A Study on the Identification of Key Elements Affecting the Efficient Operation of Grid Business under the New Power System

Lifeng Liu[1,a], Liyu Xia[2,b], Jin Liu[2,c], Jianfei Lu[2,d], Lanjun Xu[2,e],Jingyu Yang[3,f*]

{595052787@qq.com[a], xialiyu@sgeri.sgcc.com.cn[b], liujin@sgeri.sgcc.com.cn[c], lujianfei@sgeri.sgcc.com.cn[d], xulanjun@sgeri.sgcc.com.cn[e],1337721205@qq.com[f*]}

State Grid Zhejiang Electric Power Co. Ltd., Hangzhou 310007, China[1]
State Grid Energy Research Institute, Beijing 102209, China[2]
School of Economics and Management, North China Electric Power University, Beijing 102206, China[3]

Abstract: As power systems continue to evolve and technology changes rapidly, new power systems are providing more efficient and reliable operating environments for grid business. Through an in-depth study, this dissertation aims to identify the key elements that significantly impact the efficient operation of grid business in the new power system, and to provide strong guidance for decision makers and practitioners in the power industry.

Keywords: the New Power System, Grid Business, Key Elements

1 Introduction

The traditional power system consists of "source network load", through the power flow, information flow, value flow effective integration flow, realize the "thinking interaction", in order to clean power utilization, smoothing clean power intermittency and volatility, stabilize the power supply, energy storage has become the key. In order to stabilize the power supply, energy storage has become the key, and the traditional "source network and load" power system has evolved into a new "source network and load storage" power system. The power industry is the largest carbon emissions accounted for by the industry, according to the National Energy Board statistics, in 2020 China's energy consumption of carbon dioxide emissions accounted for about 88% of the total emissions, the power industry accounted for about 42.5% of the total energy carbon dioxide emissions. The share of final consumption of electricity is also rising, reaching 27% in 2019, and this indicator is expected to exceed 38% by 2035, according to the China Electricity Industry Annual Development Report 2020 published by the China Electricity Council. According to the Energy Foundation's Five Strategies to Achieve China's 2060 Carbon Neutrality Goal study, "decarbonizing the power sector" and "electrifying the end-use sector" are two key strategies. The new type of power system takes innovation as the fundamental driving force, including technological innovation, business model innovation, management innovation and service innovation, of which technological innovation is the core driving force; the new type of power system takes digitalization as the key means, through data production elements, to consolidate the digitalization foundation, enhance data productivity, realize data-supporting business, and to

IEDM 2024, February 23-25, Kuala Lumpur, Malaysia

DOI 10.4108/eai.23-2-2024.2345908

promote the digitalization of digital industry and industrial digitization. Building a new type of power system has the multiple significance of promoting clean energy transformation, enhancing energy security and reliability, improving energy utilization efficiency, promoting technological innovation and industrial upgrading, and facilitating sustainable development, etc., and plays an important role in realizing coordinated development of the economy, society, and the environment.The development of the new type of power system, including innovations in the fields of smart grids, renewable energy integration, and the energy Internet, has put forward new challenges and opportunities for the power grid operations present new challenges and opportunities[1]. In order to achieve efficient operation of the power system, it is necessary to have a deep understanding of the influencing factors so that effective business strategies and management programs can be developed. Building a new type of power system helps balance the relationship between energy demand and environmental protection, creating a more sustainable and prosperous future for society.

2. Objectives and methodology

This study aims to identify the key elements for efficient operation of grid business under a new type of power system. On July 11, 2023, the second meeting of the Central Committee for Comprehensively Deepening Reform considered and passed the Guiding Opinions on Deepening the Reform of the Electric Power System and Accelerating the Construction of a New Type of Electric Power System, emphasizing that it is necessary to deepen the reform of the electric power system, and to accelerate the construction of a clean and low-carbon, safe and abundant, economically efficient, supply-demand synergistic, flexible, and intelligent new type of power system, to better promote the revolution of energy production and consumption, and to safeguard national energy security. The proposal of the characteristics of the new power system is mainly motivated by the considerations of power source structure, power safety and security, market operation, policy instruments, and technical instruments. We adopt the following method:

LITERATURE REVIEW: To review the current literature related to the efficient operation of new power systems and grid business and to summarize the existing research results.

Comparative Analysis: Gain insights into grid business operations under the new power system and identify key issues and challenges through on-the-ground case studies.

