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Study on construction of geothermal standard system for high quality development in Xiongan New Area

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ABSTRACT

The requirements of the standard system for geothermal construction are stricter and more advanced in Xiongan New Area due to the high-quality development of geothermal. At present, the construction of geothermal standard system has made remarkable progress, but there are still some problems, such as the lack of focus of industrial standards, and the development space and vitality of local standards need to be improved. In order to further clarify the important role of standardization in the development of Xiongan New Area. Based on the needs of the geothermal industry, this paper studies the existing geothermal standards, analyzes the business needs of the development of the geothermal industry in Xiongan New Area, and determines the main businesses and key control points. According to the needs of the geothermal industry, a standard system for geothermal energy development and utilization in Xiongan New Area has been formulated, covering six majors: geothermal resource exploration and evaluation, geothermal drilling engineering, geothermal heating engineering, geothermal power generation engineering, shallow geothermal energy and geothermal resource protection. This research can standardize the scientific development of geothermal industry in Xiongan New Area and realize the sustainable utilization of geothermal. At the same time, it will lay a foundation for building a global model of high-quality development of geothermal energy industry and a new demonstration area of low-carbon and green development.

1. INTRODUCTION

Standards are the supporting force of social and economic activities and technological development, and they are also the basic system for the modernization of national governance system and governance capacity. Moreover, the standard determines the quality, and what kind of standard has what kind of quality, and only high standards have high quality. Chinese President Xi Jinping's call for "global vision, international standards, distinctive Chinese features, and future-oriented goals" in the planning and construction of Xiongan New Area has served as an important guideline for the development of the area. The city plan for Xiongan New Area as a leading-edge future city reflects the principles of innovative intelligence, green ecology, and wellbeing, as manifested in the 1+4+26 plans. The master guideline specifies 38 specific goals to be achieved by 2035 (nine for innovative intelligence, 17 for green ecology, and 12 for wellbeing), with plans also being established for goal actualization and for the route by which they are to be realized. In this situation, the development of geothermal energy in Xiongan New Area, as a basic energy industry, should be laid out ahead of time, providing low-carbon life renewable energy with high standards and high quality for the new district, and becoming an important local regional energy.

2. CURRENT SITUATION AND PROBLEMS

During the 13th Five-Year Plan period, the standardization of geothermal energy has developed rapidly, and the basic and strategic status of the standard has been significantly enhanced. In the geothermal industry, there have been different degrees of research on the construction of standard systems, the existing standards have been summarized and classified, and the geothermal energy standard system has been preliminary established. However, the linkage between standards and scientific and technological innovation is very close. Currently, the construction of geothermal standard system is mainly based on industry field analysis, with relatively wide coverage. The scope stipulated by the standard is applicable to the application of thermal technology in the interior of the industry, which belongs to the industry standard level. At the same time, the applicability of the industry standard system lacks the accuracy of the region, and the integration degree with the region is not enough. There is a lack of accurate analysis of the importance of different types of tasks in the system and the urgency of the requirements for standard formulation.

At present, Xiongan New Area has entered a period of rapid development. During the "14th Five-Year Plan" period, it is necessary to establish a high-quality geothermal standard system of Xiongan New Area with comprehensive coverage, reasonable structure, connecting and supporting facilities, openness and compatibility, so as to deepen the deep integration of standardization and science and technology, and enhance the status and role of high-quality development. Moreover, according to the national requirements, the standard level of Xiongan should be higher than the industrial standard level, so it is necessary to study and construct the geothermal standard system of Xiongan New Area. At present, some basic standards are in Xiongan, but relative to the need for high-quality geothermal development in Xiongan New Area, the existing technical standards are not perfect. It is urgent to establish a complete, systematic and advanced geothermal quality development standard system applicable to Xiongan New Area. The standard system for high-quality geothermal development in Xiongan New Area will be more refined than the standard system for the geothermal industry, more precise and more standardized in its integration with the geothermal industry. Based on the research methods of the industry standard system, this paper will construct the high quality geothermal development standard system of Xiongan New Area, and put forward standard planning suggestions, so as to enhance the supporting role of the standard system for the high quality geothermal development of Xiongan New Area.

3.CONSTRUCTION OF GEOTHERMAL HIGH QUALITY DEVELOPMENT STANDARD SYSTEM

3.1 Standard system construction ideas

According to the standard system construction Principles and Requirements GB/T 13016-2018) in the standard system construction method, it includes the determination of standardization policies, investigation, analysis, compilation of the standard system table, etc. This paper draws lessons from the existing research on standard system construction and summarizes the general idea of standard system construction (Figure 1).

