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Nuclear Sovereignty versus Nuclear Security: Renewing the ROK-U.S. Atomic Energy Agreement

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South Korea is the world's sixth-largest nuclear energy producer, with 20 nuclear power plants providing about 40 percent of its electricity. South Korea's nuclear energy development has been made possible by the ROK-U.S. Atomic Energy Agreement signed in 1972. The United States provided nuclear technologies and materials necessary for the peaceful use of nuclear energy; in return, South Korea was specifically prohibited from proliferation-related activities such as the reprocessing of spent fuel and uranium enrichment under the terms of the agreement. After three decades of successful bilateral nuclear cooperation, the two governments are due to renew the accord by 2014. However, negotiations on the new agreement between Seoul and Washington could potentially provide a source of tension and controversy. In particular, South Korea's wish for a complete fuel-cycle capability could directly conflict with President Obama's call for a nuclear weapons free world and U.S. concerns about nuclear proliferation. The bilateral negotiation between the United States and the ROK will have important implications for the global non-proliferation regime and regional security as well. This paper identifies issues and challenges regarding the renewal of the ROK-U.S. Atomic Energy Agreement and discusses the associated policy implications for the ROK-U.S. alliance.

Introduction

Nuclear power has become an important energy source for the Republic of Korea (ROK) since its first commercial nuclear power plant was opened in 1970. South Korea, being an energy-scarce country, imports 97 percent of its energy requirements. Today, South Korea is the world's sixth-largest nuclear energy producer with 20 nuclear power plants providing about 40 percent of its electricity. South Korea's nuclear energy development has been made possible by the ROK-U.S. Atomic Energy Agreement signed in 1972. Under this agreement, the United States provided nuclear technology and the materials necessary for the peaceful use of nuclear energy. South Korea was specifically prohibited from engaging in proliferation-related activities such as the reprocessing of spent fuel and uranium enrichment. After three decades

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of successful bilateral nuclear cooperation, the two governments are set to renew the agreement by 2014; however, negotiations for a renewed agreement between Seoul and Washington could potentially become a source of tension and controversy. In particular, South Korea's wish for a complete fuel-cycle capability could directly conflict with President Obama's call for a nuclear weapons free world and U.S. concerns over proliferation. The bilateral negotiations between the United States and the ROK will have important ramifications for the global non-proliferation regime and regional security in Northeast Asia. This paper identifies issues and challenges for the renewal of the ROK-U.S. Atomic Energy Agreement and discusses the policy implications for the ROK-U.S. alliance.

ROK-U.S. Atomic Cooperation

A Brief History

South Korea's nuclear energy program started in the 1950s with the Eisenhower administration's "Atoms for Peace" initiative for cooperation in the peaceful use of nuclear energy. In February 1956, the United States and the ROK signed the Agreement for Cooperation between the Government of the United States of America and the Government of the Republic of Korea Concerning Civil Uses of Atomic Energy in Washington, D.C.

South Korea soon joined the IAEA in 1957 and started its first nuclear program with a 100kw research nuclear reactor imported from the United States. For this, the United States and South Korea renewed the nuclear treaty in 1958 and renewed it again in 1965 as the power of the research nuclear reactor was upgraded to 250kw and 2mw, respectively.[1]

In the late 1960s, the Korean government decided to develop atomic energy as a major source of energy to meet its future energy demands amidst rapid economic development and rising oil prices. South Korea built its first commercial nuclear power plant in Kori in 1970 and the two governments signed the current treaty on atomic energy cooperation in 1972 that replaced the 1956 agreement. Coming into effect on March 19, 1973 with ratifications by both countries, the treaty has regulated their nuclear energy cooperation for the next 41 years until 2014.

Under the treaty, the United States would provide South Korea with all the technology, equipment, and materials necessary for building and operating nuclear power plants. In return, South Korea was strictly prohibited from any attempt to manufacture nuclear weapons. In addition, South Korea was virtually denied any attempt at reprocessing or reshaping nuclear materials as specified in Washington's approval of the treaty.[2]

ROK's Growing Nuclear Demand and Capacity

The demand for energy in South Korea exponentially increased as its economy grew rapidly in the past decades. The South Korean GDP expanded at an average annual growth rate of 8.6 percent every year over the past three decades since 1980. Power demand in South Korea has increased by more than 9 percent per year since 1990. The nation's electricity consumption showed a more than 10-fold increase from 33

billion kWh to 371 billion kWh between 1980 and 2006. Meanwhile, South Korea imports some 97 percent of its energy requirements.

Nuclear power is the most cost-effective source for the production of electricity. According to the Korea Nuclear & Hydro Power Co. (KNHP), nuclear power generation costs 39 won per kWh (about 3 US cents), compared to the cost of generating the equivalent amount of electrical power using coal (53.7 won), LNG (143.6 won) and hydro (162 won).[3] With rising fossil fuel prices, nuclear energy has emerged as a major alternative source for the nation's ever-growing energy demands. As a result, South Korea has become increasingly dependent upon nuclear power for its electricity production. South Korea now has 21 nuclear power plants in operation that provide almost 40 percent of its electricity; in addition, six new plants are currently under construction. The Ministry of Education, Science & Technology has projected that South Korea could develop its nuclear industry into one of the top five in the world and produce up to 60 percent of the nation's electricity by 2035. The government plans to have 38 nuclear power plants by 2030. The KHNP spent 4.7 trillion won ($3.68 billion) on adding new nuclear plants in 2009. It plans to spend 40-50 trillion won ($32 to 40 billion) to complete 18 new nuclear power plants by 2030.[4]

Under President Lee Myung-bak's Green Growth initiative, nuclear energy is defined as a key component of South Korea's ambitious new economic strategy to cope with the reality of declining labor productivity, while meeting the challenge of energy shortages and global warming in the twenty-first century. "Nuclear is one of the most efficient power generation methods that will lead us to a low-carbon society, and I intend to make sure that Korea keeps up with its role as one of the major suppliers of these zero-carbon power plants," said Lee.[5] Seoul has increased efforts to persuade Washington to grant South Korea permission to pursue a broader atomic program as South Korea's nuclear technologies evolve.