Expert Interviews: Conduct in-depth interviews with professionals in the power systems field to gain their experience and insights and identify key elements.

3. Grid business operation key elements identification model construction

3.1 Identify key elements

This section identifies and organizes the screened key elements from the perspective of the five characteristics of China's new type of electric power system in terms of clean and low carbon, security and abundance, economic efficiency, supply and demand synergy, and flexibility and intelligence, and constructs the identification model of key elements of grid business. The specific key elements are shown in Table 1.

Table 1. Set of key elements

feature layer	factor layer
Clean and low-carbon (A)	Utilization rate of clean energy generation on the generation side (A1)
	Share of clean energy generation (A2)
	Share of installed clean energy generation (A3)
	Clean energy emission reductions (A4)
Adequate security (B)	Reliability of electricity supply (B1)
	Allocation ratio (B2)
	N-1 pass rate (B3)
	Mean time between failures in the power system (B4)
	Composite voltage compliance rate (B5)
Cost-effective (C)	Asset utilization (C1)
	Capacity-to-load ratio (C2)
	Combined line loss ratio (C3)
	Transmission efficiency (C4)
Supply and demand synergies (D)	Grid connection rate of new energy generation (D1)
	Electricity consumption information collection system coverage (D2)
	Smart meter coverage (D3)
Flexible Intelligence (E)	FMIS ratio (E1)
	Proportion of smart substations (E2)
	Distribution automation coverage (E3)
	Coverage of new energy grid-connected simulation technologies (E4)

3.2 Methodology for determining factor weights

After the critical factor set is completed, it is necessary to determine the importance of each index to the evaluation goal, that is, the weight of each evaluation index of the grid business efficient operation evaluation index system. The method of determining the weights of evaluation indexes is divided into two categories: subjective assignment and objective assignment, which have their own advantages and disadvantages. In the research of this topic, the comprehensive hierarchical analysis method, which makes full use of the advantages of subjective and objective assignment methods, will be used for the study of evaluation indexes, and the weight values will be determined with the help of multivariate statistical clustering method.

The specific process of weighting evaluation indicators using hierarchical analysis is shown below[2-9]:

(1) Constructing a judgment matrix

Design the questionnaire of evaluation index weights for efficient operation of grid business, invite experts to compare and analyze the importance of evaluation indexes, evaluate the importance of each layer of indexes, and evaluate the importance of each index according to the five grades of 1, 2, 3, 4, and 5, and the result of the comparison of the importance of the indexes between two by two is constructed into the indexes' importance determination matrix $A=\left[a_{ij}\right]$,and finally the eigenvectors and the maximal eigenvalues of the respective matrices are found out $\lambda_{\max}$.

The results of the evaluation of the importance of the two indicators are summarized in the table 2:

Table 2. Rating Criteria

$a_{ij}=x_i/x_j$	x_i Importance in relation to x_j
1	equal importance
2	more important
3	critical
4	important
5	Absolutely important.
<1	x_j Not important relative to x_i (x_i is important relative to x_j)

(2) Calculate the weight vector

After obtaining the experts' evaluation of the relative importance of the two or two evaluation indicators through the questionnaire research method, the calculation of the degree of importance between the indicators at all levels was carried out, and at the same time, in order to enhance the comparability of the importance of the indicators, the evaluation value of the importance between the two or two indicators was normalized, and accordingly, the weights of the indicators were estimated[10-12].

(3) Consistency test

As before, the weight of each evaluation index obtained through the questionnaire method is subjectively determined by experts, when there are more indexes, it is necessary to test the judgment matrix, as well as the consistency test of the judgment matrix.

The process of consistency checking of the judgment matrix is shown below.

① Calculate the consistency evaluation index of the judgment matrix: $CI=\frac{\lambda_{\max}-n}{n-1}$;

② Find the consistency ratio of the judgment matrix: CR ;

$$\lambda_{\max} = \frac{1}{n}\sum_{i=1}^{n}\frac{(AW)_i}{w_i} \tag{1}$$

$$CR = \frac{CI}{RI} \tag{2}$$

Where $\lambda_{\max}$ is the maximum eigenvalue of the judgment matrix $A=\left[a_{ij}\right]$ and RI is the average random consistency index, the details of which are shown in Table 3.

Table3. Mean Random Consistency Index

n	RI
1	0
2	0
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45

Eventually, if the CR value, calculated according to formula (1) and formula (2), satisfies $CR < 0.1$, it indicates that the judgment matrix passes the consistency test, otherwise the judgment matrix needs to be adjusted until the judgment matrix's passes the consistency test.

