

Design of Agricultural Informationized Power Grid Power Dispatch Automation System

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Abstract: With the continuous development of China's economy and the accelerating process of urbanization, the demand for electric power resources is also gradually increasing. As one of the main bases of national energy supply, the rural power grid has received wide attention. Therefore, how to effectively utilize advanced information technology to improve the operational efficiency and service level of the agricultural network has become an urgent problem to be solved. Research Methods: Based on information technology, this paper applies automation technology to information dispatching and analyzes and researches the related theoretical knowledge, and puts forward the new ideas of power information collection and monitoring system based on PMC system and power consumption information system. With the development and research of smart grid power dispatch automation technology, it has become an important trend in China's economic development. In the GIS system, the data maintenance is convenient, and the maintenance of power facilities can be carried out on the geographic full map. When it is necessary to maintain the equipment and lines, the equipment and line mapping can be used to carry out the maintenance work. The GIS system is based on WEB to realize the business management, with a unique WEB system management interface, which realizes the business networking and automation.

Keywords: power dispatching; automation systems; automatic control

1 Introduction

With the continuous improvement of China's scientific and technological level, a large number of modern scientific and technological means have been applied to the rural power industry. The intelligent dispatch system of China's smart grid has become a new power supply system formed in the new era, which will further promote the vigorous development of China's rural power supply industry [1]. Therefore, this chapter will focus on analyzing the scheme design and research results of China's agricultural intelligent grid power dispatch intelligent control system, in order to promote the steady development of agricultural economic construction [2].

As China's smart grid construction moves steadily towards the direction of intelligent dispatch intelligence, intelligent grid construction in actual automatic control must also pay attention to the design and research of its control system to realize the rationality, stability and efficiency of intelligent grid dispatch operation, thereby promoting the rapid development of intelligentization of rural power dispatch in China [3]. Therefore, agricultural power companies should reasonably apply computers and use information means to further effectively optimize the agricultural grid system functions to enhance their utility benefits and

create a more rapid and stable working environment for the agricultural smart grid and power dispatch intelligence system to promote agricultural economic and social development.

2 Overview of Research on Power Dispatch Automation System

With the continuous improvement of China's requirements for rural residents' electricity consumption, this will put forward new demands and goals for rural residents' power quality and efficiency of smart grid power systems to a certain extent [4]. During the construction stage of agricultural smart grids, as the application of smart grid power systems becomes more and more widespread, this will also put forward new requirements and goals for the construction of rural power dispatch intelligence systems to a certain extent. The hardware facilities used in agricultural intelligent power supply systems have transitioned from dedicated to general types, with relatively high demands on the internal structure, reliability, etc. of rural power supply systems. Only by maintaining the stable operation of the power dispatch intelligence system around rural areas can the data be reasonably calculated to enhance the rationality of the system as shown in Figure 1.

