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ASSESSMENT OF THE LEVEL OF THREATS AND CONSEQUENCES OF THEIR POSSIBLE IMPACT ON THE FUNCTIONING OF THE STATE ENERGY SECURITY SYSTEM
ОЦІНКА РІВНЯ ЗАГРОЗ ТА НАСЛІДКІВ ЇХ МОЖЛИВОГО ВПЛИВУ НА ФУНКЦІОНУВАННЯ СИСТЕМИ ЕНЕРГЕТИЧНОЇ БЕЗПЕКИ ДЕРЖАВИ

Матійчук Л. П. Оцінка рівня загроз та наслідків їх можливого впливу на функціонування системи енергетичної безпеки держави. *Український журнал прикладної економіки та техніки*. 2023. Том 8. № 1. С. 77-83.

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Assessment of potential threats to the energy security of the state based on systematic approach allows management structures of all levels (state, administrative, regional, corporate) to realize the following: 1. to choose the right ways for the development of "statehood", taking into account the guarantee of the principles of energy security at all levels; 2. to take the necessary actions and decisions on the part of the authorities based on the positions of compliance with the principles of energy security; 3. to provide the best possible factors, phenomena and trends that can prevent possible obstacles that, by their nature, in one way or another will complicate the process of implementing state programs, observance of national interests of the state in relation to it; 4. to generate ideas for the implementation of various measures (based on the values of national security) aimed at neutralizing both potential threats and those already being implemented in relation to the national security system of the state. It should be remembered that assessing possible threats to the state's energy security system involves identifying possible threats and risks, analyzing threats and risks, and assessing existing threats and risks. In general, to ensure the principles of guaranteeing the proper level of efficiency and effectiveness of the policy aimed at ensuring the proper level of functioning of the energy security system, it is necessary, first of all, to carry out an organized and comprehensive assessment of the leading indicators of possible risks. These current and potential threats may hurt it. This is followed by identifying the main ways to neutralize the above risks and threats or the consequences caused by them. It is necessary to implement periodic analytical measures regarding the situation in the national energy security system (including its system-forming facilities) based on a systematic approach with the obligatory identification of several priority measures that should be implemented first in case of any critical situation. Implementation of the assessment of potential risks and threats to the energy security of the state will allow: to predict the possible situation of the state's energy security following different types, levels, and scenarios of possible adverse developments; to carry out a comparative analysis of potential risks and threats in different periods, both in the past and for predicting future ones; to implement a choice of possible scenarios, as well as the future strategy of the state to ensure compliance with the principles of proper functioning of the state's energy security; to ensure the development and implementation.
***Keywords**: threats to the security system, consequences for the security system, energy security system, impact of threats to the security system, assessment of possible risks to the security system.*

Оцінка потенційний загроз енергетичній безпеці держави на засадах системності дозволяє управлінським структурам всіх рівнів (державній, адміністративній, регіональній, корпоративній) реалізувати наступне: 1. Обрати правильні шляхи для розвитку «державності», беручи при цьому в обов'язковому порядку до уваги гарантування засад енергетичної безпеки на всіх рівнях; 2. Приймати необхідні дії та рішення з боку провладних органів, виходячи з позицій дотримання засад забезпечення енергетичної безпеки; 3. Забезпечити найкращим чином усі можливі чинники, явища та тенденції, що зможуть попередити можливі перешкоди, що за своїм змістом в той чи інший спосіб ускладнятимуть процес реалізації державних програм, дотримання національних інтересів держави відносно її системи енергетичної безпеки; 4. Генерувати ідеї щодо реалізації різного роду заходів (на засадах дотримання цінностей національної безпеки), спрямованих на знешкодження як потенційних загроз та тих, що вже реалізуються, відносно системи національної безпеки держави. Слід пам'ятати, що процес оцінки можливих загроз відносно системи енергетичної безпеки держави за своїм змістом передбачає: ідентифікацію можливих загроз та ризиків; аналіз наявності загроз та ризиків; оцінку наявних загроз та ризиків. В цілому ж, з метою забезпечення засад гарантування належного рівня ефективності та результативності політики, спрямованої на забезпечення належного рівня функціонування системи енергетичної безпеки, слід в першу чергу здійснити організоване та всебічне оцінювання основних показників ймовірних ризиків, діючих та потенційних загроз, що можуть здійснювати на неї негативний вплив з наступним визначенням основних шляхів для нейтралізації зазначених вище ризиків та загроз або ж наслідків, що були ними спричинені. Слід на засадах системності реалізувати практику періодичного здійснення аналітичних заходів відносно становища національної системи енергетичної безпеки (в т.ч. окремих її системоутворюючих