3.3 Determination of factor weights based on the hierarchical analysis method

After determining the set of key elements for efficient operation of grid business, and its weight determination method, 20 domestic experts in the field of new power systems were selected to evaluate the relative importance of key elements for efficient operation of grid business.

The specific process for determining the weights of the key elements of efficient grid business operations is shown below:

A comparison of the importance of the five characteristics was determined as shown in Table 4.

Table 4 Comparison of feature layer importance

S:feature layer	A	B	C	D	E	Wi
A	1	2	1/3	1/5	2	0.2045
B	1/2	1	1/3	4	1/2	0.1475
C	3	3	1	1/2	4	0.1978
D	5	1/4	2	1	3	0.2579
E	1/2	2	1/4	1/3	1	0.1923

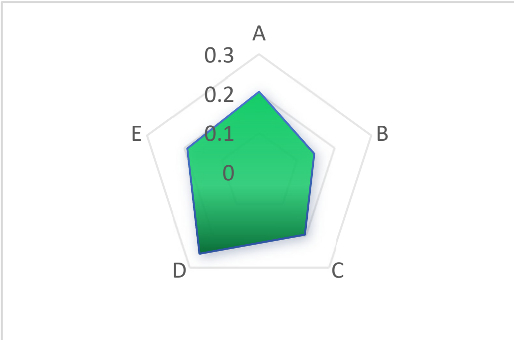

Figure 1 Five characteristics of the proportion of the weight

The consistency of the relative importance judgment matrix between the evaluation objectives of efficient grid business operation in Table 4 and the five first-level evaluation indicators of clean and low-carbon, safe and abundant, economically efficient, synergistic supply and demand, and flexible and intelligent is verified, and the consistency test results of the relative importance judgment matrix of he first-level evaluation indicators of efficient grid business operation are obtained as follows The result of the consistency test is $\lambda_{\max} = 5.4364$ That is, the judgment matrix passed the consistency test. Can be seen from Figure 1, in the five characteristics, supply and demand coordination accounted for the highest, reached 0.2579, clean low carbon, reached 0.2045. This shows that, under the background of the construction of new power system, the main factors affecting the efficient operation of power grid is collaborative efficient, because the new power system has a large number of distributed power and energy storage facilities, unified use and deployment of these equipment will become the priority of power grid business. Secondly, clean and low-carbon is one of the main goals of the construction of new power system, so in the background of new power system, clean and low-carbon characteristics will also become an important factor affecting the efficient operation of power grid business.

Table 5 Clean and low carbon characteristics

A: Clean and low-carbon	A1	A2	A3	A4	Wi
A1	1	2	2	3	0.4281
A2	1/2	1	2	1	0.2328
A3	1/2	1/2	1	4	0.1641
A4	1/3	1	1/4	1	0.1751

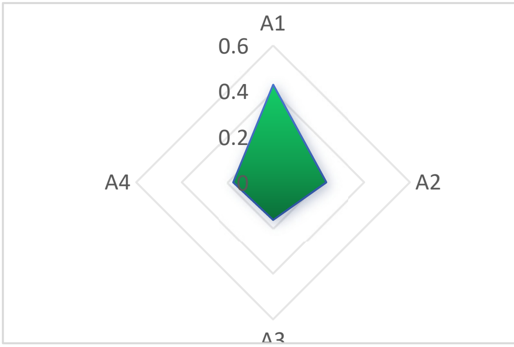

Figure 2 The proportion of clean and low-carbon factors

For the clean low-carbon features shown in Table 5, the consistency verification of the relative importance judgment matrix between the four corresponding key elements, namely, the utilization rate of clean energy on the power generation side, the share of clean energy power generation, the share of installed clean energy power generation, and the amount of emission reduction of clean energy, was obtained, and the consistency test results of the judgment matrix of the relative importance of the clean low-carbon features and their key elements were $CR = 0.0304 < 0.1$, $\lambda_{\max} = 4.0813$, i.e., the judgment matrix passed the consistency test. As can be seen from Figure 2 , among the clean and low-carbon characteristics, the utilization rate of clean energy on the power generation side is the highest, reaching 0.4281, because this factor can directly reflect whether the amateur operation of the power grid can effectively reduce carbon emissions.