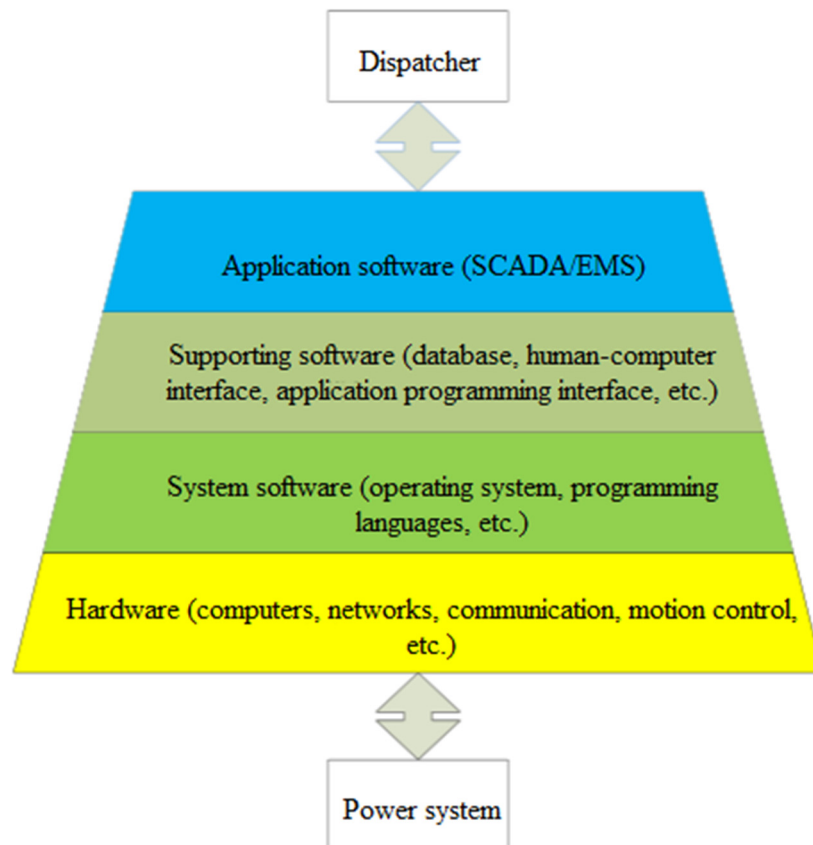


Figure 1. Schematic diagram of dispatch automation system functions.

3 Composition and Basic Characteristics of Power Dispatch Automation System

3.1 Significance of power dispatch automation system

Currently, the development of China's grid dispatch and automatic control systems is in a gradual and progressive state; it is gradually taking an irreplaceable position in the Chinese grid system. Therefore, some new development directions are also proposed for the intelligent dispatch system of the power grid, including:

3.1.1 Guarantee the informationization development of the system.

Digitalization is not only the development direction of system dispatch, but also the inevitable trend of China's grid management work. The core idea is to realize the digital application of information systems through the informationization construction of power dispatch automation systems, such as digital analog digital communication systems, to ensure that various construction processes of power grids can be reflected in digital development, thereby providing a scientific environment for the introduction of more advanced Internet information technologies and making them effectively used in the future construction of the system, so as to improve the working capacity of power dispatch automation management system [5].

3.1.2 Guarantee the system is close to the actual power grid.

The development trend of power dispatch intelligence systems close to people's livelihood reality is the main development trend in its future construction. According to the development trend of system realization, the basic situation of the current power grid system can be improved. Thereby improving the operation management capability and efficiency of the power grid. On the premise of ensuring the smooth transmission of signals, it basically meets the real-time changes of data information and ensures the application of more network technologies in the actual development of the national power grid, thereby enhancing the multi-capacity of power supply and distribution.

3.1.3 Promote intelligent control of the system.

Intelligent management of the grid dispatch automation system is not only its basic construction function, but also its most crucial form of construction. Intelligent management is constructed on the platform of informationization, through which intelligent management can achieve problem solving, integration of management problems with management problems in the grid scheduling automation system, which fundamentally promotes the transformation of the system and strengthens its comprehensive resilience to deal with sudden problems, thus guaranteeing the flexible operation of the system. It can be seen that the intelligent management of grid scheduling automation system is the most crucial content of power grid construction.

3.2 Composition of power dispatch automation system

Schemes and equipment are the two main constituent modules of the entire control system. In order to ensure the intelligence of dispatch, more in-depth research and development are carried out on the two major modules to ensure that the control system gains greater

development space. The specific contents of power dispatch automation are as follows:

Communication system. Generally used for the exchange of dispatch messages: it is constructed on the basis of multiple serial ports and can operate TCP/IP. The communication system intermediary greatly increases message time, and the system calculation process is relatively small, reducing the workload of operational personnel in the network system, thereby greatly improving the working efficiency of the communication system.

Time synchronization. Its purpose is to provide the most accurate unified time for the power dispatch automation control system, with international time positioning as the criterion, to ensure that the internal working time of the power system is unified with the world clock. Although the time synchronization system takes global time as its goal, in fact, the time adjustment module performs time adjustment and affects all nodes in the entire network system to prevent faults caused by time differences.

Communication equipment. In the front-end mode, it can complete unified management of various data and materials in the power dispatch automation control system, including early collection and later output, to realize the effectiveness of control parameters and ensure smooth transmission of system commands, thereby achieving harmonious interaction between the dispatch system and operational personnel.

Server. This is the core of the management system. The server is also divided into primary and backup. It is mainly used to store various dispatch system management data such as historical records and real-time historical data. Although the storage scale of the server is very large, it will not affect the normal work of power dispatch and automation management system. It can also realize background storage and background operations. The main purpose is to provide auxiliary functions for the management system while also being the command center of the management system.