Seoul has expressed its strong interest in revising the restrictions of the 1973 nuclear agreement so that South Korea can pursue a full nuclear fuel cycle capacity. In June 2009, the Chairman of the National Policy Committee of the governing Grand National Party (GNP) argued that South Korea should not give up its "peaceful nuclear sovereignty" in its negotiations with the United States.[6] Later, the Minister of Knowledge Economy, in charge of nuclear energy, expressed the same wish with regard to the upcoming revision of the agreement. To meet the 2014 revision deadline, which will require difficult Congressional ratification, the two governments started preliminary consultations in the fall of 2009, and held their first official discussions a year later in Washington, D.C. in 2010.

Allies with Different Agendas

South Korea's interest in revising the agreement is mainly driven by its growing energy demand and business interests. The Korean government emphasizes that its interest in a more comprehensive fuel cycle capacity is for the peaceful use of nuclear energy. At the same time, South Korea feels it has a legitimate right for advanced nuclear technology considering its commitment to non-proliferation efforts and its growing nuclear power generation capacity. Meanwhile, nuclear proliferation has become a major concern for the U.S. government with the spread of weapons of mass destruc-

tion and terrorism. The Obama administration, in particular, undertook non-proliferation as one of its main foreign policy agendas with its focus on nuclear terrorism and its nuclear weapons free world initiative. South Korea's demand for advanced fuel cycle capacity would put the United States in a dilemma between managing its alliance partnership and its global efforts for nuclear security.

ROK: "Peaceful Nuclear Sovereignty"

Several factors drive Seoul's economic interest for a full nuclear fuel cycle capability:

Firstly, South Korea argues that they need a reprocessing capability to manage the rapidly increasing stockpile of nuclear waste. After decades of running ambitious nuclear energy projects, South Korea had produced 10,083 metric tons of spent fuel by 2008. This stockpile is expected to grow to 42,000 tons by 2040 and 100,000 tons by 2100. Because of South Korea's small territory and strong public antagonism to nuclear waste, the government faces a serious challenge in managing the increasing volume of nuclear waste. Until now, South Korea has indefinitely stored spent fuel at three reactor sites. This, however, will no longer be feasible due to space limitations. According to the KHNP, the existing capacity at the three sites will be full in 2016. Rising atomic energy use will increase pressure on the existing on-site storage of spent fuel. In addition, there is no progress being made in finding a site for the centralized storage of spent fuel. Without reprocessing, increasing nuclear waste will require a minimum disposal vault area of 20 square kilometers (7.7 square miles) to accommodate the 100,000 tons of spent fuel buried 500 meters (about 1,640 feet) underground in rock caverns.[7] Finding such free space in South Korea, a country the size of the state of Virginia and with a population of about 50 million, would be enormously difficult.

Managing nuclear waste has become a major problem for most nuclear power generating countries. For example, in 2009 the U.S. government had to cancel its plan to build a nuclear waste repository large enough for 70,000 metric tons in Yucca Mountain in Nevada. Even though it is located in one of the most remote and geologically safe desert areas, the site is still the subject of controversy among environmental activists, local communities, the Congress, and federal agencies. Decades of geological research and tests, supported by $9 billion of federal funding, was insufficient to allay local residents' concerns over nuclear safety.

The South Korean government learned of the difficulty of finding such space the hard way. In 2005, after a series of tough negotiations involving mass demonstrations and local referendums, the government agreed to pay at least $1.5 billion to the city of Gyeongju to secure a two square kilometer site for low-level waste.[8] Finding a site as much as ten to forty times bigger, especially for a more high-level waste, would be nearly impossible. One alternative is reducing the volume of waste through reprocessing. If KHNP's spent fuel was reprocessed, it would need 20 to 50 percent less disposal space than for high-level waste according to an industry expert.[9]

Secondly, there is also a growing business interest. After three decades of nuclear energy development, South Korea now aims to profit from its own nuclear capacity tapping into the world's growing nuclear energy market. In December 2009, South Korean President Lee received a hero's welcome in Seoul after signing a contract to export a $20 billion nuclear power plant to the United Arab Emirates (UAE.) Under the contract, a South Korean consortium led by the Korea Electric

Power Corporation (KEPCO) would build four commercial nuclear reactors in the UAE by 2020.[10] The news signaled that South Korea has emerged as a major new supplier in the global nuclear energy market. It was a surprise to many because the South Korean firm won the contract over intense competition from two major global suppliers in the world's nuclear energy market, the French company Areva and a General Electric-Hitachi consortium. The remarkable achievement was well recognized in a report to the US Congress, "South Korea has completed the transition from passive purchaser of turn-key nuclear plants in the 1970s to major nuclear technology supplier, capable of competing with the largest and most experienced nuclear technology companies in the world."[11] In addition to the UAE contract, South Korea has agreed to provide a small research reactor to Jordan and is hoping to participate in other nuclear projects in Indonesia, Thailand, Vietnam, the Philippines, India, Poland, Kazakhstan, and Morocco.[12]

