A New Nuclear Issue on the Korean Peninsula: The Rise of Korea's Nuclear Power Industry

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In the past few months, Korea's profile as a peaceful nuclear power has risen with the announcement of a deal for its first ever export of a nuclear power plant—to the United Arab Emirates. Since that announcement, Korea has reached an agreement to build a research reactor for Jordan and hopes to win a contract to build a reactor in Turkey as well.

Korea's growth as a peaceful nuclear power has raised new issues relating to nuclear co-operation between the United States and Korea. When the initial U.S.-ROK nuclear cooperation agreement was signed in 1974, the United States was less concerned about the spread of enrichment and reprocessing technologies. However, as the United States and Korea prepare to negotiate a new cooperation agreement, one of the key issues will be Korea's entitlement to conduct pyroprocessing, a form of reprocessing, of spent nuclear fuel in Korea.

Since India conducted its first nuclear test in 1974, the United States has sought to limit the spread of fuel cycle technologies related to enrichment and reprocessing given its concerns regarding the proliferation of nuclear weapons. In addition to these concerns, the United States will have to weigh the impact of allowing Korea to pyroprocess spent nuclear fuel on its efforts to halt North Korea's nuclear weapons program. For Korea, the issue is one of necessity, as its ability to continue stockpiling spent nuclear fuel is reaching its limit.

History of Korea's Nuclear Industry

Unlike the Middle East or other parts of the world, South Korea is largely devoid of fossil fuels. It lacks its own domestic sources of oil and natural gas, and, unlike North Korea, has only minimal amounts of coal and hydroelectric power. As a result, Korea has been largely dependent upon foreign imports of oil and natural gas for its energy needs. To address this dependency, Korea has sought to secure an economical and stable supply of energy for its growing economy. Like many other emerging nations that lack large reserves of fossil fuels, Korea has come to view nuclear power as the most reliable source of energy for continued economic growth.

Korea's major push into nuclear power took place in the 1970s during its drive towards industrialization, but its domestic nuclear program dates back to 1957 when it joined the International Atomic Energy Agency. Its first reactor was a small research unit that came on-line in 1962, and its first commercial reactor came into service in 1978. During these early years, Korea largely imported nuclear reactors from abroad, and there was little opportunity for domestic firms to take part in the construction, design, and supply of the reactors.

The first generation of Korean nuclear reactors was built almost solely by foreign contractors from the United States. Later reactors would be built based on foreign designs, but would also entail greater involvement in their construction by Korean firms. In the mid-1980s the Korean industry sought to standardize the design of its reactors and embarked on an effort to achieve self sufficiency in nuclear technology. As a result, in 1987 Korea entered into a ten year technology transfer agreement, extended in 1997 for another 10 years, with Combustion Engineering, now a part of Westinghouse. From this effort came the Korean Standard Nuclear Power Plant (KSNP), with Korea's first domestic power plant coming into service in 1998.

By the late 1990s, Korea was constructing nuclear power plants from almost completely Korean design. Korea's nuclear push has made it the world's fifth largest producer of nuclear power and placed it on the verge of joining the select group of global exporters of nuclear power plants.

Green Growth and Korea's Nuclear Ambitions

In recent years, Korea has committed to a transition to low carbon, green growth. Under President Lee Myung-bak, this vision has included a commitment to alternative energies, R & D into environmentally friendly technologies, and a reduction in Korea's greenhouse gas emissions. Prior to last year's Copenhagen Summit on Climate Change, Korea committed to reduce its projected carbon dioxide emissions in 2020 by 30 percent. In making its pledge, Korea became the first nation under the Kyoto Protocol to announce emissions cuts that it is not required to undertake under the agreement. At the same time, Korea is working to increase its use of renewable energy from 2.6 percent to 11 percent of its total energy usage.

While Korea first embraced nuclear power as a way to secure its energy supplies, it has also come to see nuclear power as a key component in reducing Korea's emissions of carbon dioxide. Korea currently generates 40 percent of its electricity from 20 nuclear power reactors. By 2030, nuclear power is expected to grow to provide 59 percent of Korea's electricity, with plans to add an additional 18 nuclear reactors.

In addition to supplying Korea's domestic market, nuclear power is seen as a promising green growth export engine. The KSNP has become an internationally recognized nuclear power plant designer, and after subsequent improvements Korea has marketed the KSNP power plant design abroad for export as the Optimized Power Reactor. The demand for nuclear power is expected to grow as the world works to confront climate change. According to the World Nuclear Association, the international community will build an additional 430 nuclear plants built by 2030, with the construction of new nuclear power plants rising to 1400 by 2050.