Table 6 Abundant safety characteristics

B: Ample security	B1	B2	B3	B4	B5	Wi
B1	1	2	1	1/2	1	0.1915
B2	1/2	1	1/3	1/2	1/4	0.1459
B3	1	3	1	2	1	0.2378
B4	2	2	1/2	1	2	0.2607
B5	1	4	1	1/2	1	0.164

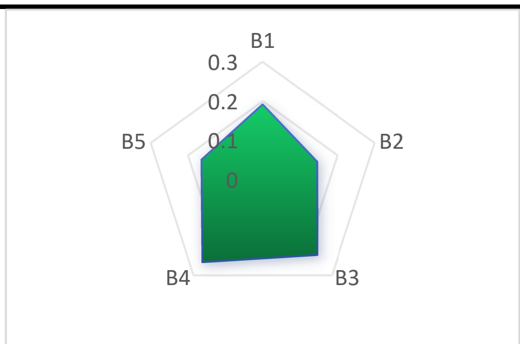

Figure 3 The proportion of safety adequacy factors

The consistency verification of the relative importance judgment matrix between the security adequacy features shown in Table 6 and the five corresponding key elements, namely, power supply reliability rate, distribution and storage ratio, N-1 passing rate, average time between failures of the power system, and comprehensive voltage passing rate, obtains the consistency test results of the security adequacy features and the relative importance judgment matrix of its key elements as $CR = 0.0675 < 0.1$, $\lambda_{\max} = 5.3024$, i.e., the judgment matrix has passed the consistency test. As can be seen from Figure 3, in the characteristics of safety and abundance, the average fault interval time of the power system has the largest weight, at 0.2607. This is because this factor can directly reflect whether the power grid operation is safe and stable, and is a very important influencing factor.

Table 7 Economic and efficient factors

C: Cost-effective	C1	C2	C3	C4	Wi
C1	1	2	2	2	0.3952
C2	1/2	1	3	5	0.2322
C3	1/2	1/3	1	2	0.2322
C4	1/2	1/5	1/2	1	0.1404

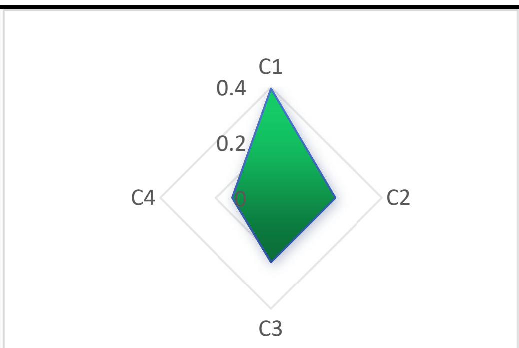

Figure 4 The proportion of economic and efficient factors

The consistency verification of the economic and efficient features shown in Table 7, and the relative importance judgment matrix between the four corresponding key elements, namely, asset utilization rate, capacity-to-load ratio, comprehensive line loss rate, and transmission efficiency, is carried out, and the consistency test results of the economic and efficient features and their key elements' relative importance judgment matrices are obtained as $CR = 0.0227 < 0.1$, $\lambda_{\max} = 4.0606$, i.e., the judgment matrices have passed the consistency test. As we can see from Figure 4, the proportion of asset utilization is the highest, reaching 0.3952.

Table 8 Synergy features of supply and demand

D: Supply and demand synergies	D1	D2	D3	Wi
D1	1	1	2	0.3874
D2	1	1	3	0.4434
D3	1/2	1/3	1	0.1692

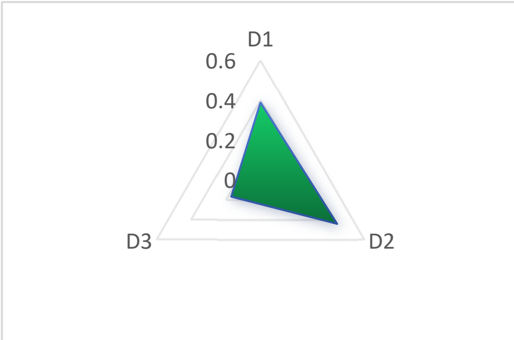

Figure 5 Supply and demand synergy indicators

The consistency verification of the supply and demand synergistic features shown in Table 8 and the relative importance judgment matrix between the three corresponding key elements, namely, new energy power generation grid connection rate, electricity consumption information collection system coverage rate and smart meter coverage rate, obtains the consistency test results of the supply and demand synergistic features and their key elements' relative importance judgment matrices as $CR = 0.0176 < 0.1$, $\lambda_{\max} = 3.0183$, i.e., the judgment matrices have passed the consistency test. As can be seen from Figure 5, the coverage rate of the electricity consumption information collection system is the highest, reaching 0.4434.