The UAE deal illustrated South Korea's vision to become a major provider in the burgeoning global nuclear power plant market. In its report to the President, then South Korea's Minister of Knowledge Economy, Choi Kyung-hwan, said, "Nuclear power-related business will be the most profitable market after automobiles, semiconductors and shipbuilding," and declared, "We will promote the industry as a major export industry." It sets a goal of capturing 20 percent of new orders for the next 20 years. This means South Korea wants to export 80 reactors, worth $400 billion, out of about 400 new commercial reactors to be ordered globally through 2030.[13] However, South Korea lacks a key nuclear technological capacity for uranium enrichment and spent fuel reprocessing. Facing tough competition from French and Japanese companies with a full nuclear fuel cycle capability, South Korea wants to have the same technological capacity. Meanwhile, South Korea imports more than US$300 million worth of enriched fuel degree uranium for its 20 nuclear power plants from foreign sources including Russia, Canada, and the United States. Industry experts estimate that South Korea will soon have enough demand for an indigenous enrichment facility when it runs 30 or more nuclear power plants in the near future.[14] Uranium enrichment capabilities will consolidate South Korea's position in the nuclear power supplier market as well.[15]

Thirdly, South Korea became interested in reprocessing to provide a long-term solution to its energy demands. South Korea has to expand nuclear energy to meet its increasing demand for energy. Each year, South Korea imports about $90 billion worth of energy. To deal with its rapidly rising energy costs and increasing carbon emissions, nuclear energy is regarded as a promising alternative. However, the price of natural uranium has risen from $20 per kilo to $140 over the decade. This makes the prospects of reprocessing used uranium more sensible in the interests of long-term economic efficiency. The recycling of uranium from spent fuel would reduce South Korean uranium imports by about one-third. South Korea imports about 3,800 tons of uranium every year. The problem is that due to technical difficulties and safety concerns, the reprocessing of nuclear waste under current technology tends to be prohibitively expensive and only a few countries, such as France and Russia, run reprocessing facilities commercially. The nuclear science community has long been engaged in the R&D of next-generation nuclear technologies that can greatly enhance the economic efficiency of reprocessing in terms of power generation and waste management. In particular, major nuclear powers such as France, Germany, Russia, and Japan have been developing next-generation reactor and waste-recycling

technology that will make reprocessing economically feasible with better fuel efficiency and less hazardous nuclear waste. As its energy demand and atomic capacity grow, South Korea aims to equip itself to become a leader in the next generation nuclear power generation as well. Researchers at the Korea Atomic Energy Research Institute (KAERI), a government-funded nuclear research center in Daejeon, have been working on pyroprocessing, along with a fast breeder reactor. The work involves conducting research-level reprocessing of spent fuel, which is strictly prohibited under South Korea's current atomic agreement with the United States.

South Korea notes that the 1987 revision of the U.S.-Japan Atomic Energy Agreement gave Japan a comprehensive agreement to develop full nuclear fuel cycle capacity. South Korea wants the same acknowledgement from the United States given its status as a major atomic power and a major US ally like Japan. In a National Assembly hearing, then foreign minister of South Korea, Yu Myung-hwan, testified, "We will make the agreement reflect the content that maximizes the peaceful and commercial uses of nuclear power." Yu explained that South Korea is prepared to negotiate on the agreement's revision, including the issue of dry processing (pyroprocessing) of spent nuclear fuel.[16]

The United States: Nuclear Non-Proliferation

The United States is the world's largest nuclear power producer, accounting for more than 30 percent of global nuclear power generation. The country's 104 nuclear reactors provide about 20 percent of total electricity output.[17] Yet, no single nuclear power project has been approved since 1977. The heightened security fears, especially after the 1979 Three Mile Island accident, have put a near halt on new construction for more than 30 years. Any attempts to build a new nuclear power plant have come under strong criticism and opposition by environmental activists, various civic organizations, and skeptics within the U.S. Congress. Meanwhile, the United States has strengthened its non-proliferation efforts in its nuclear energy cooperation with foreign countries. The Congress passed the Nuclear Non-Proliferation Act (NNPA) in 1978 under which the U.S. government would demand more extensive controls of U.S. origin nuclear material and technology from its partner countries. Since then all new peaceful nuclear cooperation agreements with 20 countries contained rigorous nonproliferation requirements on U.S. origin nuclear equipment and nuclear materials with strict conditions of U.S. approval for any reprocessing and enrichment. Those measures were far more restrictive than those contained in the existing ROK-U.S. agreement signed in 1973. The existing agreement with South Korea stipulates U.S. consent only on the reprocessing of U.S.-origin nuclear fuel. Yet, new agreement would require U.S. consent on the reprocessing of any nuclear fuel processed in U.S. origin nuclear reactors in addition to nuclear fuel directly imported from the United States. In addition, it also requires U.S. consent on the enrichment of fuel, which was not mentioned in the existing agreement. An expert expects that in the 2014 agreement revision, "U.S. negotiators will undoubtedly press for including all NNPA-specified conditions."[18]