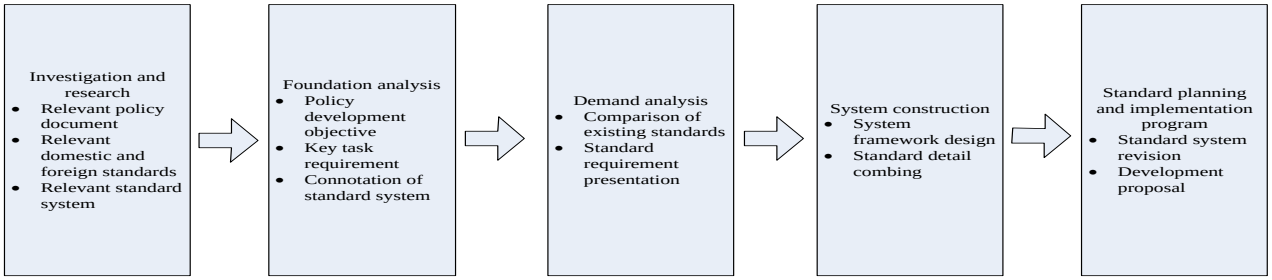

Figure 2: The general idea of standard system construction

The general idea of standard system construction is as follows: First, we should analyze the development goals, main tasks and demands of related fields with a policy-oriented approach; Then, it defines the goal and connotation of the standard system, analyzes the existing relevant standards on this basis, proposes the revision requirements of the standard system, clarifies the framework of the standard system according to certain principles, classifies the current standards and standard demands into the system, and finally completes the construction of the standard system.

At present, Xiongan New Area has entered a period of rapid development. In the 14th Five-Year Plan period, we need to move steadily. It is necessary to comprehensively set the main goals of the 14th Five-Year Plan for economic and social development and the long-range goals of 2035 proposed by the central government, firmly grasp the theme of promoting high-quality development, make scientific plans for the 14th Five-Year Plan for the New Area, promote the construction and development of Xiongan New Area with high standards and high quality, and speed up the new situation of "new image, new functions, new industries, new talents and new mechanisms".

3.2 Geothermal high-quality development standard system

Based on the construction ideas of the standard system, this paper analyzes and studies the Planning Outline of Hebei Xiongan New Area, the Control Detailed Plan of Hebei Xiongan New Area Start-up Area and other related policy documents, and summarizes the specific tasks and construction requirements for the high-quality development of Xiongan New Area. Then, we comprehensively considered the regional characteristics, urban development, industrial layout and renewable energy industry demand of Xiongan New Area, and sorted out the national standards, industrial standards, group standards related to geothermal energy in China and the standards of Xiongan New Area. Then, the development conditions and current resource distribution of geothermal energy in Xiongan New Area (including deep geothermal, shallow geothermal, reclaimed water source, heat pump, etc.) were investigated. Finally, a standard system for research on geothermal energy development and utilization standards in Xiongan New Area will be established.

In accordance with the requirements of high standard, high quality and sustainable development proposed by the state, this paper establishes a standard system that is conducive to government supervision, applicable to enterprises, meets the actual demand of geothermal energy in Xiongan New Area, and is higher than the existing industry standards, reaching the world's advanced level. This system fully considers the relationship between the characteristics of geothermal resources and industrial development. According to the geological characteristics of Xiongan New Area, it constructs a standard system framework with geothermal development and utilization as the key task, and formulates the geothermal resource evaluation method, geothermal dynamic monitoring technology, geothermal recharge technology, geothermal geological exploration technology and drilling engineering technology for the exploitation of hydrothermal and shallow geothermal resources. Guided by the geothermal demand of the region and in accordance with the task requirements of high-quality development, we have sorted out the standards and formulated the requirements, and put forward the framework of the geothermal high-quality development standard system of Xiongan New Area in accordance with the principles and requirements of standard system construction.