3.3 Basic characteristics of power dispatch automation system

3.3.1 Self-recovery.

Self-recovery as the basic attribute of China's rural smart grid and power dispatch intelligence management system, the power grid can independently recover and detect faults and problems during operation to maintain its own stable operating conditions. In computer networks, the effect of self-recovery can also be effectively reflected. The power grid system utilizes the characteristics of networking to actively detect and self-isolate risk signals, thereby enhancing the ability of the power regulation system to solve problems.

3.3.2 Compatibility.

Compatibility: It mainly manages various hydropower generation management modes for the dispatch and intelligent control system of agricultural smart power supply system to coexist with each other. Compared with the past hydropower generation management mode, the efficiency will be greatly improved to ensure the sharing of work benefits. The power generation mode of rural power grids generally consists of distributed development and centralized development. Multiple power generation modes will promote the realization of more functional effects of agricultural power systems through the effective combination of agricultural smart micro-grid and power dispatch automation system. At the same time, the

power dispatch automation system of agricultural smart micro-grid can also use backup diesel generators for effective reduction of related accident phenomena.

3.3.3 Interactivity.

Interactivity mainly refers to workers of agricultural power enterprises who can use the electric energy allocation automatic control system to directly contact agricultural population users, so as to provide more commercial power supply services for agricultural households and solve various power supply requirements of agricultural households to achieve rational allocation of electric energy resources.

3.3.4 Requirements standards for intelligent grid on power dispatch automation design.

Regarding the construction of intelligent power dispatch control system, it should be based on the current development trend of agriculture and the characteristics of rural production to ensure the safety and stability of the agricultural intelligent equipment power system. Intelligent grid power systems generally adopt an intelligent unmanned mode. To ensure the stable operation of rural power systems, it is necessary to establish a professional and effective network system to effectively monitor and transmit information and ensure the integrity of power supply information during transmission and management. In the rural power dispatch monitoring system, more attention is paid to power supply reliability, reasonable setting, and establishment of on-site monitoring system according to the actual operation status of substations.

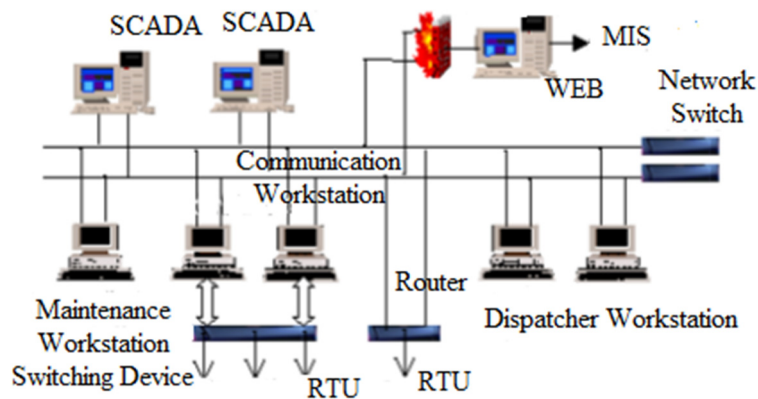


Figure 2. General structure diagram of dispatch automation system.

4 Design and Functions of Power Dispatch Automation System

One of the main purposes of building the power grid dispatch monitoring system is to realize automatic control of power generation processes in the power system through computers. Utilizing advanced computer information technology to monitor and manage the dispatch power supply system, with the assistance of distribution equipment and power generation equipment, closed management systems are formed together with channels and terminals to instantly monitor the changes in power supply signals of power generation dispatch

automation control systems. If there is a shortage of electric power supply, the control system can automatically complete the test management of the power supply system and power supply to ensure power balance and further enhance the controllability of power generation dispatch on the basis of reasonably distributing power resources. Thereby greatly improving the working efficiency of the control system as shown in Figure 2.

4.1 Overall structure design of power dispatch automation system

The overall structure design of the system is shown in Figure 3. In the system, SCADA system as a sub-system is the functional core module, which is mainly responsible for the collection and processing of grid operation data information. The data acquisition and processing module plays an important role in the SCADA system, which can complete the acquisition of different systems and suitable power data, and process the acquired data information.

