

Nonproliferation Issues in U.S.-ROK Nuclear Cooperation by Dr. Chen Kane

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Background

The ROK-US nuclear energy agreement, which was initially signed in 1972 and revised in 1974, will officially expire in March 2014. Currently, South Korea has 20 reactors in operation, six under construction, and plans to increase nuclear capacity to 38 reactors by 2030. These reactors will produce more than 110,000 tons of spent nuclear fuel by 2100.¹

South Korea also plans to become an international exporter of nuclear plants. After just recently impressively winning a US\$20.4 billion contract to develop nuclear power plants for the UAE, build a research reactor in Jordan, and train Egyptian nuclear engineers, the ROK announced its objective to export 80 nuclear reactors by 2030.²

A key driver in ROK nuclear energy planning is the management of spent fuel, with South Korean nuclear authorities estimating that they will run out of storage space for spent reactor fuel by 2016. To address this, South Korea is in the process of developing a capability, named pyroprocessing, to reduce the volume and radioactivity of spent fuel discharged from its nuclear power plants and, potentially, to recycle it by using the transuranic elements in fast reactors. Therefore, the main point of contention between the U.S. and South Korea in pursuing a renewed U.S.-ROK 123 agreement would be Seoul's attempt to obtain advanced, long-term U.S. consent (also called "programmatic consent") to pyroprocess or even reprocess U.S.-origin spent fuel and approve the use of the U.S.-obligated pyroprocessed nuclear fuel in fast reactors. The ROK also hopes the United States will conclude that pyroprocessing is not alteration in form of content and therefore will be treated more favorably than reprocessing.

The current US-ROK Cooperation agreement

The existing U.S.-ROK 123 agreement allows nuclear material supplied to South Korea to be reprocessed—or to be altered in form of content—only in facilities acceptable to both parties upon a joint determination that International Atomic Energy Agency (IAEA)

¹ Seong Won Park, "Why South Korea Needs Pyroprocessing," *Bulletin of the Atomic Scientists*, October 26, 2009.

² Cho Chung-un, "Korea Aims to be No. 3 in Nuclear Power Sector," *The Korea Herald*, Jan. 14, 2010.

safeguards may be effectively applied. To date, the U.S. has not consented to any reprocessing of U.S.-supplied nuclear fuel in South Korea.

The multidimensional non-proliferation issues under the 123 US-ROK agreement

South Korean current interest in closing the fuel cycle is constrained by its nuclear cooperation agreement with the United States (which gives Washington the right to veto the reprocessing of U.S.-origin fuel or any other alteration in form of content) and by U.S. policy towards civil reprocessing. Although the issue looks to be strictly within the non-proliferation dimension, practically it touches on broader legal, technical, strategic, political, environmental and economic issues. Whatever shape the new agreement takes, it will have significant broader bilateral, regional and global implications.

Legal Issues

The U.S. and ROK agreed to complete negotiation on the revised agreement by early 2013. The administration's objective is to submit the agreement to Congress by late 2012 or early 2013, to fit the Congressional calendar and to avoid potential obstacles arising during the 2014 mid-term elections.

Since the ROK-U.S. nuclear energy agreement was signed in the early 1970s, prior to the adoption of the 1978 U.S. Nuclear Non-Proliferation Act (NNPA), much will have to be updated. Firstly, all nuclear cooperation agreements concluded since 1978 contain far more extensive nonproliferation commitments than those included in the existing U.S.-ROK agreement. For example, under the NNPA, new nuclear cooperation agreements contain an expanded U.S. consent right to include not only nuclear material supplied by the U.S., but also all nuclear material that has been used in a U.S.-supplied reactor. South Korea operates 20 reactors of which only six were not supplied by the United States or are based on U.S. technology. Additionally, it is estimated that about two-thirds of South Korea's used power reactor fuel has been produced from nuclear material supplied under the 1974 U.S.-ROK cooperation agreement therefore, U.S.-obligated.³

Secondly, ROK has been waiting for a decision for the last few years as to whether the U.S. will consider pyroprocessing alteration in form of content. As it stands now, the administration policy is that, it will be a case-by-case decision made by each country as to whether to import or share this technology. Specifically, the U.S. decision on this issue will take place in two stages. The first stage will be a decision as to whether pyroprocessing is considered Sensitive Nuclear Technology (SNT).⁴ If it is considered SNT, the second stage will be a decision as to whether and how much the U.S. will teach the prospective country how to reprocess by exporting this technology. Or, in other

³ Fred McGoldrick, "New U.S.-ROK Peaceful Nuclear Cooperation Agreement: A Precedent for a New Global Nuclear Architecture," Asia Foundation, Nov. 2009.

