China's energy policies on nuclear energy in 2018

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1. Introduction

The nuclear power industry has been slow to grow globally since the Fukushima severe accident. But China has adopted a rapid development strategy. This is because energy demand is increasing due to rapid economic growth in recent years despite its low technology and the Chinese government have been keeping the active support and resources. Korea, which is trying to order a nuclear power plant, needs to keep looking at the policy direction of the neighboring countries. In this study, we will examine China's nuclear research and development policy and try to understand the current state of nuclear power in China.

2. Energy policy and GHG emissions status

2.1. Energy policy

As of 2018, China's energy policy is being pursued in accordance with the "Strategic action plan for energy development (2014-2020)" announced by NEA in 2014 and the "13th Five-Year Energy Development Plan (2016-2020)". In the 13th Five-Year energy development plan, they will reduce energy consumption by 15% until 2020 and expand non-fossil fuel energy supply to 18% of the total such as hydro, nuclear and renewable energy.

China faces the problems of energy supply such as demand imbalance caused by rapid economic growth, environmental pollution due to fossil fuel use, difficulty in energy transportation, and increasing dependence on overseas resources

(1) Energy resources are abundant, but the average power consumption per person is low: Based on 2016, they have 21.4% of coal, 2.9% of natural gas and 1.5% of petroleum in the world reserves. But personal power consumption is 4.05MWh barely.
(2) Environmental pollution due to fossil fuel use: China is the most emissions of greenhouse gas (GHG) country in the world. Their emissions exceed the US since 2016.
(3) Energy transport problems between power generation and consumption areas: Electricity is mainly produced in the northwestern region, while most of the power is consumed in the southeastern region, which is a dense population place and electric power transportation problems arise.
(4) Increased dependence on overseas resources: In the case of fossil fuels with a large proportion of power generation sources, petroleum and natural gas imports, excluding coal, are ranked second and fifth respectively in the world.

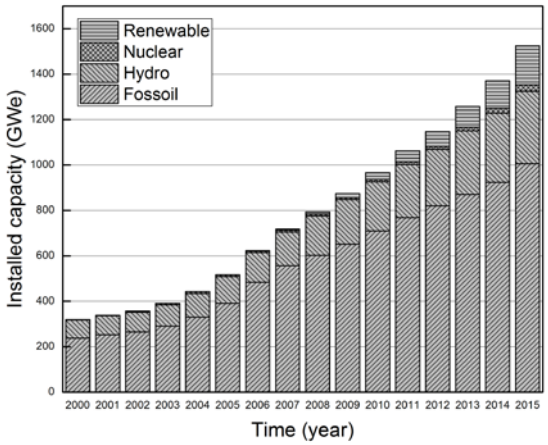

Figure 1. China's energy capacity by facility

After a major power shortage in 2002, as a result of China's efforts to develop power, the total installed capacity as of 2015 was 1,525GWe, four times that of 357GWe in 2002 (Figure 1), the total generation amount of 5,860TWh, also more than four times that of 1,654TWh in 2002. (Table Ⅰ)

Table I. China's energy output by energy source

Year	'00	'02	'05	'10	'14	'15
Total generation	1,356	1,654	2,501	4,208	5,679	5,860
Nuclear	17 (1.2)	25 (1.5)	53 (2.1)	74 (1.8)	133 (2.3)	171 (2.9)
Fossil*	1,114 (82.1)	1,337 (80.9)	2,043 (81.7)	3,333 (79.2)	4,239 (74.6)	4,264 (72.8)
Hydro	222 (16.4)	288 (17.4)	397 (15.9)	722 (17.2)	1,064 (18.7)	1,130 (19.3)
Renewable**	3 (0.2)	4 (0.2)	8 (0.3)	79 (1.9)	243 (4.3)	295 (5.0)

* coal, natural gas, oil
** solar, wind, biomass etc.

2.2. GHG emissions status

As of 2016, China's GHG emissions amounted to 9,126 million tons of CO_2eq, making it the world's largest GHG emitter after overtaking the US in 2006. About 3,760 million tons of CO_2eq are emitted in the energy sector. In particular, because of the emission of 3,647 million tons of CO_2eq (97% of the total) is made of coal, China will expand the use of non-fossil fuels to reduce GHG emissions. To achieve this, fossil power generation is expected to 65.9% reduced by 15% from

2002 and nuclear and renewable energy generation by 6.5% and 9.5% respectively.

Assuming that China will reduce its GHG emissions 18% against 2015 as suggested in the 13th Five-Year energy development plan, GHG emissions amount to 7,515 million tons of CO_2eq.

* CO_2eq (Carbon Dioxide Equivalent) is an indicator for estimating the amount of GHG

3. Nuclear policy and organization

3.1. Nuclear policy

China's nuclear policy can be divided into three stages: beginning of development → active development → development acceleration. The first to the second phase is divided by the end of the Cold War era and economic revitalization. The third phase in the second phase is divided by the Fukushima accident in 2011.

(Beginning of development Phase) As from 1950s to the end of the 1970s, CAS decided to adopt the "Outline of the Science and Technology Development Vision Plan from 1956 to 1967" in 1956, mainly for the purpose of military use of nuclear power. However, in 1966, the research and development was suspended due to the Cultural Revolution. In 1974, the "728 Project", the first nuclear power plant project in China, is started.

- Decided to 'localize nuclear reactor through independent development and introduction of advanced technology', which is the basic policy of reactor research and development
- In addition to adopting the PWR as the main model, introduced reactors in the US, France, Canada, and Russia to develop various types of reactors.