Table 9 Flexible intelligent features

E: Flexible and Intelligent	E1	E2	E3	E4	Wi
E1	1	1/2	2	2	0.2611
E2	2	1	3	2	0.4176
E3	1/2	1/3	1	3	0.197
E4	1/2	1/2	1/3	1	0.1242

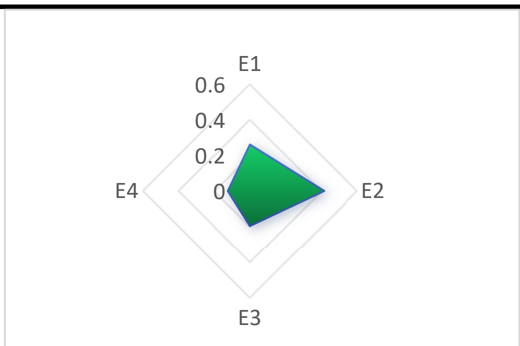

Figure 6 Flexible intelligence factor accounts for the proportion of the weight

The consistency verification of the relative importance judgment matrix between the flexible intelligent features shown in Table 9, and the four corresponding key elements, namely, the proportion of regulation and control integration system, the proportion of intelligent substations, the coverage of distribution automation, and the coverage of new energy grid-connected simulation technology, obtains the consistency test results of the flexible intelligent features and the relative importance judgment matrix of its key elements, which are $CR = 0.0976 < 0.1$, $\lambda_{\max} = 4.2606$, i.e., the judgment matrix has passed the consistency test. As shown in Figure 6, the weight of the proportion of smart substation reaches 0.4176, accounting for the highest proportion among the flexible intelligent characteristics. This is because the smart substation is the key and foundation for the construction of a new power system and the realization of flexible and intelligent operation of the power grid.

Finally, summarizing the content of the calculation of the weights of the evaluation indexes for efficient operation of the grid business as above, the weights of the evaluation indexes for efficient operation of the grid business are determined as shown in Table 10.

Table 10 Weight of evaluation index

Secondary indicators / Level 1 indicators	A	B	C	D	E	Wi
	0.2579	0.2045	0.1978	0.1923	0.1475	
A1	0.1915					0.0335
A2	0.1459					0.0392
A3	0.2378					0.0298
A4	0.2607					0.0486
A5	0.164					0.0533
B1		0.4281				0.0631
B2		0.2328				0.0343
B3		0.1641				0.0242
B4		0.1751				0.0258
C1			0.3952			0.0782
C2			0.2322			0.0459
C3			0.2322			0.0459
C4			0.1404			0.0278
D1				0.2611		0.0674
D2				0.4176		0.1077
D3				0.197		0.0508
D4				0.1242		0.032
E1					0.3874	0.0745
E2					0.4434	0.0853
E3					0.1692	0.0325

4. Conclusions

Combining the data in Table 10, we can draw the following conclusions:

(1) Strengthening clean low-carbon and building a green grid evaluation system.

Define the principles for the establishment of the evaluation system. From the systematic, scientific, industry-specific, operable and comparable aspects, etc., to clarify the principles of the evaluation system, to ensure that the evaluation index system can comprehensively reflect the grid operation of multiple types of objectives, effectively improve the rationality of the selection of indicators and the scientificity of the determination of the weights, to ensure that the evaluation indexes accurately reflect the benefits of grid operation in the context of a new type of power system. Taking into account the environmental friendliness of the grid with the goal of reducing non-clean energy and environmental pollution, objectively reflecting the level of clean energy consumption, the level of energy consumption of the scheduling operation mode and the environmental pressure brought about[13]. To ensure the implementation of grid security control in the context of a new type of power system, it is necessary to formulate a security control strategy covering the entire business and process of the grid, focusing on the key points of security monitoring, relying on the construction of a standardized security system, strengthening the monitoring of security risks and improving the level of security management as the main line, and implementing multi-dimensional and hierarchical security risk control to promote Organic unification of real-time safety and long-term safety of the power grid, in order to realize the safe and reliable operation of the power grid.

