

Analysis of World Nuclear Market and Strategy of Korean NPP's Competitiveness Improvement for Exportation

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1. Introduction

World nuclear industry is recently having dynamic period of change. Demand of nuclear power increased dramatically in 2000s, so called 'Nuclear Renaissance', but Fukushima accident (2011) chilled down the nuclear industry and increased the uncertainty of world nuclear power plant (NPP) demand. After Fukushima accident, each country gradually settled down their own plan of electricity and some countries, especially developing countries, were still eager to adopt nuclear power. China, India and USA (nuclear adopted countries) are planning tremendous number of NPPs to meet their increasing electricity demand and Saudi Arabia, Vietnam (nuclear adopting countries) are also planning to include nuclear power in their energy mix as a long-term plan.

Korea has exported 4 units of APR1400 to the UAE in December, 2009. Korea became sixth NPP supplier country and our economic feasibility and safety features were started to evaluate worldwide. Nuclear industries became a new driver of Korea's export and nuclear industries in Korea are now expecting another NPP export to Middle-eastern countries, including UAE and Saudi Arabia, based on the first-mover's advantage at the UAE.

In 2000s, five countries (Japan, USA, France, Russia and Korea), which are able to build NPP, focused on NPP export more than domestic construction. Global trend of world nuclear market changed rapidly, especially after NPP export to the UAE. By the global trend, hegemony of nuclear market migrated from supplier country to buyer country. Nuclear companies started cooperating rather than competing. Financing to developing countries become more important. Furthermore, Korea's winning strategy in UAE affected competitor countries a lot. Their strategy evolved and their competitiveness has improved much more than before. Now, Korea should plan advanced strategy for exporting additional NPPs with the consideration of new trend and evolved competitors before it is too late.

2. Global Trend and Market Analysis of World Nuclear Market

2.1 Changes in Rule of Game

One of the major changes in nuclear export market is that the pivot of nuclear power market migrated from the domestic market of supplier countries to overseas market of developing countries. In the early phase of nuclear power industry, most of NPP was built for the domestic demand. The domestic demand from the supplier countries was comparatively larger than the overseas NPP export until 1980s. As a result, the NPP supplier held the pivot of nuclear export market.

However, the circumstance of nuclear export market has changed since 1990s. Saturation of domestic NPP market and the series of nuclear accident, including TMI accident (1979) and Chernobyl accident (1986) chilled down the construction of domestic NPP in supplier countries. After 1990s, the number of NPP export started to overtake the number of domestic NPP construction except for 2006~2000, when the constructions in China and Russia were accumulated. Therefore, the pivot of nuclear export market moved to buyer countries and the needs of those countries drove the nuclear export market.

Main characteristics of current nuclear export market are M&A and alliance of nuclear industry. In 1980s, many nuclear companies, originated from single nation, did M&A and became multinational companies to overcome the period of nuclear recession initiated by TMI and Chernobyl accident. In 2000s, so called 'The Nuclear Renaissance', several multinational companies further increase their size and competitiveness by alliance with each other to prepare the increasing demand of NPP. Framatome (France) merged with Siemens (Germany) and became the largest nuclear company AREVA in 2001. Moreover, AREVA cooperated with MHI (Japan) in 2007. Westinghouse (USA) was merged by Toshiba (Japan) in 2006 and GE (USA) and Hitachi (Japan) made a joint venture, GE-Hitachi against Toshiba-WEC. Russia also established a national conglomerate, ROSATOM by merging private companies and government organizations. AREVA, Toshiba-WEC, GE-Hitachi and ROSATOM are now considered as the major nuclear companies capable to export NPP. Since major countries concentrated on their capability into single consortium, the competition

between NPP supplier companies is intensified to the national competition for a while.

By extension, current trend of nuclear export market changed to national alliance beyond the national competition. After KEPCO consortium exported NPP to UAE, major countries reinforced the unity of domestic consortium and sought a way to cooperate with other nations to overcome their weak points, such as financing capability, fuel cycle management and so on. In addition, China is going to participate in the member of major supplier countries.

2.2 Changes in World Nuclear Market

Possible nuclear export markets and their characteristics were reconsidered and reclassified by the changes of rule of game. The world nuclear market can be mainly divided into open market and closed market. Open market is again classified into first-time buyer, emerging countries and developed countries by their maturity of nuclear industries.