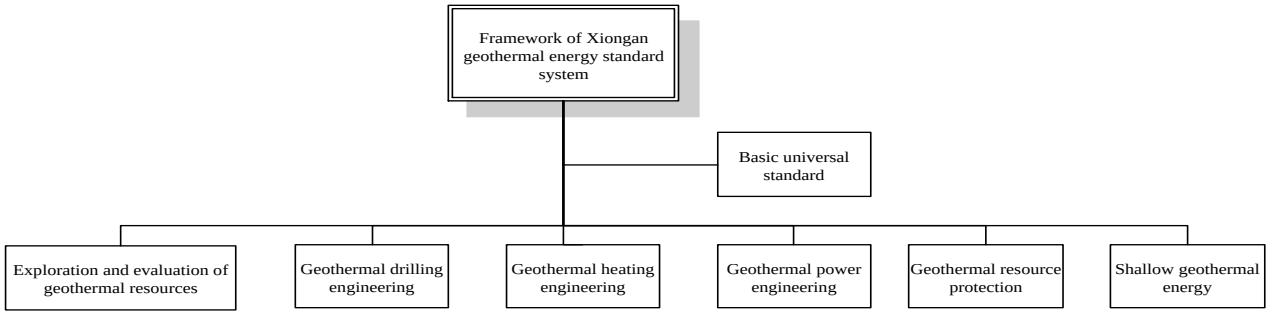

Figure 2: The general idea of standard system construction

3 Standard development content

In this paper, the geothermal energy development and utilization standard system of Xiongan New Area is divided into general basic standard and professional category standard according to the needs of different directions of geothermal energy development and utilization in Xiongan New Area.

General basic standards mainly include Terms of Geothermal Energy, Requirements for the Preparation of Feasibility Study Reports of Projects Directly Utilizing Geothermal Energy, General Principles for the Preparation of Geothermal Development Regional Planning, and Guidelines for the Design of Intelligent Geothermal Management Platform. These standards directly incorporated into the system are widely used and have a guiding significance for the whole process of geothermal development and utilization. According to the process and technological process of geothermal energy exploration, development and utilization, 7 professional categories have been divided, and a total of 87 standards have been included, including 6 national standards, 45 industrial standards, 8 local standards and 28 Xiongan standards. (The standard system mainly considers the technical requirements in the development and utilization process of hydrothermal geothermal energy and shallow geothermal energy in Xiongan New Area. It is recommended that 28 standards be developed).

The standard system is classified according to 7 specialties, among which there are 4 basic general professional standards, which are mainly broad guidance standards. There are 16 professional standards for geothermal resources exploration and evaluation, which mainly specify the comprehensive use of various advanced exploration technologies such as geological survey, geophysics and geochemistry to determine the geological conditions and heat storage characteristics of geothermal fields with high precision. These technologies can realize the fine exploration of geothermal resources and the fine description of heat storage in the new district. Based on the evaluation method of renewable energy, the geothermal resources should be scientifically evaluated to provide a scientific and reliable resource basis for the development and utilization of geothermal energy in the new district. There are 24 professional standards for geothermal drilling engineering. These standards specify the technical requirements for the whole life cycle of drilling design, pre-drilling preparation, drilling and construction, logging, cementing, completion, disposal of abandoned Wells and drilling fluids in order to ensure the safety, environmental protection, quality and efficiency of geothermal drilling in Xiongan New Area, which is located in a densely populated area and a resource-sensitive area. There are 13 professional standards for geothermal heating engineering, which specify that the new district construction projects should prioritize the use of geothermal energy as the basic energy. They should optimize the design, realize intelligent geothermal management, efficient use of geothermal energy, reduce operation and maintenance costs, and ensure the synchronous realization of green, low carbon, low cost and high efficiency of geothermal energy. According to the characteristics of geothermal resources in Xiongan New Area, there are 7 professional standards for geothermal power generation engineering, which specify the survey and design of geothermal power generation projects, the selection of dual-medium power generation technical equipment, construction, operation and maintenance, and power grid access and other technical requirements, providing advanced technical preparations for the construction of geothermal power generation demonstration projects in the New area. There are 7 professional standards for geothermal resource protection, which stipulate that factors causing reservoir damage should be analyzed before exploitation, and measures for reservoir protection should be formulated. In the development and utilization, all raw water should be recharged in the same layer to achieve the purpose of green and sustainable recycling of geothermal resources. Geothermal project dynamic monitoring and regional heat storage dynamic monitoring can assist management departments to supervise and protect geothermal resources, which is especially important for the planning and development of geothermal energy in new areas. There are 16 standards for shallow geothermal energy. Shallow geothermal energy is widely distributed in the New Area, which is a favorable supplement to hydrothermal geothermal resources. The series of standards for shallow geothermal energy stipulate the technical requirements for resource evaluation, survey and design, construction and operation, energy efficiency monitoring, energy efficiency evaluation and analysis of shallow geothermal energy such as soil, renewable water, sewage and surface water, etc., providing a standard basis for the construction management and energy efficiency evaluation of shallow geothermal energy in the new district. There are 87 standards in the whole system (Table 1).