об'єктів) з обов'язковим визначенням ряду пріоритетних заходів, що варто реалізовувати в першу чергу у випадку настання різного роду критичної ситуації. Реалізація оцінки потенційних ризиків та загроз енергетичній безпеці держави дозволить: спрогнозувати можливе становище СЕБ у відповідності до різних видів, рівнів та сценарії можливого негативного розвитку подій; здійснювати порівняльний аналіз потенційних ризиків та загроз за різних часових проміжків як минулих періодів, так і для прогнозування майбутніх; реалізувати вибір можливих варіантів розвитку подій, а також майбутньої стратегії держави щодо гарантування дотримання засад належного функціонування СЕБ; забезпечити розробку та реалізацію необхідних заходів для нівелювання ризиків та загроз, що сприятимуть підвищенню до належного рівня СЕБ держави;
Ключові слова: *загрози СЕБ, наслідки для СЕБ, Система енергетичної безпеки, вплив загроз СЕБ, оцінка можливих ризиків для СЕБ.*

Introduction

Thus, the procedure for identifying threats and risks is to identify the possibility of their occurrence and subsequent structuring and assess the possible overall consequences of their negative impact [5].

Further, after identifying possible threats and risks of their occurrence, it is necessary to clearly outline the list of actions and the algorithm for their identity that will maximize their implementation or at least reduce the level of their impact on the state's energy security system and its elements [7].

Many studies have been devoted to the study of energy policy issues at both theoretical and practical levels. Most of them to some extent reveal the main provisions that have already been covered in various scientific documents. Among the researchers in this area, it is worth noting Kupchak V.R., Pavlova O.M., Pavlov K.V., Lagodienko V.R. [7].

Among the scholars who support the idea of consolidating and socializing the defined goals of the state's energy security, we should mention Kupchak V.R., Novosad O.V., Pavlova O.M., Pavlov K.V., Lagodienko V.R. and others [1, 6].

Determination of the purpose and goals of the research

The purpose of this article is to assess the potential threats and possible consequences of their impact on the functioning of the state's energy security system.

Presentation of the main research material

Identification of possible threats and risks includes the following algorithm of action:

1. Clearly define the sources, as well as the established causes of their occurrence;
2. Identification of several events and circumstances that are likely to occur because of threats and risks of their occurrence;
3. Outlining the features of the negative impact that has already occurred, including material damage, moral damage, etc.

The following methodological sequence is usually used to identify threats and risks that pose a danger to the state energy security system:

- evidential method (formed based on critical principles of chronological analysis);
- expert method (identified by specialized experts as a result of analyzing a clear set of systemic issues);
- induction method (inductive thinking) [6].

Possible threats and risks of their occurrence can be identified in the following forms:

- not explicitly expressed signs of fear of probable threats, as well as a public concern;
- public dissatisfaction, which was established and identified based on the results of the assessment of the general policy of implementation in the ESS and its employees;
- identification of trends towards a sharp change in indicators reflecting the results of ESS functioning (Fig. 1).

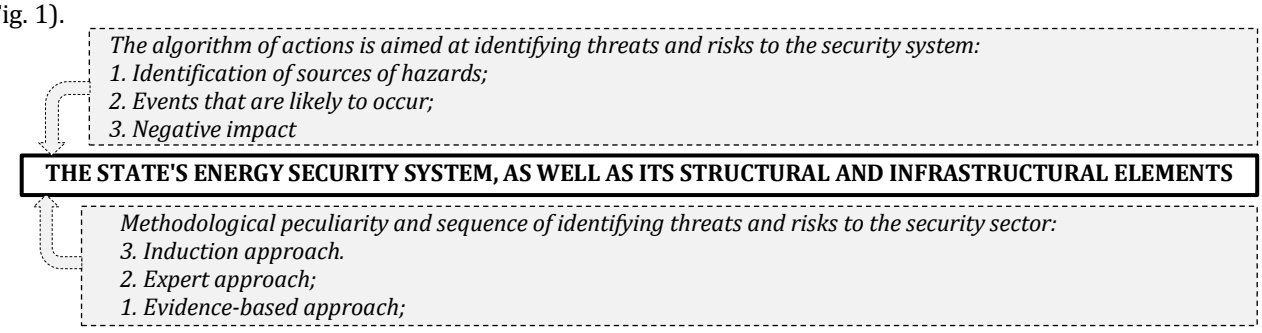

Fig. 1. Peculiarities of identifying risks and threats to the energy security system (ESS), as well as the algorithm and methodological sequence of measures aimed at their identification

After identifying threats and risks using the forms suggested above, they should be clearly and concisely outlined. The source of the threat and the scope of its negative impact on the internal (specific) subsystem of the ESS or specific elements of the ESS should be reflected.