⁴ U.S. DOE defines SNT as "Information on uranium enrichment, nuclear fuel reprocessing, and heavy water production whose export is controlled under the NNPA; i.e., such information that is not RD, not publicly available, and important to design, construction, operation, or maintenance of related facilities." U.S. law permits SNT to be transferred outside the coverage of a 123 agreement provided that certain other conditions are satisfied as provided by Sec. 57 of the Atomic Energy Act of 1954.

words, how much the possession of this technology would help a country if it decided to pursue plutonium separation.

The U.S. administration holds that if pyroprocessing resulted in separation then it is alteration in form of content. However, pyroprocessing constitutes of a two-stage process. The first, electro-reduction, reduces the volume of waste without separation. The second, electro-refining, includes refining and separation. If the ROK asks for U.S. programmatic consent only for electro-reduction, the administration will probably grant it. By only reducing the volume of waste, South Korea's storage problem will be temporarily addressed, allowing time to find a sustainable long-term solution.

If it fails to obtain the rights to process U.S.-origin fuel, South Korea legally has other options. ROK could acquire uranium and enriched uranium from countries other than the U.S., including Russia and France. Also, Korea's inventory contains a large amount of Canadian-origin spent natural uranium fuel from the four CANDU reactors and spent French-supplied PWR fuel that was irradiated in French supplied reactors in Korea. Those countries may agree to approve further processing of fuel they sell to Seoul.

Technical Issues

The current agreement holds back South Korean scientists from conducting "hot" experiments in the ROK. South Koreans have asserted that the pyroprocessing technology they have developed is not reprocessing because no plutonium is separated from other transuranics when they are separated from uranium. South Koreans also argue that the technology is proliferation resistant and that any concerns about pyroprocessing can be addressed by effective safeguards.

As such, South Korea has signaled it has every intention to continue pursuing pyroprocessing technology. ROK already built a laboratory-scale Advanced Conditioning Processing Facility (ACPF) and in 2007 the Korean Ministry of Science and Technology announced a civil nuclear energy plan that aims to build a fast reactor and a pyroprocessing fuel cycle by 2028. The plan is first to begin construction of a pilot pyroprocessing facility by 2011, to be completed by 2016. The Ministry also plans a semi-commercial facility to be in place by 2025.

To promote the ROK's desire to gain U.S. programmatic consent of hot pyroprocessing in South Korea, Korean researchers have been working on pyroprocessing safeguards with U.S nuclear labs as well as the IAEA with the goal of demonstrating that pyroprocessing can be effectively safeguarded. As part of the process for developing safeguards procedures and criteria for pyroprocessing, South Korea submitted a design information questionnaire (DIQ), which provided the IAEA with a description of the process, facility, and nuclear materials to be safeguarded in the ACPF. After resubmitting a revised DIQ, a physical and design inventory verification as well as environmental sampling were performed by the IAEA in 2006 and facility attachment has been completed and is in force as of 2007. The ACPF has been classified as an "other" R&D

facility. It constitutes one material balance area, four material flow and five physical inventory key measurement points.⁵

In parallel, the U.S. has engaged ROK scientists on joint pyroprocessing experiments involving nuclear fuel at U.S. laboratories.

However, because pyroprocessing technologies pose several proliferation risks, the U.S. has long approached the issue with great caution. The U.S. has agreed to such cooperation on the R&D level only on a case-by-case basis and South Korean scientists have been restricted to use in South Korea of natural uranium, which does not contain plutonium. The critics of pyroprocessing argue that:

- ❖ Pyroprocessed material is not as radioactive (and thus “self-protecting”) as spent fuel and that further processing to weapons-usable plutonium is not very hard. In practice, pyroprocessing technology separates most fission products from the plutonium, therefore removing the major technical barriers to its use in nuclear weapons.
- ❖ Pyroprocessing also involves access to working with plutonium in metallic form, the form most often used for weapons. In this respect, pyroprocessing is actually worse than aqueous reprocessing in terms of their respective proliferation risks.⁶ Pyroprocessing’s technical processes can be altered relatively quickly and easily to yield pure plutonium rather than a non-weapons-usable mixture.
- ❖ By keeping a variety of radioactive materials with the plutonium, pyroprocessing will make accurate nuclear material accounting more difficult. An effective safeguards approach for such facilities should be developed and designed to detect both misuse of the facility, the acquired technology and know-how as well as the diversion of nuclear material.

Additional reluctance from the U.S. to agree to pyroprocessing in ROK is based on 2004 IAEA revelations that South Korea failed to report in a timely manner on a variety of nuclear tests including uranium enrichment and plutonium separation. These revelations provoked sentiments in Washington that the U.S. cannot fully trust South Korea, at least from the perspective of nuclear non-proliferation.