Indeed, the Obama administration has made nuclear nonproliferation one of its key foreign policy initiatives. At the same time, the Obama administration seems to be less enthusiastic about the peaceful use of nuclear energy in contrast to the previous Bush administration. Under its Global Nuclear Energy Partnership (GNEP) ini-

tiative, the Bush administration pushed for the development of next-generation nuclear reactors for a more environmentally friendly and efficient use of nuclear energy. It encouraged international collaboration in developing new technology as well as securing a stable supply of nuclear energy.[19] Under the Bush administration, South Korea collaborated on the initiative regarding R&D of next-generation nuclear power plants with the Idaho National Research Laboratory (INL) in pyroprocessing. However, from the beginning, President Obama has focused on nonproliferation, as he was deeply concerned about the potential for nuclear terrorism. After declaring his vision of a nuclear weapons free world in Poland in May 2009, he called for a commitment by the international community for a world free of nuclear weapons in his first appearance to the UN General Assembly in September 2009.[20] In April 2010, President Obama convened a Nuclear Security Summit in Washington, D.C. with leaders from 47 countries, including all major nuclear powers. Again, the agenda was heavily focused on preventing nuclear terrorism and controlling the spread of nuclear materials. The summit produced a joint communique in which peaceful nuclear energy was mentioned as the last item among 12 measures for enhancing nuclear security.[21] Given President Obama's pledge to secure sensitive nuclear materials and strengthen nonproliferation efforts such as NPT and IAEA, it is unlikely that the Obama administration will be enthusiastic about South Korea's demand for a comprehensive agreement that will allow Seoul to engage in reprocessing. Indeed, a key administration official, Ellen Tauscher expressed deep reservations about this request. During her confirmation hearing, Tauscher, the Under Secretary of State for Arms Control and International Security, stated that giving South Korea consent to reprocessing would not be "necessarily appropriate."[22]

Issues and Challenges

The bilateral negotiation for the renewal of the Atomic Energy Agreement between Washington and Seoul has important regional and global implications that present serious challenges for the two allies to develop an optimum solution. The negotiation would unfold in different fashion with various issues and challenges based on what South Korea demands and how the United States reacts.

South Korea's Push for Reprocessing

The best scenario for the United States would be a simple renewal of the current agreement without major revisions about the fuel cycle issues. The United States would push for stricter regulations on enrichment and reprocessing issues, as mentioned earlier in this paper. Given the sensitivity of the issues for the U.S. government and its alliance management, the South Korean government may decide to forego the reprocessing issue in return for America's cooperation in other areas such as the support for South Korea's nuclear plant exports to a third party that is subject to heavy U.S. export control regulations due to licensing issues. Different actors within the Korean government are divided over the merit of pursuing reprocessing. Some worry about the enormous costs of developing reprocessing facilities without the promise of an immediate payoff from the ambitious project.[23] Other concerns include the political cost of strained relations with the United States and negative

reactions from other neighboring countries as those countries will become suspicious of South Korea's intentions for sensitive nuclear technology.

However, there are also strong voices in favor of pursuing nuclear autonomy for economic as well as political reasons. It is likely that the Korean government will seek a certain level of right for reprocessing in the name of "peaceful nuclear sovereignty." If not demanding the entitlement to full-scale reprocessing and enrichment, Seoul may well insist on U.S. consent to research-level reprocessing for its work on next-generation nuclear technology. In fact, to address U.S. concerns about proliferation risks, the South Korean government has emphasized that the next generation nuclear technology they are working on, called pyroprocessing, is proliferation resistant, and greatly eases the waste management issue. Current plutonium uranium extraction (PUREX) reprocessing separates spent nuclear fuel into uranium, plutonium, and other nuclear wastes, some of which can be used to create nuclear weapons and pose a proliferation risk.

Pyroprocessing extracts uranium, plutonium, and other fissionable materials in a mixture. The mixed plutonium in the reconstituted fuel is to be burned in a fast-breeder reactor.[24] Advocates argue that pyroprocessing is proliferation resistant because it is difficult to separate plutonium from reconstituted fuel; in addition, the pyroprocessed product is thermally and radioactively too hot to be used for nuclear weapons fabrication.[25] At the same time, the new technology is environmentally friendly in terms of nuclear waste management, not to mention reducing greenhouse gases. The new process will burn off the most toxic part of the spent fuel and the resulting radioactive waste would decay to the level of natural uranium in roughly 300 years, as opposed to 300,000 years under the traditional PUREX system. Due to the significantly reduced volume, heat, and radioactive level of pyroprocessed nuclear waste, the new technology will create a future spent fuel repository up to 100 times smaller than the current system. This will drastically reduce the cost of atomic power generation involving waste management, as well as the concerns over the environmental impact. South Korean researchers prefer to call the technology a "recycling" of spent fuel as opposed to a "reprocessing" of it.[26]

However, there are concerns over this promise. Most of all, the new technology is not feasible yet due to the high cost of building fast-reactors to burn fuel from pyroprocessing. The Generation IV International Forum (GIF) projects that the deployment of a next-generation reactor will be possible between 2020 and 2030 at best.[27] Furthermore, some U.S. experts argue that pyroprocessing is not much different from reprocessing. They argue that pyroprocessing goes through the same procedure of reprocessing. In addition, whoever acquires pyroprocessing technology will be able to reprocess spent fuel if they wanted to.[28] A 2008 U.S. Department of Energy study concluded that the alternative reprocessing methods such as pyroprocessing did not offer many advantages over traditional reprocessing in reducing proliferation risks by states.[29]

Dangerous Message to Global Nonproliferation Regime

South Korea's push for full nuclear fuel cycle agreement, no matter how symbolic it may be, would place the United States in a dilemma. First, it would seriously complicate the efforts of the United States to set up a global nonproliferation regime. For Washington, accepting South Korea's demand for a comprehensive fuel cycle capacity

would set an important precedent for other countries pursuing aggressive nuclear programs. They would say if South Korea is allowed to reprocess, they should have the same right of reprocessing for the peaceful use of nuclear energy. This will create a dilemma for the United States and other nuclear powers in their efforts to prevent the proliferation of the sensitive technology used for nuclear weapons. For example, the South Korean case could have sensitive implications for the ongoing negotiations with Iran regarding its suspected enrichment program. Iran claims that its nuclear program is strictly for peaceful purposes and it has the right to pursue the full nuclear fuel cycle, including uranium enrichment. Washington may face stronger objections from Iran who would label the efforts of the U.S. to limit Iran's nuclear program as a double standard.