Therefore, it is important to support Sukhodola's opinion that it is desirable to avoid the verbal approach to formulating nouns to describe processes such as "improvement", "strengthening", "reform", etc. in the process of characterizing threats and risks to the ESS. After all, threats and risks are difficult to structure clearly and formulate in terms of their content, as they are usually reflected as vague facts, a kind of hints, which in general do not allow for their easy identification and subsequent elimination [3].

- ESS risks and threats are usually substantially interrelated, as they arise systematically (interdependently);
- ESS risks and threats are mainly characterized by the complexity of their occurrence and impact;
- ESS risks and threats are not perceived in the same way and are not formulated in a specific way;
- risks and threats in terms of the level and significance of their impact on the ESS and in total may vary and change depending on trends in the ESS. Moreover, the standard principles of the ESS functioning (previously perceived as usual) in terms of the external environment may eventually become a source of new risks and threats;
- over time, the level of possible realization and probability of occurrence of threats and risks may also change. Indeed, the probability of some threats is decreasing and others are increasing;
- there may be also problems in assessing the extent of the impact of individual threats. As a result, the assessment of individual threats may not be precise enough.

It should be noted that new threats may be periodically detected and identified, along with possible threats that have already been identified and are already affecting the level of functioning of the ESS. This process is primarily facilitated by the level of danger to the state and its society, a significant level of attention to threats by the population, and the possibility (impossibility) of urgent elimination of threats and potential risks. The main stages of this process include:

1. Identification and perception of the newly identified threat by state institutions, ESS institutions, and, ultimately, society;
2. State institutions, ESS institutions, and society that have identified the risk before the threat occurs or the threat that already affects the ESS, as well as have shown interest and initiative to implement measures aimed at neutralizing them;
3. Generating policies to ensure a high (increased) level of security policy implemented in the ESS [1].

Because security policy resources are usually limited and do not allow eliminating all the identified threats and dangers to the ESS, there is a need to rank threats and risks (conditional allocation of the most significant threats and risks in the negative sense).

Adequately analyzing threats and risks to the energy security system is equally important. The process of analyzing threats and risks to the functioning of the ESS is to determine the level of its vulnerability and its structural and institutional components. It is also essential to analyze the likely consequences of the impact of the current threat or individual risks of its possible occurrence in the presence or complete absence of actions of the energy security system governing bodies aimed at its elimination.

We see the following algorithm of actions and its list for the successful implementation of the analysis of threats and hazards to the state energy security system with the aim of its elimination:

1. What exactly is the cause of concern? (Identification and characteristics of the threat).
2. What exactly affects the stability of the energy security system and its components? (Identification of the factor and its causes).
3. Which objects of the energy security system are most vulnerable to a potential threat to the functioning of the energy security system? (Identify vulnerability points or ESS objects most likely under threat).
4. What are the possible impacts on the ESS from the identified threats and hazards, including the impact on the stability of functioning and the level of potential losses? (Identification of the extent of negative impact on the ESS due to the identified threat) [2].

For example, one of the possible threats to the energy security system is a missile attack by Russia (definition of the threat being realized); on the strategic energy networks of Ukraine (influence factor), resulting in damage or destruction of essential elements – ESS facilities (vulnerability); which causes a forced interruption of the process of energy supply to the state's population in significant volumes (the result of the risk or realization of the threat – consequence).

Thus, the procedure for assessing each of the threats already identified, both for the energy security system as a whole and for its objects, is based on determining the generalized (total) risk of a potential threat and its practical realization by combining the generalized negative consequences as a result of the realization of a particular potential threat, which is a consequence of the overall level of vulnerability of the state's energy security system with the corresponding probability value.