(2) Quantitative rating and construction of a system of security sufficiency indicators

The key to establishing a grid security evaluation index system to evaluate grid security, quantitatively evaluate the grid security level, and reasonably reflect the security level of grid enterprises is to build a security evaluation index system that meets the characteristics of the electric power industry. Regularly update and improve the index system. At the same time, it is necessary to grade management and implement the security risk pre-control system to grade management of security risks, and preventive control for different levels of security risks. The safety management personnel in the process of grid construction and operation management are divided into levels and responsibilities, clarifying the authority of different levels, avoiding multiple management, and ensuring the simplicity of the management level in order to effectively transfer information and implement safety management. From the safe power supply level, voltage security, grid operation risk and other all-round, deep-level scanning of the security weakness of the grid area, put forward the grid security risk pre-control measures, through the enterprise management and grass-roots personnel to work together to promote the safe and reliable operation of the power system. Improve security risk management and control, but also need to build the inspection system and effectiveness evaluation system, strict security assessment to serve as a safeguard, around the purpose of process control, the formation of the various sectors of the risk of collaborative security organization system[14]. Strict control of grid operation control and safety assessment, strengthen the organization and implementation of safety work, you can establish a regular assessment mechanism for safety production, the implementation of on-site supervision and inspection. The implementation of safety work should comprehensively consider the safety conditions of different power grid enterprises, and should work on the construction of the security organization system.

(3) Continuous improvement of economic management and economic efficiency

Establish a comprehensive asset management system. Grid enterprises should establish a complete asset management system, including asset management processes, systems and norms, to ensure the systematic and standardized nature of asset management work. Through the development of asset classification, standardized management and information technology support, the full life-cycle management of all types of assets is achieved, including all aspects of asset procurement, use, maintenance and disposal. Strengthen data and informationization support for asset management. Grid enterprises should strengthen the collection, integration and management of asset data, establish a unified asset management information system, and realize the timeliness, accuracy and reliability of asset data. Through the support of informatization technology, it provides functions such as asset information query, asset change tracking, asset risk assessment, etc., which provides scientific basis for asset management decision-making. Optimize asset allocation and investment decision-making. Grid enterprises should rationally allocate asset investment, including grid equipment, engineering projects and material procurement, according to business needs and long-term planning. Asset allocation strategies and investment plans are formulated through comprehensive consideration of factors such as asset operating efficiency, investment risk and capital return rate. At the same time, it strengthens asset service life assessment and renewal planning to ensure the best utilization and optimal allocation of assets. Strengthen asset maintenance and conservation management. Grid enterprises should establish a sound asset maintenance management system, including equipment repair and maintenance, process management and safety management. Through the development of maintenance plans, equipment inspections and anomaly warning mechanisms, the normal operation and efficient operation of grid equipment is guaranteed, and the risk of failures and power outages is reduced. At the same time, asset care work is strengthened to extend the service life of equipment and increase asset value. Increase investment and actively adopt emerging technologies.

(4) Focusing on supply and demand synergy and scientific utilization of new types of electricity

Focus on synergy and scientific application of security control systems. By applying the grid security and stability control system, it can effectively prevent the occurrence of large-area power outages and maintain the security and stability of the power grid. The safety and stability devices of the control system are connected and exchange information through fiber optic data channels, combined with the collection of system-related data, to strengthen the identification of the system's operation mode, and in the event of a failure of the regional grid contact line or the main unit, to determine the system's failure pattern, implement the control measures of unlisting and load cutting, thus reducing the probability of system blackout failure, improving the application level of the safety control system, and effectively control the security risk of the power grid. Focus on prevention and establish a sound technical supervision organization. Advance prevention and control, focus on improving the risk warning mechanism. By analyzing the safety risks of the power grid, improve the level of enterprise safety risk prevention, and promote safety management from after management to advance prevention and control of the main change. Wind power and solar power generation have the characteristic of uncontrollable output, and the system becomes complicated after accessing these power sources, such as coordination, operation control, and scheduling management of the distribution grid. Therefore, improve the risk early warning mechanism of the smart grid, strengthen the security risk monitoring in the production process and security management, so as to accurately and timely prevent and control the security risks brought about by intermittent renewable energy sources after connecting to the grid, reasonably prevent the risks, and avoid the occurrence of security accidents.

(5) Grid enterprises should conduct flexible risk assessment and security intelligence detection.