When designing the data acquisition and processing module, it is necessary to consider the unified storage and processing of data in different formats. In this way, the collected data can be stored in a database and made available to the power dispatching system. Through unified data storage and processing, the system can manage grid data more efficiently and provide accurate and reliable information support.

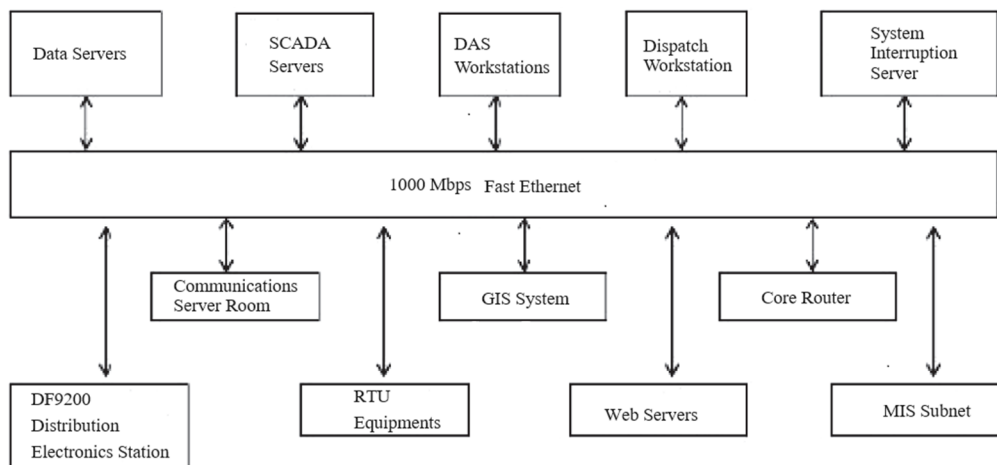


Figure 3. Overall structure design of power dispatch automation system.

The human-machine interface module of the SCADA subsystem is the interface module of the system that realizes the interactive operation between human and machine and provides support for the feasibility of the system. The main function of the human-machine interface is to complete the basic operation of power dispatching and to map the data of the SCADA system. By studying the supported functions, it is possible to simulate the debugging of the operating state and situation of the equipment under different systems. The HCI module also enables version upgrades and alarm functions, and categorizes and grades events to filter negative events.

In the SCADA system, the SCADA server, GIS system and DAS workstation integration module can effectively collect, process and dispatch system data, which is the basis for

realizing power scheduling and monitoring, the WEB server module is used to store and display system data, and the power dispatching staff can read the data information in the WEB server module through the human-computer interaction module to complete the grid DAS distribution network software is responsible for real-time monitoring of the operation status of the distribution network, evaluating and formulating the best operation scheme. DAS distribution network software includes several functional modules, which can realize dynamic operation under the control of the power dispatch system. GIS distribution network system is mainly used for obtaining and processing geographic location information of power equipment and circuits in the power grid, and providing basic functions such as location information of equipment and interface query for the power dispatching system. query and other basic functions.

GIS is a technology that can independently establish a GIS platform, which can improve the storage speed of spatial data and realize the heterogeneous processing of real-time information. Through the cache function, the GIS system can directly access the database after integrating the graphic data and real-time information, thus improving the efficiency of the system. In addition, the GIS system can ensure the integrity of data information and realize efficient query display function. Figure 4 shows the structure diagram of the GIS system.