Table 1 Standard system of geothermal energy development and utilization in Xiongan New Area

Standard Category	Total Number	Serial Number	Standard Number	Standard name
Basic General	1	1	NB/T 10097-2018	Geothermal energy terminology
	2	2	NB/T 10098-2018	Requirements for the preparation of feasibility study report of geothermal energy direct utilization project
	3	3	DB13/T 2551—2017	Drafting general rules for regional planning of geothermal development
	4	4	Standards for Xiongan New Area	Guidelines for the design of intelligent geothermal management platforms
	5	1	GB/T 11615—2010	Geological exploration of geothermal resources
	6	2	DZ/T 0331—2020	Estimation and evaluation methods of geothermal resources

Standard Category	Total Number	Serial Number	Standard Number	Standard name
Exploration and evaluation of geothermal resources	7	3	NB/T 10264—2019	Specifications for geothermal resources geophysical exploration technical
	8	4	NB/T 10263—2019	Evaluating methods of geothermal reservoirs
	9	5	NB/T 10702—2021	Technical specification for interpretation of gravity, magnetic and electric data in geothermal resources exploration
	10	6	NB/T 10699—2021	Specification for geothermal geochemical investigation
	11	7	NB/T 10698—2021	The technical specification for productivity evaluation of geothermal well
	12	8	NB/T 10697—2021	Exploration and assessment standard of geothermal fields
	13	9	NB/T 10714—2021	Technical requirement of preparing geothermal reservoir development plan
	14	10	NB/T 10701—2021	Technical regulation for microtremor survey in geothermal exploration
	15	11	NB/T 10716—2021	Specification for collection and preservation of geothermal fluid samples
	16	12	NB/T 10703—2021	Technical regulation for tracer test in geothermal reservoir
	17	13	DB13/T 2554—2017	Technical procedures of Single-well provide geothermal resources evaluation
	18	14	Standards for Xiongan New Area	Technical specification for geothermal geophysical exploration in Xiongan New Area
	19	15	Standards for Xiongan New Area	Technical Guidelines for Evaluation of hydrothermal geothermal heating resources
	20	16	Standards for Xiongan New Area	Guidelines for the development and design of hydrothermal geothermal heating and heat storage
Geothermal drilling engineering	21	1	DZ/T 0260—2014	Technical specification for geothermal well drilling
	22	2	NB/T 10266—2019	Specification for geothermal well drilling engineering design
	23	3	NB/T 10267—2019	Drilling geological design specification for geothermal wells
	24	4	NB/T 10268—2019	Technical specification for mud logging of geothermal wells
	25	5	NB/T 10269—2019	Geothermal well logging technical specification
	26	6	NB/T 10272—2019	Technical requirements for geothermal wellhead device

Standard Category	Total Number	Serial Number	Standard Number	Standard name
Geothermal drilling engineering	27	7	NB/T 10704—2021	Technical specification for pre-drilling engineering and equipment installation of geothermal well
	28	8	NB/T 10706—2021	Technical specification for cementing geothermal well
	29	9	NB/T 10707—2021	Technical specification for geothermal well completion
	30	10	NB/T 10709—2021	Code for acceptance of geothermal well drilling and completion engineering
	31	11	NB/T 10710—2021	Quality requirements and evaluation specifications for original geothermal well logging information
	32	12	NB/T 10696—2021	Design method of borehole structure of geothermal well
	33	13	NB/T 10708—2021	Technical specification for drilling well control in hydrothermal well
	34	14	DB13/T 2571—2017	Technical specification for geothermal well construction
	35	15	Standards for Xiongan New Area	Technical guidelines for hydrothermal geothermal drilling
	36	16	Standards for Xiongan New Area	Drilling geological design specification for geothermal wells
	37	17	Standards for Xiongan New Area	Specification for geothermal well drilling engineering design
	38	18	Standards for Xiongan New Area	Technical specification for pre-drilling engineering and equipment installation of geothermal well
	39	19	Standards for Xiongan New Area	Technical specification for geothermal well construction
	40	20	Standards for Xiongan New Area	Technical specification for surveying (recording) well of geothermal well
	41	21	Standards for Xiongan New Area	Technical specification for cementing geothermal Wells
	42	22	Standards for Xiongan New Area	Technical specification for geothermal completion
	43	23	Standards for Xiongan New Area	Code for acceptance of geothermal well drilling and completion engineering
	44	24	Standards for Xiongan New Area	Guide to Disposal of Geothermal Abandoned Wells and Long shut-ins
	45	1	CJJ 138—2010	Technical specification for geothermal space heating engineering
	46	2	NB/T 10273—2019	Code for design of geothermal space heating station
	47	3	NB/T 10275—2019	Technical code for waste heat use of oilfield produced water