The methodological principles of assessing threats and risks of their occurrence in the energy security system include:

- quantitative principles - allow to calculate the level of ESS vulnerability, the generalized amount of losses from the consequences of threats, and the probability of risks realization; in case the amount of losses incurred is insignificant, either the number of total losses or their probability should be calculated;

- semi-quantitative principles – in their content, they provide various kinds of comparative scales of potential ESS vulnerability;

- qualitative principles – allow outlining the level of ESS vulnerability, as well as the probability and consequences of the practical realization of threats and risks of their occurrence from the viewpoint of significance.

The choice of specific methodological approaches for assessing threats and risks to the energy security system directly depends on the specific situation for implementation and the availability of initial indicators for calculation. In the case when there is a need to implement a full-fledged assessment, the following indicators are analyzed:

- conclusions of professional experts on the subject matter, which are grouped based on already known indicators for the assessment of the absolute value of probability;

- indicators of chronological values; used to identify specific situations, circumstances, and events that have already occurred in the past with the subsequent comparison of the obtained values of the probability of their occurrence in future chronological periods;

- in the case when there is a shortage of indicators of chronological values of indicators, the presence of risks, and the possibility of realization of specific threats, the "probability" should be calculated because of the analysis with the subsequent generalization of existing practical experience and publicly available information on the energy security system and its system-forming facilities.

Nevertheless, it should be outlined that a full assessment of the values of quantitative indicators is usually difficult to implement, in fact, due to the lack of a clearly defined strategy for implementing a mathematical model that combines the values of indicators characterizing risks, the scope of threats to their implementation, the level of vulnerability of ESS elements and objects, as well as the consequences of the direct impact of the above on the ESS.

Given the above, we consider it necessary to compare the calculated values of the indicators of the probability of threats and risks of their occurrence about the indicators of the ESS functioning with the obligatory expert assessments of industry professionals in order to form the values of an independent assessment of the level of the state energy security system, as well as processes and phenomena that periodically arise in the process of its functioning. The practical application of the expert assessment to determine the level of functioning of the energy security system should be in the following cases:

1. The shortage of values of ESS functioning indicators, as well as the significant complexity of the task, do not allow industry experts to collect comprehensively and systematize the information necessary for the study on their own;

2. There are several factors and circumstances that, taken together, can directly affect the process of implementing decisions on leveling possible threats to the state's ESS in the future;

3. The indicators of available statistical information need to be revised, reliable, and biased;

4. Various options are available to prevent or neutralize threats to the ESS.

To summarize, conducting a study involving expert opinion on threats to the state's energy security system and its elements (objects) can significantly increase the specification of results when developing a strategy to prevent possible risks and mitigate existing threats.

Thus, to ensure the systematic, logical and consistent presentation of the material, we have developed and proposed the author's vision of the structures of interdependencies of the energy sectoral areas of the ESS in relation to potential threats, factors of influence, sensitivity and consequences of their impact on the ESS in relation to the seven main threats that, in our opinion, are most likely to occur and can directly affect the state energy system (Fig. 2):

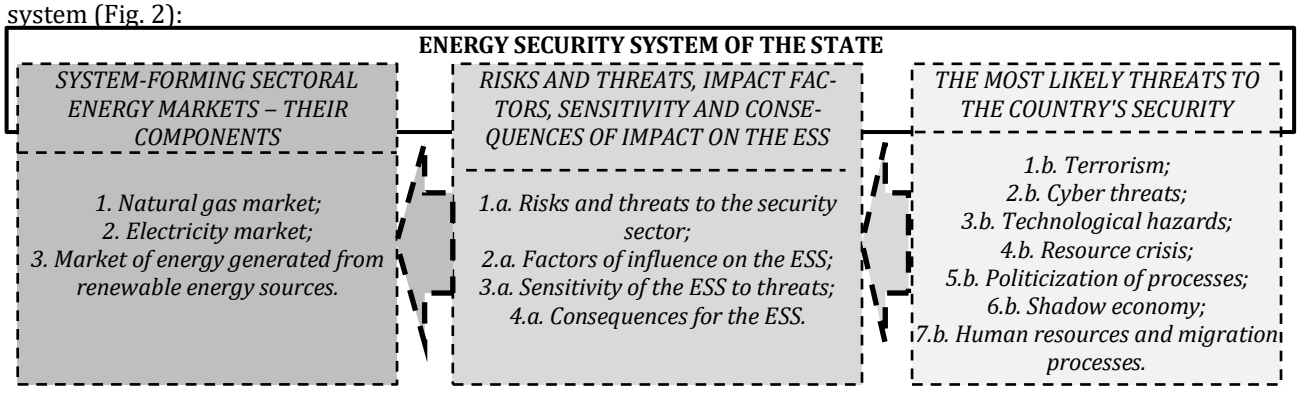

Fig. 2. The structure of interdependencies of the sectoral energy areas of the ESS considering possible threats, components of influence factors, the level of sensitivity of components, as well as consequences for their functioning (in terms of potential risks of occurrence)