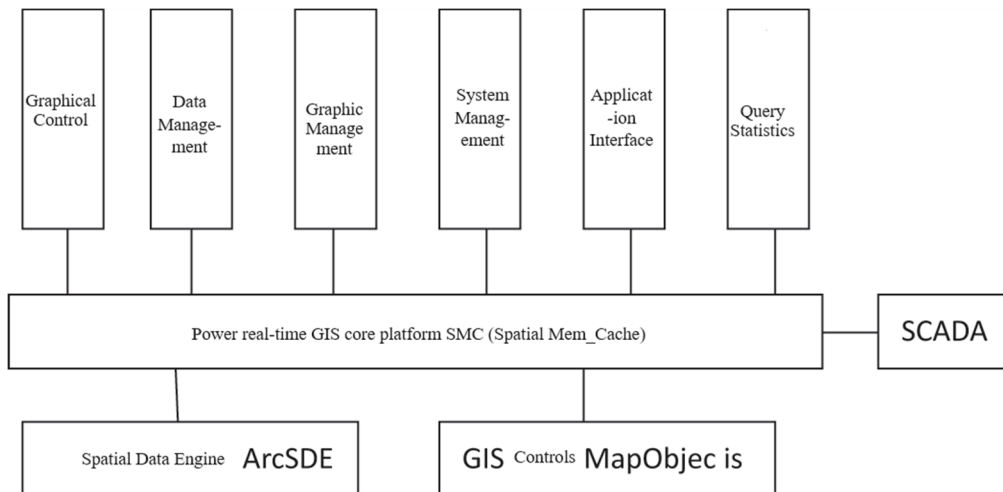


Figure 4. Structure diagram of GIS system.

4.2 Realizing monitoring of automation system

The main purpose of the power dispatch automation control system is to put the power supply work in a state that can be monitored and managed, so as to provide relevant power data and references for the adjustment of the control system, and make controlling analyses and evaluations at the same time. Therefore, when the power dispatch automation control system detects system abnormalities, it can purposefully identify abnormal events and monitor the development trend of abnormal events to provide appropriate response measures, or adopt alarm warning methods to transmit abnormal phenomena in the system when the control system cannot make automatic control of abnormal events, so as to ensure that inspection personnel discover power supply faults in time, take safety measures, closely monitor

abnormal phenomena, maintain normal power supply in time, and prevent the recurrence of power supply incidents as shown in Figure 5.

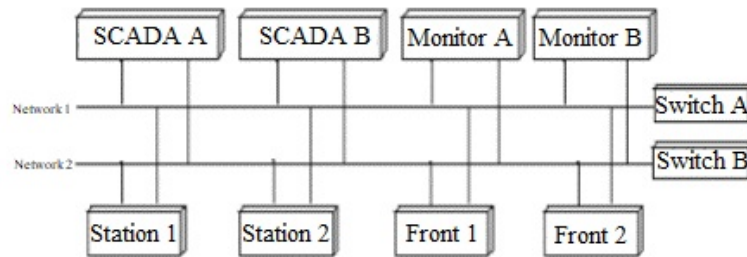


Figure 5. Main station system network structure diagram.

4.3 Guarantee the rationality of dispatch

Dispatch rationality not only meets the needs of the intelligent dispatch system of the power grid, but also guarantees the balance of power supply and distribution within the power grid system. The principle of high efficiency and low consumption is always adhered to in power transmission and distribution work, with power transmission and distribution efficiency as the main objective. Only by ensuring effective electric power dispatch can the correct control of dispatch be realized. To ensure the rationality and effectiveness of dispatch allocation, the intelligent dispatch of the national power grid system can be effectively regulated and the operating costs of the national power grid system can be controlled. Meanwhile, the electric load in controlled can be reasonably controlled. This realizes the highest precision for the power supply and distribution of the national power grid system, which is more conducive to national power companies gaining greater profit maximization.

4.4 Future development of power dispatch automation

With the high degree of automation development of the power dispatch system and the continuous deepening and reform of the grid system, in order to ensure the safe and stable operation of the grid, the power dispatch center will also adopt various management modes of parallel work with application systems, including management systems for key energy billing, management and dispatch in the field of power supply. Each of the above operational systems can simultaneously carry multiple applications. The characteristics are: 1) they can share messages and exchange data with each other; 2) more application systems can be integrated and new application functions extended to reduce the development cost and use complexity of standard interfaces; 3) support interoperability between heterogeneous operational systems. It can be applied to the special technologies of various companies. To achieve the above standards, it is necessary to monitor the power dispatch information system technology and implement the following applications: IEC61970 uses CIS technology to access all kinds of public information in the entire power system. Its technical goal is to solve the problems of heterogeneity and interconnection of data and information sharing and various resource sharing in the national power system, so as to enable national power companies to achieve higher efficiency and economic benefits. This will also become the development trend of intelligent management systems for power dispatch in the future. China's intelligent dispatch

system has gradually completed the transition from "experience-based regulation" to "analytical regulation." It is believed that in the near future it will surely develop vigorously into the stage of "intelligent power dispatch."

