (gas, coal, fuel oil, light oil products in general, electricity, heat energy), %.
<i>6. Investment activities, protection of the rights of investors in FEC, control over foreign investments in fuel and energy companies of strategic importance to ensure the defense and security of the state</i>	
<i>State level:</i> 6.1s. The ratio of the amount of non-payments to sales organizations (for the country as a whole) by retail consumers of electricity for electricity supplied to them (consumers) in the current year to the total sales value of all electricity supplied to retail consumers in the same year related to the same indicator for the previous year, p.u. 6.2s. The ratio of the amount of non-payments to electricity generating companies (for the country as a whole) by grid companies for electricity supplied to grid companies in the current year to the total wholesale cost of all electricity supplied by electricity generating companies to grid companies in the same year related to the same indicator for the previous year, p.u. 6.3s. The ratio of the amount of non-payment to grid companies (for the country as a whole) by the sales organizations for the electricity supplied to these organizations in the current year to the total cost of all electricity supplied by the grid companies to organizations in the same year related to the same indicator for the previous year, p.u. 6.4s. – 6.8s. Implementation of investment programs by the FEC sectors (oil production and transportation, oil refining, gas industry, coal industry, electric power industry), p.u.	
<i>8. Energy saving and energy efficiency of technologies, equipment and materials used in the FEC sectors and at energy facilities of consumers</i>	
<i>State level:</i> 8.1s. The relative change in the specific energy of gross domestic product, %.	<i>Regional level:</i> 8.1r. The relative change in the specific energy of gross regional product, %.
<i>9. Ensuring antiterrorist security and safety of FEC infrastructure and facilities, including in emergency situations</i>	

State level:

9.1_s. The ratio of the number of acts of terrorism at the Russia's FEC facilities in the current year to the number of such acts in the previous year, p.u.

9.2_s. The ratio of the number of emergencies in the Russia's FEC in the current year to the same value in the previous year, p.u.

It can be noted that in some groups of indicative analysis (in this table) the list of indicators is not complete. This applies mainly to group 6 in terms of ensuring the protection of investors' rights, controlling foreign investments in Russia's FEC organizations, which are of strategic importance for the defense and security of the state. There is a feeling that the indicators of this orientation are not directly related to the process of reliable, uninterrupted fuel and power supply to consumers, affecting this process indirectly. Such indicators in the general system of indicative analysis in accordance with the provisions of the new Doctrine, apparently, should be brought in by the specialized organizations dealing with these issues professionally.

The values of all indicators listed in this table except for indicators 2.10_r - 2.14_r should be calculated on the basis of official statistical information. The values of indicators 2.10_r - 2.14_r are calculated using specialized mathematical models that take into account all the technological aspects of the operation of energy systems that are related to the reliability of the fuel and power supply to consumers in various conditions. In addition, the peculiarities of the interrelated work of these industries in a Russia's FEC should be taken into account. This approach will make it possible to take into account the internal potential (diversification of sources of fuel and energy resources, interchangeability of fuel and energy resources, etc.) of the FEC to minimize the negative effects of the realization of various ES threats. Such a model apparatus, for example, was created and is actively used to study issues of ES in ESI SB RAS [10–13].

The table shows that in group 2, concerning the issues of reliability and sustainability of the processes of fuel and power supply to consumers, most of the regional level indicators are concentrated. These indicators are as close as possible to the fuel and power supply systems of the regions. The values of these indicators together form the ability to assess the situation with the reliability of supplying all types of final energy to consumers in each region. Solving such a problem at the level of consideration of state indicators is impossible because of the too large level of aggregation.

6 Conclusion

In this paper, based on an analysis of the text of the Doctrine of Russia's Energy Security, approved in 2019, an attempt was made to highlight the fundamental indicators to characterize the situation in terms of the technological reliability of the fuel and power supply to energy consumers within the country. Monitoring the values of the indicators of the federal and regional levels formulated for each group of analysis will help to identify the main problem points in the organization of fuel and power supply to consumers in the country and its regions in relevant aspects. Such an approach will

provide an idea of the directions and degree of transformation of existing trends in ensuring the ES of the country and its regions.

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