Global Trend of Nuclear R & D

Tae Joon LEE[a*], Sooeun Kim[a], Mirae Yun[a], Jieun Joo[a], Maeng-Ho Yang[a]
[a]*Future Strategy Research Division, Korea Atomic Energy Research Institute. 989-111, Daedeok-daero, Yuseong-gu, Daejeon, 34057, Korea.*
[*]*Corresponding author: tjlee@kaeri.re.kr*

1. Introduction

The objective of study is to investigate and analyze the state of nuclear energy research and development according to the nuclear policies of major foreign countries and to draw implications for the direction of nuclear energy research and development of Korea. As the Fukushima nuclear accident (March, 2011) and the Paris Climate Convention (Dec., 2015) impacted nuclear policies of nuclear power countries, this study divided the policies into six types. Leading nuclear power promotion (China), maintaining large-scale nuclear power industry (France), Conversing energy policy towards new construction and expansion of nuclear power plant (UK), Resolving Fukushima nuclear accident and recovering nuclear power industries (Japan), conversing energy policy towards abolition of power generation (Germany, Switzerland) This study drew implications through analysis of nuclear policy and R & D status of the seven countries for Korea.

2. Methods and Results

Based on the six nuclear policy bases, this study investigates and analyzes the environment and topics/tasks of nuclear research and development of seven countries. The status of nuclear energy research and development of international organizations was investigated and analyzed in order to supplement national analysis and to understand global trends. he environment of nuclear research and development was examined in terms of the state of nuclear energy policies and administrative organizations related to nuclear energy research and development The topics and tasks of nuclear energy research and development are examined on the basis of on research and development contents (goals and main content) and uses (purpose and expectation effect).

In-depth investigation of the current state of nuclear R & D was carried out in terms of external environment, national policy environment, R & D themes and tasks. First, local field surveys are conducted to collect and supplement data as much as possible in Korea. Second, taking into account trends of R&D are well recognized by nuclear scientists and engineers in research institutes and universities, their knowledge was used to their fullest extent through technical seminars, advisory meetings, interviews and email consultations. Third, we collected the latest information about R & D trends from agenda and material at bilateral or multilateral international meetings. Fourth, KAERI experts (IAEA, NEA, U.S.) dispatched locally, experts in other institutions (STEPI, China) contributed to this project. Fifth, data were collected from foreigners (UK, Japan) and foreign embassies in Korea (France, EU) working at domestic nuclear institutions (universities, research institutes). Sixth, publicly available materials (authorized institutional publications, Internet publications) are collected in consideration of the lateness.

3. Results

The status of nuclear energy research and development based on the nuclear policy of major nuclear power countries was investigated and analyzed as follows. China, leading the nuclear power promotion, is pursuing research and development for securing the world-class technology in almost all of the roads from the third generation in operation, the fourth leading generation type, and the small roads. France's nuclear research and development focuses on safe operation and management of nuclear, spent fuel, and final disposal sites for the purpose of enhancing safety of nuclear power system and enhancing competitiveness of nuclear industry. The UK has undertaken research and development on nuclear reactors, recovery of old nuclear power industries, dismantling of old nuclear facilities, management of spent nuclear fuel and developing future-oriented small reactors. Japan has been focusing on R & D on Fukushima Nuclear Power Plant accidents and the safety of existing nuclear power system. In order to maintain the existing nuclear industry and to restore the competitiveness of the future nuclear power market, the US is focusing on supporting nuclear power industries, developing advanced nuclear reactor concepts and innovating nuclear cycle technology. Under the policy of de-nuclearization, the German government is investing heavily in research and development to strengthen nuclear safety, i.e reactor safety, radioactive waste management and radiation protection. Switzerland is also focusing on the research and development for the safety of nuclear facilities under the policy of de-nuclearization, and conducts related research and development to prepare for the future change of global nuclear technology. All of Nuclear R&Ds organized by OECD/Nuclear Energy

Agency and European Union aims at strengthening nuclear safety both now and in the future.

3. Conclusions

There are two implications for Korea's nuclear research and development through the analysis of nuclear research and development environment and topics/tasks of seven countries. First, regardless of the difference in nuclear policy in each country, almost all countries are actively promoting research and development for safety improvement. Nuclear safety research aims not only to secure safety of nuclear reactor , but also to manage spent nuclear fuel (treatment and disposal) and decommission. The goal of reactor safety is to prevent severe accidents and improve existing technologies and develop new concept of technologies including accident-resistant nuclear fuel. R & D on spent fuel management is relatively different depending on the nuclear policy of the country but also the spent fuel management policy. R & D on decontamination and decommission is being actively carried out in the UK where there are many old-age nuclear facilities, in Japan which are striving to resolve the Fukushima nuclear accident. R & D on economical improvement of nuclear power is mainly limited for aging mitigation and life extension of nuclear power plants in the USA. Second, R & D for future nuclear technology innovation tend to depend on nuclear policy. In Germany and Switzerland, which are pursuing the policy of de-nuclearization, the research and development of 4th-generation reactors and small-scale reactors are not being stood out. China, which is promoting nuclear power, is actively developing GIF type 4th generation reactor and small/ultra-small-scale reactor. The United States has been actively investing the R & D on versatile test reactor (VTR), supporting private's R & D of small modular reactor while the UK has begun developing a small modular reactor. In France and Japan, there is a movement to reduce or stop R & D on GIF 4th generation nuclear reactors, and both countries are not actively promoting small/ultra(micro) nuclear reactors. The results obtained through this study are expected to be used to check the Korean Nuclear R & D policies and strategies under the energy conversion policy, and to enhance the feasibility of technological and economic validity of Korea's nuclear R & D projects. It can be used to supplement the current policies and plans of Korea's nuclear R & D by identifying and implementing policy directions or topics that have not yet been reflected at present, in the process of shifting the nuclear R & D paradigm to people's life and safety.

REFERENCES

[1] Atomic and Alternative Energies Commission (CEA) 'Gen II & III R&D on LWR Severe Accidents,' 23rd Meeting of the Korea-France Joint Coordinating Committee on Nuclear Energy (JCCNE), Paris, 4 July 2018.

[2] C. Georges 'Towards Increased Cooperation of R&I Activities for Decommissioning,' 23rd Meeting of the Korea-France Joint Coordinating Committee on Nuclear Energy (JCCNE), Paris, 4 July 2018

[3] Federal Ministry for Economic Affairs and Energy (FMEAE), 7th Energy Research Programme of the Gederal Government-Innovation for the Energy Transition, September, Berlin, 2018

[4] K. Horio, Chronology of Japan's Nuclear Policy and Governance, SERC/CRIEPI, 2019.04.

[5] Nuclear Regulation Authority(NRA), Enforcement of the New Regulatory Requirements for Commercial Nuclear Power Reactors, 2013.07.08.

[6] UK Department for Business Energy and Industrial Strategy, Advanced Modular Reactor (AMR) Feasibility and Development (F&D) Project - Abstracts from the Applicant Organisations. 2018.

[7] US Department of Energy (USDOE), FY 2020 Congressional Budget Request: Budget in Brief, DOE/CF-0156, March, p32-34, 2018

[8] US Department of Energy (USDOE), Nuclear Power Summary – News & Notes, February, pp7-9, 2019