(Active development Phase) From 1980 to 2010, the '863 Plan', a high-tech industrial development plan, was implemented in the background of the end of the Cold War era, China's reform and opening flow, and economic revitalization. At this time, the main purpose of nuclear energy development in China is changed from military use to peaceful use, and the nuclear industry is fostered. CNNC, which is a state-owned enterprise, becomes a propelling subject.

-In 1983, China pursued the modernization of four fields such as agriculture, industry, science and technology, defense and also promoted economic development and scientific technology development simultaneously.

- Especially in the 1990s, the secondary industry has grown rapidly, and the problem of electric power generation to meet the power demand in the northeast region, which is a heavy chemical industrial base, and the southern part where the export industry has developed,
- On the other hand, since coal, which is a major energy resource, is located in the North China region, it has difficulties in transportation of electric power and actively promotes localization of nuclear power as part of electric power generation.

(Development Acceleration Phase) From 2011 to 2030, "12th Five-Year Energy Development Plan (2011-2015)" and "13th Five-Year Energy Development Plan (2016-2020)", "Long-term Energy strategy Research in China (2030, 2050)" is based on the contents.

- Following the expansion of the nuclear power plant business, state-owned CNNC was enlarged and CGN's and SPIC's role was expanded.
- After the Fukushima nuclear accident, China reviewed the Nuclear Safety Development Plan by accepting the point of safety and operation management of the NPP** which had been raised before the accident, due to the development of various reactor types.
- According to the "Nuclear Safety Plan" established it is impossible to build a new nuclear power plant with the existing model. They are trying to develop "HPR1000" which is suitable for export as well as unification of domestic production.

**nuclear power plant

In the "13th Five-Year Energy Development Plan" currently being implemented in 2018, the target is set as 58 GWe for operation capacity and 30 GWe for new construction in 2020. The main contents are as follows.

- The safety of the nuclear power plant was reviewed by Fukushima nuclear power plant accident, but the facility capacity plan of the new nuclear power plant in 2020 is the same as the "12th Five-year energy generation plan".
- In addition, the construction of new reactors 'CAP1400' and 'HPR1000', which have intellectual property rights, are mainly built and securing the site for the construction of the internal zone.
- Construction of 'ACP100', which represents the multi-purpose integrated Small Modular Reactor (SMR), commercialization of the Sodium-cooled Fast Reactor (SFR), promotion of the High Temperature Gas-cooled Reactor (HTGR), Thorium Molten Salt Reactor (TMSR), continue research and development as a next-generation reactor.
- Establishment of large-scale spent fuel reprocessing plant construction and nuclear experts training program.

3.2. Nuclear development system

Under the management of the State Council, China's nuclear energy development system is mainly based on SASAC and NDRC. There are also other government organizations, MEP, MOST, MIIT, NEC and MOH. There are the participation of government organizations such as NNSA, SASTIND, CAEA, NEA and which are classified as state-owned enterprises of CNNC, CGN, and SPIC. They can contribute more than 50% to the nuclear power (NP) business. (Figure 2)

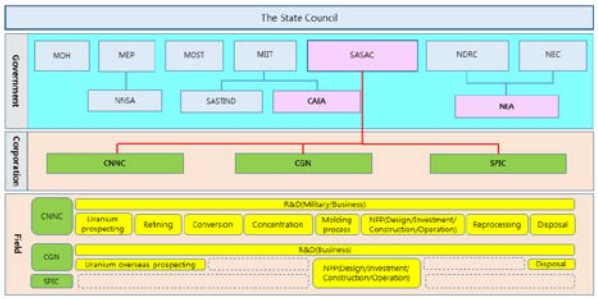

Figure 2 NP development system and field

- SASAC oversees state-owned companies CNNC, CGN and SPIC, and NDRC approves nuclear business.
- NEC conducts establishes, implements and supervises of energy development strategies, and NEA functions as a secretariat.
- NEA is responsible for the management of nuclear power generation, planning, project review, establishment and implementation of technical standards, development of nuclear energy science and technology and management of NPP emergency response.
- CAEA under MIIT is mainly responsible for policy making and international cooperation on the peaceful use of nuclear energy, and SASTIND is responsible for policy on the military use of nuclear power.
- CNNC is the largest nuclear power company in China, mainly responsible for nuclear power design, but it will be a large nuclear power state-owned enterprise with facility manufacturing function as the merger with CNEC, the nuclear power construction company, in 2018. The scale is about 110 trillion won.
- CGN was established in 1994 and is in charge of nuclear research and development. It is expanding its nuclear business through 20 subsidiaries. As of 2018, CGN is about 4.7 trillion won in assets.
- SPIC is a state-owned enterprise established by the merger of SNPTC, which has experienced localization of nuclear power plants in 2015, and its capital is about 770 billion won by 2016.

REFERENCES

[1] TEPIA, 中国原子力ハンドブック 2015, 東京: Tepia.
[2] TEPIA, 中国原子力ハンドブック 2012, 東京: Tepia.
[3] BP, Statistical Review of World Energy 2017
, 中国原子力ハンドブック 2012, 東京: Tepia.
[4] IEA, CO2 Emissions from Fuel Combustion, 2017
[5] 中国能源中长期发展战略研究项目组(2011), 中国能源中长期(2030、2050)发展战略研究：电力 油气, 北京: 科学出版社