First, it is necessary to outline potential risks and threats to the functioning of the state's energy security system based on the approaches mentioned above, with the following sectoral and energy allocation:

1. Gas market;
2. Electricity market;
3. Renewable energy market.

To achieve the most understandable, clear, and objective study on determining the level of vulnerability of the state's ESS in terms of threats, factors of influence, sensitivity, and consequences of potential risks and threats, we decided to structure the analytical material as follows:

1. a. Risks of threats to the functioning of the state's security;

2. a. Component factors of influence on the ESS;

3. a. Sensitivity of the elements and objects of the ESS to internal and external threats to the ESS functioning;

4. a. Consequences for the functioning of the ESS;

... in the context of the seven risks of threats indicated in the figure, which, in our opinion, are the most likely and may affect the state energy security system:

1. b. Terrorist acts committed against the energy security system;

2. b. Danger as a result of cyberattacks against the security of the state;

3. b. Technological hazards that threaten the normal and balanced functioning of the ESS;

4. b. Resource crisis in the functioning of the ESS;

5. b. Politicization processes on the part of the state regarding the strategic capabilities of the ESS;

6. b. Shadowing of economic processes in the structure of the functioning of the ESS;

7. b. Personnel and migration processes within the structure of the ESS contribute to the outflow of highly qualified personnel that ensures its average level of activity.

The following text provides a more detailed description of the problematic features of the gas, electricity, and RES components of the state energy security system:

1. a. Risks of threats to the functioning of the ESS in terms of generation, transportation, and distribution of natural gas, electricity, and energy generated from renewable sources.

1. b. Terrorist attacks; theoretical acts; military operations; military attacks; martial law;

2. b. Cyberattacks;

3. b. The continuous process of degradation of infrastructure facilities in the energy sector; impacts on the environmental situation in the places of energy generation;

4. b. Debt situation; financial and economic crisis in the energy sector; shortage of energy resources; dependence on new technologies and resources; instability of processes in terms of energy supply and consumption;

5. b. Low level of professionalism in the implementation of proper energy policy; state (external) influence on the formation of sectoral energy markets; blocking of energy supplies; stopping of energy transit; blocking of integration measures; pricing of energy resources depending on external factors in the float; unbalanced distribution of revenues among energy market participants; imperfect supervisory measures;

6. b. Imperfect competition in the energy sector; asymmetric information provision by energy market participants;

7. b. Loss of human resources; low level of professionalism in developing strategies and policies for the development of energy markets;

2. a. Composite factors of impact on the ESS in terms of generation, transportation, and distribution of natural gas, electricity, and energy generated from ESS;

1. b. Physical impact (destruction) on energy infrastructure facilities and personnel ensuring their operation; destruction of energy infrastructure facilities and blocking their operation; arson and explosions; armed use; the liquidation of personnel;

2. b. Bot farms that disseminate information aimed at destabilizing the energy sector of the state; malicious and spyware, etc.;

3. b. Insufficient modernization processes at energy infrastructure facilities; lack of a unified approach to the selection of a technical control system and technical policy; theft of energy resources;

4. b. Increase in mutual debt obligations between participants of different energy markets (including sectoral ones), which hinders their servicing; the insufficient volume of energy resources to meet national needs through domestic production and generation; inability to meet the growth in energy demand;

5. b. Not preventing new threats, but dealing with the consequences of existing ones; selective approach to selecting specific (designated) consumers of energy resources on special conditions; selective approach to applying sanctions; backroom dealing; promoting high profits of certain energy market players; unjustified state support; unjustified obstacles to imports; shutting down interconnectors at the will of third parties (states);

6. b. Lack of adequate infrastructure investment support;

7. b. Forced migration processes; higher level of attractiveness of conditions for employment of domestic specialists; insufficient institutional development for professional development and retraining of industry specialists;

3. a. Sensitivity of the elements and facilities of the ESS to internal and external threats to its operation in terms of generation, transportation, and distribution of natural gas, electricity, and energy generated from renewable sources;