As for such U.S. concerns, South Korea would argue that it is different from a "rogue state" that wants to develop nuclear weapons. Its nuclear program is strictly for peaceful purposes. South Korea is a full member of the NPT and IAEA; in addition, it has followed all nonproliferation measures that include the most recent additional protocols of the IAEA. In particular, South Korea's proven record of nuclear transparency was officially recognized by the IAEA when South Korea was included in the Integrated Safeguards (IS) country list by the IAEA on July 1st, 2008.[30] However, South Korea's claim is not fully appreciated due to its past activities.

In 2004, it was discovered that South Korean researchers conducted a small-scale secret uranium enrichment test that was in violation of the IAEA provision. The shocking revelation, reported by the South Korean government itself and later resolved by IAEA, raised concerns about South Korea's intentions. It is widely known that South Korean authority was trying to develop nuclear weapons in the 1970s. Washington would fear that giving consent to South Korea's reprocessing right would send a wrong message to the increasing number of countries who want to develop a nuclear industry. So far, the U.S. government has sought to restrict the proliferation of reprocessing and never approved the reprocessing of the U.S.-obligated used nuclear fuel. The only exception was EURATOM, Japan, and most recently India who already had existing reprocessing and enrichment facilities.

Hampering Efforts toward a Nuclear Weapons Free Korean Peninsula

Meanwhile, South Korea's claim for reprocessing is complicated by its own existing pledges. One would argue that South Korea's pursuit of reprocessing and enrichment right violates its own pledges in accordance with the 1992 Joint Declaration on Denuclearization of the Korean Peninsula. Against the backdrop of the end of the Cold War in Europe, the Roh Tae-woo administration (1988–1993) of South Korea pursued reconciliation with former enemies like North Korea. After announcing the unilateral withdrawal of U.S. tactical nuclear weapons, the Roh government issued a joint declaration with North Korea in February 1992 that the two countries would not pursue any kind of nuclear weapons program. In addition, they also pledged not to carry out nuclear reprocessing and uranium enrichment.[31] Accordingly, South Korea was expected to abide by its own promise. A U.S. official pointed out that "the existence of a reprocessing plant in South Korea would be inconsistent" with the Joint Declaration of 1992.[32]

Yet, the most serious challenge for both Washington and Seoul comes from a third party: North Korea and its nuclear program. Allowing South Korea reprocessing

would make it more difficult in dealing with North Korea's claims of peaceful use for its nuclear program. North Korea may demand the same reprocessing rights, even if it finally decides to give up its nuclear weapons program.

In past negotiations, North Korea has insisted its right to possess a full nuclear capability for peaceful purposes. The 1994 Agreed Framework between Washington and Pyongyang included building two light water reactors (LWRs) for North Korea as a key element of the settlement. Later, on September 19, 2005, the Joint Statement of the Fourth Round of the Six-Party Talks also acknowledges North Korea's right to the peaceful use of nuclear energy, which may include reprocessing in conjunction with possible provision of LWRs to North Korea. Indeed, North Korea reportedly demands the provision of LWRs as a key component of a nuclear deal. After a series of defiant nuclear provocations by Pyongyang, including two nuclear tests) the United States thinks it is undesirable to allow North Korea any form of nuclear capability, whether or not it is for civilian or military purposes. Yet, Pyongyang may demand the same rights if the United States agrees to South Korea's reprocessing. In 2004, the North Korean authorities defended their nuclear program citing the reported case of South Korea's secret test of uranium enrichment. In 2009 when the United States and the international community condemned North Korea for its long-range missile launch, North Korea claimed it was a satellite and noted that South Korea's satellite launch in the same year was regarded as legitimate by the international community.

South Korea would argue that its case is different from that of North Korea. While North Korea is a case of denuclearization of a weapons program, South Korea is a case of bilateral atomic energy cooperation for peaceful use. South Korean nuclear scientists are currently working on peaceful nuclear energy that is more proliferation-resistant as well as environmentally friendly. As for the 1992 Denuclearization pledge, one could argue that South Korea, as a sovereign state, has a right to forfeit its own commitment should it be deemed necessary. Indeed, North Korea has already violated the joint declaration by developing nuclear weapons since then. North Korea's nuclear weapons program and two nuclear tests clearly nullify the joint declaration. Furthermore, the September 2005 Joint Statement leaves the possibility open that North Korea could have a full nuclear fuel cycle by acknowledging its peaceful use of nuclear energy.[33] However, at the same time the Joint Statement also reaffirms that "the 1992 Joint Declaration of the Denuclearization of the Korean Peninsula should be observed and implemented." No matter what the arguments put forward by both Seoul and Pyongyang, Washington will be extremely concerned about the possible complications that would result from allowing Seoul any kind of reprocessing rights, while still trying to persuade Pyongyang to and its nuclear ambitions. Sharon Squassoni, an expert at the Center for Strategic and International Studies in Washington, said, "It is hard to imagine a member of Congress who would support facilitating spent fuel recycling by South Korea if it is seen to make negotiations with North Korea more difficult."[34]