With the increasingly developed home electricity market, more market economy participants will need the power dispatch automation system that can complete functions such as data query and upload. This requires the power dispatch automation system to have higher security protection performance in intelligent regulation. Although the State Grid Corporation of China and the Ministry of Commerce have already formulated technical standards related to the power grid, it can be predicted that the power grid will face more new challenges in secondary security protection issues. At the same time, intelligent dispatch management systems will be able to meet higher requirements in terms of security protection.

5 Trends in the Development of Power Grid Power Dispatch Automation System

5.1 Digital development

Digital development has become the main goal of the current rural smart grid power dispatch automation system. It is precisely because of this that in the current stage of development of rural smart grid power dispatch systems, technological workers must digitize rural power grid signals in order to develop rural intelligent power dispatch automation systems more effectively and complete agricultural smart grid dispatch [6]. In order to complete the digital development of the rural smart grid power regulation intelligence system as soon as possible, it is necessary to reasonably control the rural smart grid system by utilizing the characteristics of network sharing and practicality of the Internet, so as to improve the regulation precision of the rural smart power supply system. At the same time, the intelligent management system of power grid regulation information in rural areas will develop in the direction of digitization, and its ability to comprehensively handle power grid dispatch information data from all over the country will also gradually improve. In the operation stage, it will be able to actively eliminate potential risks, making rural power grid operation safer and faster.

5.2 Integrated development

The intelligent management system of power dispatch of rural smart grids is developing in the direction of integration, driving the improvement of system power grid data efficiency to ensure the overall benefits of power dispatch. By reasonably applying integrated means, the fragmented data information collected by the rural intelligent power grid dispatch management system during the operation stage will be reasonably integrated and systematically adjusted to improve the effectiveness of dispatch. At the same time, by utilizing the data mining structure, reasonable compilation of power grid adjustment schemes has been carried out to make the degree of intelligence and integration of the intelligent management system of rural intelligent power grid power dispatch more prominent.

5.3 Predictability of structure

Currently, with the continuous improvement of rural living standards, rural residents'

electricity consumption is also increasing gradually. The previous rural power supply system could not provide quality, low-power public services for all rural populations. Through the construction of predictability of structures of rural smart grids and power dispatch automation systems, problems in service quality existing in rural power industry can be gradually optimized. The agricultural power industry can also install agricultural intelligent metering devices in the intelligent management system of rural smart grid power dispatch to diagnose and analyze the power supply demand of different rural households, and conduct rational power transmission and provide data support for future rectification work. In addition, under this condition, the agricultural power industry can also carry out further extension and expansion by introducing clean power into the grid to realize agricultural resource saving and environmental protection and improve the power supply situation for rural residents.

6 Conclusion

With the development and research of smart grid power dispatch automation technology, it has become an important trend in China's economic development. Although there are still differences in the level of smart grid construction in rural areas of China relative to that of developed cities across the country, the development of smart grid power dispatch automation system plays an indispensable role in realizing the rational distribution of electric energy across the country. In the GIS system, data maintenance is convenient, and the maintenance of power facilities can be carried out on the geographic full map. When it is necessary to carry out maintenance on equipment and lines, it is possible to carry out maintenance work by means of equipment and line mapping. The GIS system realizes business management based on WEB and has a unique WEB system management interface, which realizes business networking and automation. In the operation process, the GIS system has powerful customization functions, including custom form and custom query, etc., which can effectively respond to various changes and situations.

References

- [1] Shi Zhiqiang, Qi Wei, Yan Yimou, Shi Wenjie, Wang Jiale. Brief introduction to the application of reactive power voltage automatic control technology in power dispatch automation systems [J]. *Technology and Market*, 2020, 27(9): 2.
- [2] Li Jin, Li Wencao, Qiu Rongfu, etc. Power dispatch automation AVC closed-loop control method based on generalized backward difference method [J]. 2021.
- [3] Xia Xin, Wang Xiaolu, Wang Zixin, etc. A safety detection system for a power dispatch automation system: CN112802306A [P]. 2021.
- [4] Tang Xiangying, Hu Yan, Geng Qi, etc. Multi-time scale optimization dispatch of integrated energy systems considering multi-flexibility [J]. *Power System Automation*, 2021, 45(4): 10.
- [5] Han Chunli. Practical application of electronic information technology in power automation systems [J]. 2020.
- [6] Shi Hongsheng, Xiao Xingming. Research on power dispatch automation system based on SCADA [J]. *Engineering Technology*, 2022(24).