On the technical level, an additional point of contention during the negotiations will be on the amount of fuel currently in South Korea which is of U.S. origin. Because the existing 123 agreement does not include administrative procedures, South Korea has not been required to report annually on material transfer. That also means that the U.S. and the ROK will have to agree on an amount which will be the baseline for future accounting procedures. This number is important first to better know how much plutonium South Korea’s reactors has produced from 1972 to 2014. But even more

⁵ Ho-Dong Kim, “Current Status of Safeguards R&D for Advanced Fuel Cycle at KAERI,” JAEA-IAEA Workshop on Adv. S/G Tech. for NFC, Nov. 13, 2007.

⁶ United States Senate, Thomas B. Cochran Testimony Before The Committee On Energy And Natural Resources, Hearing On Energy And Scientific Research, Development, Technology Deployment, Education And Training Testimony, Natural Resources Defense Council, July 18, 2001, http://docs.nrdc.org/nuclear/files/nuc_01071801a_216.pdf

important – how much of the current fuel in Korea is not U.S.-obligated and does not require U.S. programmatic consent. It can be expected that South Korea will push for a high percentage of non-U.S. origin fuel. The Korean logic will be that if the U.S. will not grant them programmatic consent, they could try to get it from France, Canada, Australia or Russia. There have been reports that President Lee Myung-bak's scientific advisers have been urging him to adopt a long-term nuclear energy strategy less reliant on U.S.-type thermal reactors and more reliant on fast reactors and pyroprocessing, in part to break South Korea's traditional nuclear energy dependence on Washington.

Economic Issues

Pyroprocessing is designed to treat metal fuel for liquid sodium-cooled reactors and is not optimal for the ceramic uranium-oxide fuel used by the light water reactors that are today's standard reactors. To date, there are no known fuel cycles that rely on pyroprocessing showing any promise of being economical in the foreseeable future. For pyroprocessing to become relevant in South Korea, the ROK will have to build a number of fast reactors. This will require a significant investment that is arguably not cheaper than other alternatives until a long-term solution is found.

It seems that there is also a split within Seoul about the economic dimension and cost-effectiveness of pyroprocessing. While it is very clear that KEARI pushes for pyroprocessing technology, budget and economic analysts believe that it might be too expensive; they are not sure South Korea is ready to build numerous fast reactors and whether other alternatives will not be cheaper. Foreign Ministry officials are also reluctant to support pyroprocessing due to the concern that it would play into DPRK's hands and risk any future agreement.

Political Issues

The Obama administration has brought a fresh perspective to the role of nuclear non-proliferation, energy cooperation and 123 agreements and how these fit within the administration's broader policies. Understanding these underlying motives in contrast to Bush administration policies could bring greater foresight as to what to expect during the U.S.-ROK 123 agreement negotiations.

Bush's non-proliferation approach relied mostly on attempts to convince the major nuclear suppliers to strengthen limitations on transferring enrichment and reprocessing technologies. It worked through the NSG and the G8 to prevent such technology being transferred to countries that do not possess them already. The Obama administration, on the other hand, has been trying to take a more cooperative approach. For example, it endorsed the creation of an international fuel bank which would not require recipients to renounce enrichment and reprocessing. Also, while continuing to support the Bush administration's attempt to reach a compromise on strengthening NSG export controls, it does not pursue limitations as strict as those the Bush administration initially proposed.⁷ With regards to bilateral nuclear cooperation agreements, the Obama administration has

⁷ Miles Pomper, "U.S. International Nuclear Energy Policy: Change and Continuity," a paper for the Centre for International Governance Innovation Nuclear Energy Futures Project, Nuclear Energy Futures Paper No. 10, January 2010.

continued so far with the Bush administration policy. It finalized the UAE agreement after incorporating few stricter conditions. It also did not pick up the 123 Russia agreement abandoned by the Bush administration after Russia-Georgia 2008 crisis.

Despite this continuity, there is a significant difference in how the two administrations perceive the role of nuclear cooperation agreements. The Bush administration perceived these agreements as a diplomatic tool that served to enhance U.S. national security by preventing new countries from accessing sensitive technologies as well as a tool to become more involved in regional non-proliferation efforts. The Obama administration, on the other hand, perceives nuclear cooperation agreements as part of a broader energy, environment and economic security policies. By promoting nuclear cooperation agreements, the current administration tries to achieve a broader and more inclusive international energy framework. In this regard, the administration also hopes to support, revive, and open up the U.S. nuclear industry.

Strategic Issues

The U.S.-ROK nuclear cooperation agreement will probably be the first cooperation agreement the Obama administration will negotiate and present to Congress for approval. As such, the administration is very conscious that it will set the standards and criteria for future nonproliferation agreements. It will also shed light on the administration's policies with regards to reprocessing, export controls, waste and energy among other topics. Any decision therefore, within the U.S.-ROK cooperation agreement will take into account its broader bilateral, regional and global implications.