Testing the ROK-U.S. Alliance

The most important challenge for Washington and Seoul is to prevent the issue from becoming a test-case for the alliance. During their summit meeting in June 2009, President Obama and President Lee promised close cooperation regarding the peace-

ful use of nuclear energy, among others.[35] Yet, any hint of U.S. objections to South Korea's demand for "peaceful" nuclear sovereignty could send the current amicable alliance relationship into turmoil, as shown during the fierce anti-American rallies in Seoul over the U.S. beef import issue in 2008. Many South Koreans often compare the ROK-U.S. revision of the atomic agreement with the U.S.-Japan revision in the 1980s. In its renegotiation in the late 1980s of its nuclear agreement with the United States, Japan acquired an advanced agreement on full-scale spent fuel reprocessing and uranium enrichment. Japan has become the only non-nuclear weapons state with a full reprocessing capability.[36] Washington believed that Japan posed no proliferation risk given its excellent nonproliferation credentials; however, many in South Korea think that they deserve the same right. Washington seems to have difficulty in giving the same benefit of doubt to South Korea when it comes to sensitive nuclear technology. They may say South Korea is different from Japan, which already had reprocessing and enrichment plants under the existing agreement that was agreed to before North Korea's nuclear program was revealed.

Yet, it will be difficult for the United States to simply ignore South Korea's demand and its growing nuclear capacity because South Korea, along with Japan, is one of the most important U.S. allies in Asia. It will be a challenge for the United States to balance its bilateral alliance management with Seoul and its commitment to global nonproliferation efforts. An editorial in the Chosun Ilbo, a prominent Korean newspaper, warned the ROK-U.S. alliance could, "come under strain if Washington stubbornly insists on blocking South Korea from reprocessing."[37] For many Koreans the negotiation could be another test case for the U.S. commitment to the alliance after the very controversial KORUS FTA negotiations. The U.S. attitude could be regarded as another referendum on America's sincerity and respect for South Korea's status as a key ally. The comparison with Japan would provide a compelling case for both critics and supporters of the alliance in Korea. In addition, the 2008 Bush administration's decision to award another long-term consent to India for reprocessing nuclear waste will make it more difficult for U.S. negotiators to persuade Seoul to forgo the same right.[38] How minor they might be, some strong nationalists may even argue for the need for South Korea to have its own nuclear weapons program. Recently, Kim Dae-Joong, a prominent Korean conservative journalist called for a South Korean nuclear weapons program.[39] In addition, some members of the National Assembly argued for having a "conditional" nuclear option until the complete resolution of North Korea's nuclear issue.[40]

The Korean government stated that the revision should contribute to mutual economic interests as well as the strengthening the ROK-U.S. alliance.[41] At the same time, the United States needs to acknowledge South Korea's growing technology capacity as well as the demand for advanced atomic usage. To resolve their different interests and approaches to future nuclear cooperation, the two countries need to find a third way. An American expert suggested that the United States might make some commitment to approve long-term pyroprocessing in South Korea. Instead of a full approval of commercial reprocessing, the United States and South Korea could launch a joint R&D project in which South Korea is allowed to research level reprocessing to fully develop proliferation-resistant pyroprocessing technology. In addition, the IAEA would be invited to work together to develop advanced safeguards techniques.[42] A similar suggestion has been made by South Korean experts as well.[43] ROK and U.S. scientists have already been collaborating on pyroprocessing

since 2005 under the Department of Energy's International Nuclear Energy Research Initiative at Argonne and the Idaho U.S. national laboratory. In addition, Korean scientists have collaborated with both IAEA and Los Alamos National Laboratory scientists on safeguards for pyroprocessing since 2002. ROK-U.S. joint-research on pyroprocessing and its safeguards would address Seoul's aspirations to become a leader in next-generation nuclear technology, without giving South Korea long-term consent for outright reprocessing of its own. In an interview with the Korean media, the American ambassador to Seoul, Kathleen Stevens, said that the United States and South Korea could find a solution to take into consideration both South Korea's reprocessing aspirations and international concerns over nuclear non-proliferation.[44] After the first official meeting between delegations from both sides, the two governments announced that they had discussed a proposed joint study on nuclear power reactor spent fuel disposition options, including pyroprocessing.[45] For this, the two sides agreed that they will proceed with negotiations for the US-ROK Atomic Energy Agreement revision by 2014, while discussing the joint research on pyroprocessing on a separate track.[46] It remains to be seen whether the two-track approach will eventually lead to a successful conclusion of the difficult negotiations.

Conclusion

A successful conclusion of a new ROK-U.S. Atomic Energy Agreement could "establish a model for reconciling the nuclear fuel cycle aspirations of an advanced nuclear power with global concerns about the proliferation risks of reprocessing."[47] However, renewing the agreement presents serious challenges for the two allies. First, the ongoing disputes with North Korea's nuclear weapons program raise a fundamental question about the rationale of allowing a full fuel cycle for South Korea. Second, unlike the case of the U.S.-Japan negotiations in the late 1980s, during which the Reagan administration supported Japan's desire for a full nuclear fuel cycle, the current Obama administration seems to be less enthusiastic about, if not opposed to, reprocessing cooperation with South Korea, as President Obama emphasizes nonproliferation with his nuclear-free world initiative. Given its emphasis on the ROK-U.S. Alliance as its key pillar of foreign policy, the Lee administration has been cautious not to allow this issue to become another test-case for the alliance both domestically and internationally. At the same time, the Lee administration regards nuclear energy as a core component of South Korea's future growth strategy. It has developed a keen interest in a full nuclear fuel cycle capability.