Standard Category	Total Number	Serial Number	Standard Number	Standard name
Geothermal heating engineering	48	4	NB/T 10711—2021	Code for design of geothermal pipe network
	49	5	NB/T 10713—2021	Code for construction and acceptance of geothermal pipe network
	50	6	NB/T 10712—2021	Technical code for intelligent geothermal energy station
	51	7	DB13/T 2550—2017	Code for design of geothermal utilization engineering
	52	8	Standards for Xiongan New Area	Technical guidelines for hydrothermal geothermal heating engineering
	53	9	Standards for Xiongan New Area	Technical Guidelines for construction and quality acceptance of heating (cold) engineering
	54	10	Standards for Xiongan New Area	Technical guidelines for Operation and maintenance management of heating (cooling) systems
	55	11	Standards for Xiongan New Area	Technical guidelines for intelligent monitoring of hydrothermal geothermal heating engineering
	56	12	Standards for Xiongan New Area	Technical specification for heat transfer in hydrothermal Wells
	57	13	Standards for Xiongan New Area	Technical specification for application of medium and deep geothermal buried pipe heating system
Geothermal power engineering	58	1	GB/T 19962—2016	Technical rule for connecting geothermal power plant to power network
	59	2	GB/T 28812—2012	Steam turbines specification for geothermal power station
	60	3	GB 50478—2008	Code for investigation of geotechnical engineering of geothermal power plant
	61	4	GB 50791—2013	Code for design of geothermal power plants
	62	5	NB/T 10270—2019	Performance acceptance test code on geothermal power unit
	63	6	NB/T 10271—2019	Calculation guide for thermal performance of geothermal power generation systems
	64	7	Standards for Xiongan New Area	Technical specification for geothermal dual-medium power generation
	65	1	DZ/T 0330—2019	Technical regulations for geothermal return water reinjection of sandstone reservoir
	66	2	NB/T 10099—2018	Technical requirements for geothermal reinjection
	67	3	NB/T 10715—2021	Standard for geothermal resources dynamic monitoring
	68	4	DB13/T 2553—2017	Operating procedures for geothermal reinjection

Standard Category	Total Number	Serial Number	Standard Number	Standard name
Geothermal resource protection	69	5	Standards for Xiongan New Area	Technical requirements for geothermal reservoir protection
	70	6	Standards for Xiongan New Area	Technical requirements for recharge of hydrothermal geothermal heating
	71	7	Standards for Xiongan New Area	Regulation for dynamic monitoring of geothermal resources
Shallow geothermal energy	72	1	GB 50366—2005	Technical code for ground-source heat pump system
	73	2	CJJ/T 291—2019	Standard for engineering investigation of ground-source heat pump system
	74	3	DZ/T 0225—2009	Specification for shallow geothermal energy investigation and evaluation
	75	4	JGJ/T 438—2018	Technical standard for utilization of geothermal energy through piles
	76	5	NB/T 10265—2019	Exploration specification for shallow geothermal energy development project
	77	6	NB/T 10274—2019	Monitoring and evaluation specification for shallow geothermal energy development impact on the geological environment
	78	7	NB/T 10276—2019	Acceptance specification for shallow geothermal underground heat exchange project
	79	8	NB/T 10277—2019	Technical specification for shallow geothermal drilling
	80	9	NB/T 10278—2019	Technical code of shallow geothermal energy monitoring system
	81	10	DB13/T 2552—2017	Technical specification for groundwater heat pump system
	82	11	DB13/T 2555—2017	Technical code for ground-coupled heat pump system
	83	12	Standards for Xiongan New Area	Ground source heat pump engineering design guidelines
	84	13	Standards for Xiongan New Area	Technical specification for engineering of regenerative water heat pump systems
	85	14	Standards for Xiongan New Area	Technical guidelines for construction and quality acceptance of ground source heat pump engineering
	86	15	Standards for Xiongan New Area	Technical guidelines for intelligent monitoring of ground source heat pump systems
	87	16	Standards for Xiongan New Area	Specification for performance evaluation of energy saving and emission reduction in heat pump system operation

4 SUGGESTIONS ON GEOTHERMAL QUALITY DEVELOPMENT STANDARD SYSTEM

According to the construction of geothermal high-quality development standard system in Xiongan New Area, the following suggestions are put forward:

(1) The promotion and implementation of geothermal energy standards needs to be increased

Government authorities should publicize more standards, especially in the energy planning and construction process of the Xiongan New Area. The government should recommend preferential use of geothermal energy as a form of green energy, and let construction units understand the role of standards and specific requirements in the full life cycle management of geothermal energy.