1. b. Insufficient physical protection of the energy infrastructure; lack of measures to prevent threats to the energy infrastructure at the design stage;

2. b. Insecurity of interfaces of professional industry equipment; insecurity of software for automation of energy infrastructure management processes, etc.;

3. b. Physical deterioration and technical obsolescence of the energy infrastructure; lack of automation processes; lack of a strategic reserve of energy resources;

4. b. Dependence of internal pricing on external energy quotations; asymmetry of information on the energy market; imperfect balancing of energy resources;

5. b. Insufficient mechanisms for realization of political responsibility for wrong decisions; the constant presence of the energy sector in conditions of incomplete transition from the administrative to the market model of functioning; lack of transparent principles in terms of decision-making; dependence on imports of Russian energy carriers, including natural gas;

6. b. Different and non-transparent operating conditions for gas market participants; market abuse; the existence of "contrived" barriers to entry of new participants in the energy transportation and distribution markets;

7. b. Lack of qualified personnel in the industry; low level of qualification of energy sector personnel; significantly lower salaries of qualified employees compared to neighboring countries; limited career opportunities; internal conflicts within and between energy transportation and distribution institutions;

4. a. Implications for the functioning of the ESS in terms of generation, transportation, and distribution of natural gas, electricity, and energy generated from renewable sources;

1. b. Unstable functioning of the energy sector; insufficient protection of national energy interests; danger to health and life of the population; instability of technological and communication systems; emergency shutdown of infrastructure energy capacities; interruption of energy supply;

2. b. Violation of the principles of confidentiality and secrecy; reduction of the level of availability of electronic information resources; information theft; unauthorized access to the levers of control over remote servers and other computer systems; complete blocking of computer equipment; emergency shutdown of sectoral energy facilities; disruption of existing communication connections; shutdown of energy supply to sectoral infrastructure facilities;

3. b. Low level of efficiency in the use of energy resources; unstable functioning of the energy sector; increased accident rate; interruption of the energy supply process; direct dependence of reliable energy supply to some areas of the state on the availability of acceptable pressure capacity in the energy mains; interruption of the energy supply process;

4. b. Deterioration of the welfare of the industry and the population; increase in social payments; price increases; economic losses;

5. b. Lack of adequate protection of national interests; lack of implementation of a predictable and transparent policy; corruption; low level of trust in management and industry leaders; constant low level of functional efficiency of the energy sector; periodic unprofitability of the energy sector for individual market participants; dependence on energy suppliers;

6. b. Loss of liquidity of sectoral enterprises; increased bankruptcies in the energy sector; tax evasion by gas market participants; unacceptable tariff policy for a specific range of consumers; economic losses; reduced budget revenues;

7. b. Low level of efficiency of the state energy sector; low level of stability of the energy sector; insufficient quality of infrastructure services for energy supply.

Conclusions and prospects for further investigations

In general, summarizing the above, the most significant threats to the energy security system of the state and its components (gas, electricity, and renewable energy) are largely correlated and are as follows. There are elements of degradation of all sectoral energy systems and networks that form them. This phenomenon is primarily caused by the hostilities taking place on the territory of Ukraine. The outflow of professional human resources caused by the war is also worth noting. No less painful for the state's energy security system is the termination of transit through Ukraine, the debt, and economic crises, etc.

In general, in order to ensure the principles of guaranteeing the proper level of efficiency and effectiveness of the policy aimed at ensuring the proper level of functioning of the energy security system, it is necessary to carry out an organized and comprehensive assessment of the leading indicators of potential risks. These current and potential threats may hurt it. This is followed by identifying the main ways to neutralize the above risks and threats or the consequences caused by them.

It is necessary to implement periodic analytical measures regarding the situation in the national energy security system (including its system-forming facilities) based on a systematic approach with

the obligatory identification of several priority measures that should be implemented in case of any critical situation.

Implementation of the assessment of potential risks and threats to the state's energy security will allow:

- to predict the possible situation of the ESS in accordance with different types, levels and scenarios of possible negative developments;

- to carry out a comparative analysis of potential risks and threats in different time periods of both past periods and for forecasting future ones;

- to implement a choice of possible scenarios and the future strategy of the state to ensure compliance with the principles of proper functioning of the ESS;

- to ensure the development and implementation of the necessary measures to mitigate risks and threats that will contribute to the improvement of the state's ESS to the appropriate level.

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