South Korea's rise as a new contender for a share of the lucrative international nuclear energy market provides some new opportunities for ROK-U.S. atomic cooperation. The United States would demand that South Korea ensures nonproliferation in the exports of nuclear plants to a third party. This could provide Seoul and Washington with more opportunities for cooperation in nuclear nonproliferation as well as in nuclear energy. To achieve its ambitious goal of exporting 80 reactors by 2030, South Korea aims to build a more self-sufficient nuclear capability.[48] It means that South Korea wants to be free from residual intellectual property constraints by its original licensor, the United States. Meanwhile, South Korea could be a good partner for a recent U.S. interest in nuclear energy as a source for cheap and environmentally friendly energy. In a February 2010 news conference, President Obama unveiled a

plan to offer loan guarantees for the construction and operation of two new nuclear reactors, the first on U.S. soil for the first time in 30 years.[49] Should the Obama administration decide to pursue a more active nuclear energy policy as a way to solve climate change while addressing its dependence on foreign gas and oil, Washington may find South Korea a good business partner. South Korean companies may participate in bids for new nuclear power plants in the United States. Meanwhile U.S. companies may form partnerships with South Korean companies. In a recent contract with the UAE, the KEPCO consortium included the U.S. company, Westinghouse, which expects its share of the contract to be worth up to $1 billion, about 5 percent of the total $20 billion, which will generate or sustain several thousand U.S. jobs.[50]

To reach an advanced nuclear agreement with the United States, South Korea should make it clear that its nuclear program is peaceful and for commercial purposes only. The U.S.-Japan Atomic Agreement is based on Japan's long standing commitment to the peaceful use of nuclear energy. As the first and last victim of nuclear weapons, Japan has established itself as a strong advocate of the anti-nuclear weapons movement, with its three non-nuclear principles of non-possession, non-production, and non-introduction of nuclear weapons.[51] South Korea should be very cautious not to send a mixed message to the United States and the world regarding its nuclear energy program. It would be a grave mistake to argue for "nuclear sovereignty" based on popular nationalist sentiment. In a recent poll, 69 percent of Koreans supported South Korea's own nuclear development to counter North Korea's nuclear program.[52] Both the South Korean leadership and media need to be careful not to create unnecessary suspicions of Seoul's nuclear intentions. For this, the successful hosting of the 2012 nuclear summit in Seoul would greatly boost South Korea's credentials on its commitment to nonproliferation and the peaceful use of nuclear energy. Meanwhile, Washington has to be careful not to make this issue another test-case for the alliance that the two governments have promised to upgrade as a "strategic alliance" to meet the challenges of the 21st century. Both the Executive office and the Congress should acknowledge Seoul's legitimate concerns regarding its growing nuclear waste management problem as well as its fully developed nuclear capacity. Despite immediate difficulties in dealing with North Korea, it should consider the potential of a long-term cooperative nuclear partnership with Seoul. Together they have to build a new partnership to lead the new frontier of nuclear energy that is peaceful, safe, cheap, and environmentally friendly.

Notes

1. *Kwahak Kisul (Scientific Technology) 2.0 Newsletter*, July 31, 2009.
2. Ibid.
3. World Nuclear Association, "Nuclear Power in South Korea," March 2010, http://www.world-nuclear.org/info/inf81.html.
4. Ibid.
5. Myung-bak Lee, "Shifting Paradigm: A Road to Global Green Growth," *Global Asia* 4, no. 4 (Winter 2010): 8–12
6. On June 12, the Board issued a statement saying that the 2014 revision of the Atomic Energy Agreement should allow South Korea to reprocess its nuclear waste for peaceful purposes. *Munhwa Ilbo*, June 16, 2009.
7. Assuming that the geological formation would likely contain faults, the vault area may

have to be as large as 40 square km. "Commercial pyroprocessing costs unknown, U.S., Korean officials say," *Nuclear Fuel*, September 7, 2009