Bilaterally, some in South Korea perceived the unprecedented acquisition of a US\$20.4 billion contract to develop nuclear power plants for the UAE as a game changer which marked the beginning of a new relationship with the United States over nuclear power. The agreement makes South Korea the world's sixth exporter of nuclear plants. It also strengthens South Korea's claim for closing the back-end of the nuclear fuel cycle. By managing every component of the fuel cycle, the ROK will be in an even better position to offer full range of nuclear services and to attract additional contracts.

The current 123 agreement is based on a so-called "reciprocal relationship" but much has changed in the US-ROK relations since 1974. Specifically, the U.S. and South Korean nuclear industries are now closely intertwined. The U.S. nuclear industry relies heavily on Korean reactor components. It is conceivable that during the negotiation if the U.S. refuses to grant South Korea programmatic consent, Seoul in return will threaten to put restrictions on U.S. companies exporting Korean reactor components. However, such a move could meet in return with U.S. threats to limit South Korea from exporting U.S. technologies such the ones embedded in the Korean reactors.

Regionally, if ROK possesses a plutonium separation facility, it will have the ability to manage every component of the fuel cycle. This capability has political and military implications for dismantling North Korea's nuclear program. Washington has considered the 1992 North and South Korean Joint Declaration on the Denuclearization of the Korean Peninsula, in which both parties agreed to forego possession of enrichment and

reprocessing facilities, as a key component of realizing nuclear stability on the Korean Peninsula. The U.S. concern is that any South Korean pyroprocessing program would undermine the 1992 North-South denuclearization declaration while the U.S. is attempting to dismantle North Korea's nuclear program. The U.S. decision to allow programmatic consent in the ROK will therefore also have implications as to whether it will be perceived as encouraging a violation of that declaration. Although the ROK claims the declaration is null and void because DPRK has violated it, since the U.S. tries to revive it, these efforts would be jeopardized by a programmatic consent to the ROK. As it stands now, Washington's position is that a reprocessing facility would jeopardize the satisfactory resolution of the nuclear issue in the North, including a nuclear-weapon-free Korean Peninsula.⁸

Globally, U.S. policy towards reprocessing U.S.-origin fuel in other countries has exhibited an impressive continuity. To date, the U.S. has approved reprocessing of U.S.-obligated nuclear fuel only in EURATOM and Japan—and has agreed to consent to such reprocessing in a future Indian reprocessing facility. In all of these cases the agreements also include a robust safeguards regime. The U.S. has granted consent to reprocessing only in countries that already have advanced nuclear programs, including reprocessing and enrichment plants, impeccable nonproliferation credentials and are located in areas of only limited proliferation danger. The ROK differs from Japan and EURATOM on all three accounts - it has neither built nor operated reprocessing facilities, it is located in a very volatile region and its non-proliferation credentials are not immaculate.⁹

Although allowing ROK reprocessing will not be as controversial as the 123 U.S.-India agreement, it will meet with serious objections within the arms control community in the U.S., in Congress and internationally. It will be claimed that such a decision cannot be made on a case-by-case basis and U.S. strategy should be consistent across the board. Engaging in pyroprocessing research could encourage or provide an excuse for other non-weapons states to do the same, thus giving these states yet another avenue to get close to a weapon option. While less concerned by South Korea's true intentions, no one would want to see Iran engaging in pyroprocessing.

Conclusions

It is impossible to look on the ROK-US nuclear cooperation agreement only through the non-proliferation prism. The negotiations will cover broader technical, legal, economic, energy, environmental aspects and its conclusions will have important bilateral, regional and global implications.

⁸ McGoldrick, "New U.S.-ROK Peaceful Nuclear Cooperation Agreement: A Precedent for a New Global Nuclear Architecture."

⁹ The U.S.-India 123 Agreement grants consent in principle; India agreed to establish a new national reprocessing facility under IAEA safeguards and the parties will agree in the future on arrangements and procedures for reprocessing U.S. spent fuel there. Besides of the fact that it would have to be seen how to Obama administration deals with this aspect of the agreement, Bush officials, testified that the arrangements that would be negotiated with India to permit reprocessing would be submitted to Congress for review and approval.

As for the short-term, the U.S. should be cautious and conscious about which steps it takes when granting ROK scientists the right to work on pyroprocessing and other relevant R&D in the U.S. or ROK. Such decisions should take place within the broader view of what the U.S. signals to South Korea and the potential resulting expectations. If there is no real intention in Washington to grant South Korea programmatic consent, Washington should realize that its current steps contradict such a future decision.

The U.S. should also actively engage with South Korea to develop solutions to the ROK waste problem. At the same time, the U.S. should engage the IAEA and South Korea on developing methods and procedures for effectively safeguarding pyroprocessing. Before the United States makes any commitment to pyroprocessing, it should better understand what safeguards, if any, could provide sufficient assurances that materials are not misused for weapons programs and that there can be timely detection of a diversion of a significant quantity of plutonium or other fissile material in such facilities.