(2) The exploration of geothermal resources will be intensified

The government may fund or encourage relevant enterprises and institutions to invest funds to strengthen the exploration of geothermal resources, carry out higher precision exploration of geothermal resources according to resource exploration and evaluation standards, conduct fine evaluation of heat storage, improve the reliability of resource evaluation, and provide scientific basis for the development and utilization of geothermal resources.

(3) The whole process management of geothermal energy projects needs to be improved

The government should be strict in the approval of geothermal energy projects. Geothermal mining rights, drainage permits and environmental assessments should be reviewed according to the requirements of the standard, and the approval process should be simplified; At the same time, it is suggested to evaluate the project development scheme based on geothermal energy standards, so as to ensure the renewable energy attribute of geothermal energy development and utilization, and realize the scientific development and sustainable utilization of geothermal resources. It is suggested to use the geothermal dynamic monitoring system to strengthen the supervision of geothermal projects during and after operation.

(4) The importance of monitoring and protecting geothermal resources

It is suggested to establish and improve the dynamic monitoring network system of geothermal resources according to the monitoring standards, so as to master the change trend of geothermal resources and geological environment in Xiongan New Area. This can meet the scientific development and supervision requirements of geothermal resources in Xiongan New Area, provide a basis for government decision-making and development planning, and achieve the protective exploitation of geothermal resources.

(5) The supervision and reward of geothermal energy projects needs to be Increased

For hydrothermal geothermal energy projects, it is suggested to strengthen the operation management of geothermal recharge according to the recharge standards, and entrust a third-party professional certification institution to carry out geothermal recharge certification, so as to ensure that the project can achieve the same-layer recharge of all raw water and balanced drainage and irrigation. It is suggested to strengthen the monitoring and analysis of energy conservation in shallow geothermal energy projects according to energy conservation monitoring standards. Through supervision and management, the government can give financial subsidies and rewards to projects that meet the requirements of recharge standards and have significant energy-saving effects, so as to promote the development and utilization of geothermal energy.

(6) Through the construction of demonstration projects, inspection and improvement of the standard system

The establishment of the geothermal energy standard system in Xiongan New Area is based on the relevant national and industrial standards. However, this system still needs to be adjusted and supplemented through the actual project operation. This paper proposes to establish several demonstration projects of geothermal energy development and utilization in Xiongan New Area. We can comprehensively understand the development of geothermal energy resources, the efficiency of terminal utilization and the impact of geological environment in the process of geothermal energy development and utilization according to the operation and management of demonstration projects. This process of practice can improve the standard system of geothermal energy in Xiongan New Area.

Based on this, this paper suggests that we should focus on strengthening the standardization support work in the professional field of standards, so that standardization can play a leading role in high-quality development.

5 CONCLUSION

This paper establishes a high-quality development standard system for Xiongan New Area, defines the important direction of high-quality geothermal development in Xiongan New Area, and also finds out the supporting role of the standard system for geothermal field. Finally, this paper puts forward some suggestions on standard formulation planning for high quality development. In the standard system table, we proposed 28 standards for the Xiongan New Area to be developed. The technical level of the standards in Xiongan New Area should be higher than the industry standard and reach the world's advanced level. The applicability and technical requirements of the standards should exceed the current level. The geothermal standards to be formulated in Xiongan New Area can be divided into three categories: The first category is the technology that urgently needs to be unified for geothermal energy utilization and engineering construction. Such standards have important guiding significance for the improvement of geothermal industry level. Therefore, it should be formulated as soon as possible, including professional standards for resource exploration and evaluation, resource protection, heating engineering and shallow geothermal energy. The second category is the standard that needs to be developed after one or two years of development, mainly drilling engineering standards. The third category is forward-looking standards, mainly geothermal power engineering standards. Studying the standard system of Xiongan New Area can support the high-quality development of the geothermal industry. After that, we will carry out research on the green development of new energy.

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