8. The $1.5 billion total package deal included $300 million in cash payable upfront to the municipal government with an additional $600 per waste drum for a total of almost $50 million in full capacity, as well as moving KHNP headquarters to the city and building a proton accelerator and associated research facilities to create new jobs in the city. Seong Won Park, "Why South Korea needs pyroprocessing," *Bulletin of the Atomic Scientists*, October 26, 2009.
9. Seong-won Park, "Why South Korea Needs Pyroprocessing," *Bulletin of the Atomic Scientists*, October 26, 2009.
10. South Korean reports also anticipated another US$20 bil. in revenue with a potential follow-on contract for long-term operation and maintenance of the units over 60 years. Yonhap News, December 28, 2009; Herald News, December 28, 2009.
11. Mark Holt, "U.S. and South Korean Cooperation in the World Nuclear Energy Market: Major Policy Considerations," *Congressional Research Service Report for Congress* (R41032).
12. *Financial News*, March 9, 2010.
13. "South Korea Seeks to Boost Reactor Exports," *World Nuclear News*, January 13, 2010.
14. Private interview with a researcher from the Korea Atomic Energy Research Institute (KAERI).
15. South Korea is interested in fabrication of low enriched uranium (LEU) for power generation. High-enriched uranium (HEU) is used for nuclear weapons.
16. *The Hankyoreh Sinmun*, July 7, 2009.
17. *World Nuclear Association*, "Nuclear Power in the USA," February 2010, http://www.world-nuclear.org/info/inf41.html.
18. Fred McGoldrick, "New ROK-U.S. Peaceful Nuclear Cooperation Agreement: A Precedent for a New Global Nuclear Architecture," Center for U.S.-Korea Policy, November 2009.
19. Mary Beth Niktin, Anthony Andrews, and Mark Holt, "Managing the Nuclear Fuel Cycle: Policy Implications of Expanding Global Access to Nuclear Power," *CRS Report*, July 1, 2009, http://www.ncseonline.org/nle/crsreports/09July/RL34234.pdf.
20. "Text of Obama's UN speech," *The Huffington Post*, September 23, 2009, http://www.huffingtonpost.com/2009/09/23/obama-un-speech-text_n_296017.html.
21. The White House, "Communiqué of the Washington Nuclear Security Summit," April 13, 2010, http://www.whitehouse.gov/the-press-office/communiqu-washington-nuclear-security-summit.
22. "Testimony of Ellen Tauscher, Nominee Under Secretary of State for Arms Control and International Security," Senate Armed Services Committee, http://lugar.senate.gov/sfrc/pdf/TauscherQFR.pdf.
23. After decades of investment involving US$20 billion, the Japanese reprocessing facility in Rokkasho is still in its test stage.
24. Seong-won Park, Miles A. Pomper, and Lawrence Scheinman, "The Domestic and International Politics of Spent Nuclear Fuel in South Korea: Are We Approaching Meltdown?" *Korea Economic Institute Academic Paper Series* 5, no. 3 (March 2010): 1–7.
25. Park, "Why South Korea Needs Pyroprocessing."
26. Despite all the promising benefit of pyroprocessing, some experts have been raising a series of questions regarding the feasibility of the pyroprocessing technology itself. Most important of all, the technology is not fully developed yet. Advocates of pyroprocessing admit that they needs decades of research before fully commercializing the technology. The ROK's research lab at KAERI has operated a laboratory-scale facility since 2008. KAERI plans to establish an engineering-scale mock-up by 2012 and to demonstrate an engineering scale process by 2016. A commercial-scale plant is planned for 2025.
27. The consortium includes the United States, Argentina, Brazil, Canada, China, France,

Japan, Russia, South Korea, South Africa, Switzerland, and the UK. They are working on six different types of new reactor technologies. World Nuclear Association, "Generation IV Nuclear Reactors," http://www.world-nuclear.org/info/inf77.html.

28. Daniel Horner, "S. Korea Pyroprocessing Awaits US Decision," *Arms Control Today*, July/August 2009, http://www.armscontrol.org/act/2009_07-08/SouthKorea; Edward Lyman and Frank von Hippel, "Reprocessing Revisited: the International Dimension of the Global Nuclear Energy Partnership," *Arms Control Today*, April 2008, http://www.armscontrol.org/act/2008_04/LymanVonHippel.
29. However, the same report also acknowledged that pyroprocessing presents more challenge for non-state actors to convert into a nuclear weapon. Pyroprocessing was regarded as the most proliferation-resistant among the four alternatives. Office of Nonproliferation and International Security, Department of Energy, "Draft Nonproliferation Impact Assessment Statement for the Global Nuclear Energy Partnership Programmatic Alternatives," (December 2008), 66–70, http://nnsa.energy.gov/nuclear_nonproliferation/documents/GNEP_NPIA.pdf.
30. South Korean officials emphasize that the IS membership vindicates South Korea's commitment to nuclear transparency and commitment to the NPT, especially after an incident involving unreported reprocessing experiments by Korean scientists in 2004. "Korea Joins the Member of IS by IAEA," http://www.kinac.re.kr/.
31. Section 3 of "ROK-DPRK Joint Declaration of the Denuclearization of the Korean Peninsula," January 20, 1992.
32. Daniel Horner, "S. Korean Pyroprocessing Awaits U.S. Decision," Arms Control Association, http://www.armscontrol.org/act/2009_07-08/SouthKorea.
33. Full text of the September 19, 2005 Joint Statement of the Beijing Six-Party Talks, http://www.chinadaily.com.cn/english/doc/2005-09/19/content_479150_2.htm. The last paragraph of article 1 said, "The DPRK stated that it has the right to peaceful use of nuclear energy." The other parties expressed their respect and agreed to discuss, at an appropriate time, the subject of the provision of a light water reactor to the DPRK.
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37. "S. Korea Must be Allowed to Reprocess Spent Nuclear Fuel," *Chosun Ilbo*, February 16, 2010.
38. George Perkovich, "Global implications of the U.S.-India Deal," *Daedalus*, Winter 2010.
39. Dae-Joong Kim, "Time for South Korea to Develop its Own Nuclear Arms," *Chosun Ilbo*, January 11, 2011.
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41. Ministry of Foreign Affairs and Trade, *E-Newsletter*, no. 331, http://news.mofat.go.kr/enewspaper/articleview.php?master=&aid=3350&ssid=24&mvid=1003.
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47. McGoldirick, "New ROK-U.S. Peaceful Nuclear Cooperation Agreement: A Precedent for a New Global Nuclear Architecture," (The Center for U.S.-Korea Policy, 2009), 13, http://asiafoundation.org/resources/pdfs/McGoldrickUSROKCUSKP091130.pdf.
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49. Michael D. Shear and Steven Mufson, "Obama offers loan to help fund two nuclear reactors," *Washington Post*, February 17, 2010.
50. Mark Holt, "U.S. and South Korean Cooperation in the World Nuclear Energy Market: Major Policy Considerations," *CRS Report for Congress* (2010), 7.
51. Campbell, Kurt M. and Sunohara, Tsuyoshi, "Japan: Thinking the Unthinkable," *The Nuclear Tipping Point: Why States Reconsider Their Nuclear Choices* (The Brookings Institution: 2004), 218–53.
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