In late 2009, Korea was awarded a contract to export its first nuclear power plant—to the United Arab Emirates (UAE). In winning the contract to build four reactors in the UAE, the Korean-led consortium was able to underbid competitors from the United States, Japan, and France, which have dominated the nuclear power industry for decades. Led by the Korea Electric Power Corporation, the consortium has a reputation for constructing power plants quickly and running them efficiently, something that cannot always be said of its competitors. All told, the contract with the UAE is expected to be worth $20 billion for construction and another $20 billion for running the reactors.

Shortly after winning the contract in the UAE, Korea won a contract to construct a 5 megawatt research reactor in Jordan. At the signing ceremony for the agreement, Khaled Toukan, the chairman of the Jordan Atomic Energy Commission, praised the development of Korea's nuclear technology and indicated that he believed that Korea possessed the world's best nuclear reactor technology. He also indicated that Korea is likely to receive contracts for the construction of more than one commercial reactor in the future. In addition to its successes in Jordan and the UAE, Korea is looking to win bids to build nuclear power plants in other countries and is in preliminary talks with Turkey and China. All told, Korea hopes to export up to 80 nuclear reactors by 2030.

Renewal of the U.S.-Korea Nuclear Agreement

Since first bringing its reactors on-line, Korea has accumulated more than 10,083 tons of spent nuclear fuel and is adding another 700 tons each year. It is estimated that the accumulation of spent fuel will grow to 110,000 tons by the end of the century if Korea proceeds with its current plans to construct 18 new

reactors. This is increasingly becoming a problem for Korea, as its capacity to store spent fuel is reaching its limits.

Because of the scale of the problem and domestic politics in Korea, the development of a long-term storage facility is not practical. Korea is seeking to use pyroprocessing, a form of reprocessing that is seen as more resistant to proliferation than traditional forms of reprocessing spent nuclear fuel, both to reduce the amount of material that will need storage and to reclaim usable fuel. To this end, Korea has begun constructing a test facility for conducting pryroprocessing.

As part of its Academic Paper Series, KEI recently posted on its website a paper on this topic by Park Seong-won, Miles Pomper, and Lawrence Scheinman. The paper, entitled "The Domestic and International Politics of Spent Nuclear Fuel in South Korea: Are We Approaching Meltdown?" explores the constraints that Korea faces from both its domestic political situation and the current U.S.-ROK nuclear cooperation agreement.

The current domestic political situation makes storing spent fuel in either one large facility or multiple facilities in Korea impractical. If one facility were constructed for all of Korea's expected spent fuel it would cover the same area as Manhattan. Park, Pomper, and Scheinman note that, after trying for years to gain public support for a storage facility, Seoul has been able to gain support for a low-and intermediate-level facility in Gyeongju only by providing a series of incentives that would make storing more toxic fuel economically impractical. To secure the facility in Gyeongju, the government had to agree that no additional storage facilities would be located there, and to provide a one-time contribution to the city of $300 million and an additional $600 for each waste drum stored in the facility. In addition, it had to agree to relocate the headquarters of Korea Hydro and Nuclear Power to Gyeongju, to build a proton accelerator and related research facilities in the area, and to provide additional long-term federal support to the area.

If long-term storage is not an option, Korea also faces obstacles to reprocessing its spent nuclear fuel. Korea's ability to conduct reprocessing is subject to the U.S.-ROK nuclear cooperation agreement, which is set to expire in 2014. As part of its renegotiation, Korea would like the United States to allow for the reprocessing of spent fuel through pryroprocessing in any new agreement. However, as the authors note, while the original cooperation agreement requires that spent fuel be reprocessed at a facility agreeable to both parties that is subject to IAEA inspections, the United States has sought to prevent the spread of enrichment and reprocessing technology to prevent the proliferation of nuclear weapons since India's "peaceful" nuclear test.

Initially, the Bush administration seemed open to pyroprocessing as a solution to spent fuel and did not consider it to be a form of reprocessing. However, Park, Pomper, and Scheinman note that a subsequent draft nonproliferation impact assessment found that pyroprocessing was not significantly better than traditional reprocessing in preventing the risk of proliferation and that the Obama administration appears disinclined to agree to Seoul's request for pyroprocessing to be included in any new agreement. However, they argue that to win the administration's support for Korea's pyroprocessing efforts "South Korea may have to be willing to take on new global nonproliferation commitments commensurate with its new role as a major global nuclear technology supplier, or in some cases be more public about doing so."