Up to 2030, electricity demand from NPP export market is expected to 68GW. In the past, EPC-Turnkey contract was the common business type to export NPP. However, current and future business type of NPP export market migrate to EPC (Engineering, Procurement and Construction) plus Operate type, including EPC O&M (Operating and Maintenance) and BOO (Build, Own and Operate), also including BOT (Build, Own and Transfer). EPC+Operate market (55%) is larger than EPC-Turnkey market (45%). Since India takes 80% of electricity demand from EPC-Turnkey business, the majority of NPP exporting countries prefer to export nuclear power by EPC+Operate (O&M, BOO/BOT) type of business.

3. Strategies of Major Competitor Countries

3.1 Japan

Main strategy of Japan is based on 'All Japan' system and M&A/partnership between individual corporations. After Japan failed to make a contract with UAE, Japan reinforced governmental support to complement the limitation of civil industries. Japan established JINED, a private and public joint organization, to integrate the capability of both private industries and government for same goal. Japanese government provided comprehensive supports, including diplomatic, financing support. At the same time, individual corporations participated in nuclear business by doing M&A and taking a partnership with foreign corporations in case of country without JINED. Therefore, Japan is fully prepared with 'All-Japan' system and wholehearted support from government, especially financing; however, Japan has lack of capability for independent construction of NPP.

3.2 France

AREVA (France) emphasizes their overall solutions of nuclear. AREVA and EDF covered all required chain to build and operate NPP. AREVA's advanced technology based on plenty of experience of construction, fuel supply and operation. AREVA has the largest share of world nuclear reactors. In addition, AREVA has already have operation model of oversea NPPs. AREVA cooperated with EDF and EDF had operating experience of oversea NPPs. In summary, France is well prepared by overall technology and oversea operating experience, but France has relatively weak capability of financing compared to other competitors.

3.3 Russia

Recently, Russia's state atomic energy corporation, ROSATOM swept the world NPP export market. ROSATOM has exported 12 cases of NPP exports from 2010 to 2014. ROSATOM is equipped with export preferred nuclear industry and total SCM (Supply Chain Management). Russia's export preferred nuclear industry, so called 'Wolf Spider Strategy', means that Russia's nuclear industry originally not just stays in domestic market but also hunts oversea market. Similar to the case of France, all service of whole nuclear cycle is united in one ROSATOM system. Furthermore, Russia provides exclusive fuel management. If when buyer country requests treatment of spent fuel, Russia even takes the spent fuel to their territory. For financing, Russia can support customers with audacious contract conditions, because Russia is free from CIRR (Commercial Interest Reference Rates), only applied to OECD members. Therefore, Russia is able to provide total SCM and audacious condition of financial support; however, Russia's financing capability is getting weaker than before due to harsh economic environment originated by low oil price and high RUB-USD exchange rate.

3.4 China

Nuclear industries in China have been enhancing the competitiveness for NPP export by M&A and unification of reactor models. China's nuclear companies kept increasing their size to compete with global competitors and to beware of duplicated investment due to non-unified reactor models from individual nuclear companies. China has only proceeded the export project to the countries which military/economic cooperate with China. China has supported NPP to Argentina and Pakistan so far. To sum up, China can provide package deal and abundant of funding from government; however, China has never competed with foreign competitors before.

4. Strategies for NPP Exportation

Based on the description on strategies of other competitors, Korea's problems and advantages were summarized on Table 1. For non-contracted countries, partnership with certain competitor countries will be the most effective method, because Korea still has had unsolvable problems, such as financing capability and management of back-end fuel cycle, described above. Those problems cannot be solved just by the re-organization of business system or the willingness of government. It seems to be almost impossible to hold new exportation project from financially incapable countries without foreign partners due to the lack of political and financial capability of current government.

Table 1. Summary of Korea's problems and advantages

Problems	Advantages
> Poor willingness of government	> Agile response capability
> Inefficient business system	> Fast NPP construction/cost efficiency
> Poor support from government	> Independent overseas construction
> Limited financing	
> No capability to handle back-end cycle	
> No multinational collaboration	

In general, one of the considerable combinations is Korea-Japan-USA alliance. Korea is in charge of EPC, Japan supports financing and deficient technology (with USA partner), and Japan-USA handles fuel supply and back-end fuel cycle based on new agreed terms of ROK-US Nuclear Cooperation Agreement. This combination was judged to best way to collaborate with global companies.

Paying attention to many delayed (or potentially delayed) constructions from Russia, intercepting the construction work will be available in case of contracted countries. Korea can emphasize the short construction time, high responsiveness and mild/equal diplomatic position to the target countries.

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