Through comprehensive flexible risk assessment of power grid systems and equipment, potential threats and vulnerabilities are discovered, and corresponding protection strategies and measures are formulated. Regular security testing and penetration testing are conducted to assess the security and weaknesses of the system, and timely repair of vulnerabilities and reinforcement of protective measures. At the same time, it improves the supervision of the security of the grid information system and perfects the security intelligent monitoring function. It provides stable basic support and relevant auxiliary functions for grid information system automation operation and maintenance work, and helps operation and maintenance personnel to realize multi-angle, multi-interface, intuitive and accurate assessment of the operating status of the grid system, and to timely and accurately find and deal with faults, and to improve the overall grid system operation and maintenance automation management efficiency and final quality. The power grid has shifted from "source follows load" to "load-source coordination", and the scientific management of the load side (virtual power plant) and the energy-saving control of terminal energy consumption (integrated energy service) are the industrial development trends; empowered by cloud technology, AI technology and IoT technology, the development of integrated energy service has entered into the production and distribution of electricity. The development of comprehensive energy services has entered the stage of production and marketing integration, using hierarchical distributed computing to realize the optimal use of multi-energy comprehensive energy in a single park, AI technology to realize multi-energy load prediction, multi-energy generation budgets, multi-objective optimization (energy cost + energy efficiency), and the use of industrial Internet of Things technology to realize unified detection and control of energy, carbon, equipment, environment, temperature control, and so on.

Acknowledgments. This paper is a phased achievement of Science and technology projects of State Grid (Research on key technologies application of power grid management mode reform under the new power system, 1400-202257465A-2-0-ZN).

Reference

[1]Mingjun H ,Penghui Z ,Shuxiao L .The Impact of Energy Internet Enterprise Construction on Power Grid Business Organization Mechanism[J].IOP Conference Series: Earth and Environmental Science,2021,829(1):

[2]He H ,Hailei H ,Qinyong Z , et al.Research on evaluation algorithm and index of resilience power system under energy transformation[J].IOP Conference Series: Earth and Environmental Science,2020,529(1):012007-.

[3]Sun Q ,Liu X ,Li X , et al.Research on Evaluation Method of First-class City Distribution Network[J].IOP Conference Series: Materials Science and Engineering,2019,677(4):

[4]Muhammad M ,Linlin L ,Mushahid M A , et al. Prediction of flash flood susceptibility using integrating analytic hierarchy process (AHP) and frequency ratio (FR) algorithms [J]. Frontiers in Environmental Science, 2023.

[5]Rukhshanda R ,Sagheer M A ,Elżbieta J, et al. Guidelines for the Technical Sustainability Evaluation of the Urban Drinking Water Systems Based on Analytic Hierarchy Process [J].

Resources, 2023, 12 (1): 8-8.
[6]A S A B , Nurwatik . Alternative Route Planning Analysis of Tourism Transport Using Analytical Hierarchy Process (AHP) and Network Analysis Methods (Case Study: Jember Regency) [J].IOP Conference Series: Earth and Environmental Science, 2023, 1127 (1):
[7]Rogheyeh E , Ali M B . Marketing methods for electronic resources in medical libraries: a study on the application of the analytical hierarchy process.[J]. Journal of the Medical Library Association : JMLA, 2022, 110 (3): 332-339.
[8]Antonio M A ,Reinaldo I M ,António G , et al. Machine Learning-Driven Approach for Large Scale Decision Making with the Analytic Hierarchy Process [J]. Mathematics,2023, 11(3): 627-627.
[9]X. W, E. W.Evaluation of smart grid based on AHP-anti-entropy weight method[J].IPPTA: Quarterly Journal of Indian Pulp and Paper Technical Association,2018,30(8):478-481.
[10]Yang L, Yunling W, Ting L, et al.Evaluation of New Power System Based on Entropy Weight-TOPSIS Method[J].Mathematical Problems in Engineering,2022,2022
[11]Zesen L, Xin W,Linyuan W, et al.Research on evaluation index system of new power system[C],2022:
[12]Liu J , Liu N .Review on Business Operation Mode and Technical Economy Evaluation of Micro-Grid[J].Advanced Materials Research,2014,3247(960-961):1523-1526.
[13]Hao B, Yuli W.Digital power grid based on digital twin: Definition, structure and key technologies[J].Energy Reports,2022,8(S16):390-397.
[14]Weixuan M , Jiaxu C,Jin L .Research on Operation Mechanism optimization framework of Power Grid Business Organization under the new circumstances[J].Journal of Physics: Conference Series,2021,1848(1):