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: Challenges of Proliferation and Implication for the Korean Peninsula

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Nuclear Security 2012

: Challenges of Proliferation and Implication for the Korean Peninsula

Ⅷ. New Nuclear Renaissance: Challenges for Nuclear Non-Proliferation?

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1. Introduction

The 'peaceful use of nuclear energy' constitutes one of the three pillars of the Non-Proliferation Treaty(NPT), along with disarmament and non-proliferation. As stipulated in Article Ⅳ of the NPT, all the Parties to the Treaty are guaranteed "the inalienable right" to develop research, production and use of nuclear energy for peaceful purposes.[1] At the same time they have the responsibility to "accept safeguards, as set forth in an agreement to be negotiated and concluded" with the International Atomic Energy Agency (IAEA) for the purpose of preventing diversion of nuclear fissile materials for military purposes.[2]

The 'peaceful use of nuclear energy' includes nuclear energy generation of electricity. According to the IAEA, there are currently 441 nuclear power plants in operation in 31 countries.[3] Sixty-one nuclear power plants are now in the process of being built across the globe, and an additional 489 plants are scheduled to be ordered by 2030 or are under review.[4] That is, nuclear energy as an alternative to fossil fuel-based energy is now experiencing a second renaissance, since the first nuclear renaissance effected in response to the two oil

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* Some parts of this chapter are adapted from Jae Jeok Park, "Arrival of Nuclear Renaissance: Issues and Prospect," *IFANS FOCUS*, No. 2010-08 (The Institute of Foreign Affairs and National Security: Seoul, 2010).

[1]– United Nations, "The Treaty on the Non-Proliferation the Nuclear Weapons (NPT)," at <http://www.un.org/en/conf/npt/2010/npttext.shtml>.

[2]– *Ibid*.

[3]– IAEA, "Latest News Related to PRIS and the Status of Nuclear Power Plants," at <http://www.iaea.org/programmes/a2/>.

[4]– World Nuclear Association, "World Nuclear Power Reactors & Uranium Requirements," at <http://world-nuclear.org/info/reactors.html>.

shocks in the 1970s faded away as a result of safety concerns caused by nuclear accidents such as the ones at Three Mile Island in 1979 and Chernobyl in 1986. As an example, on 16 February, 2010, U.S. President Barack Obama announced a loan guarantee of $8 billion to begin building nuclear power plants in the U.S. for the first time in 30 years. However, special attention must be paid to the fact that despite the current situation where over 80% of the world's nuclear power generation is concentrated in the OECD countries, the new renaissance of nuclear power generation will be led by the developing countries.[5] About 50 developing countries that currently do not have nuclear power plants have announced to the IAEA that they intend to build them in the future.[6]

The renaissance of nuclear power generation which is expected to be led by developing countries is seen as both an opportunity and a challenge for the international community.[7] It is an opportunity in the sense that, as mentioned earlier, nuclear energy has been developed as an effective alternative to fossil fuel out of the international community's concern over the depletion of fossil fuels and the anti-environmental consequences of fossil fuel-based energy development.

On the other hand, with an increase in the number of (potential)

5– Mary Nikitin, Anthony Andrews and Mark Halt, "Managing the Nuclear Fuel Cycle: Policy Implications of Expanding Global Access to Nuclear Power," *CRS Report for Congress,* RL34234 (1 July, 2009), pp. 7－8.

6– Jose Goldemberg, "Nuclear Energy in Developing Countries," *Daedalus*, Vol. 138, No. 4 (Fall 2009), p. 72.

7– Christopher Chyba and J. Crouch, "Understanding the U.S. Nuclear Weapons Policy Debate," *The Washington Quarterly*, Vol. 32, No. 3 (July 2009), p. 33.

nuclear reactor states, nuclear weapons states(NWS) are faced with an increasing need to control those states' energy programs within the NPT regime. This was born out of a concern that (potential) nuclear reactor states' nuclear energy programs could produce nuclear materials that would be used in developing weapons or diverted into the hands of nuclear terror groups for various purposes. A case in point is the nuclear fuel cycle. Nuclear generation of electricity involves the following nuclear fuel cycle: uranium mining → uranium enrichment → fuel fabrication → power generation → burn-up → reprocessing.[8] During this process, certain kinds of technology and equipment used for uranium enrichment and reprocessing could be diverted to producing nuclear weapons. In fact, India successfully produced nuclear weapons using plutonium extracted from reprocessing nuclear fuel, and Pakistan was also able to produce nuclear weapons based on highly enriched uranium (HEU).[9] Therefore, the advent of a new nuclear renaissance would pose a great challenge for the international community unless the nuclear fuel cycle of (potential) nuclear reactor states is managed within the NPT regime.

It is in this context that this chapter examines institutionalized arrangements for managing (potential) nuclear reactor states' nuclear fuel cycles. It first points out the limitations of the current arrangements designed to control non-nuclear weapons states' (NNWS') (potential)

8– Nikitin, *et al*., "Managing the Nuclear Fuel Cycle," pp. 10－18.

9– Joel Ullom, "Enriched Uranium Versus Plutonium: Proliferant Preferences in the Choice of Fissile Material," James Martin Center for Nonproliferation Studies, at <cns.miis.edu/npr/pdfs/ullom21.pdf>, pp. 5－8.

nuclear fuel cycles. It then introduces initiatives designed to insure the stable supply of nuclear fuel and the safe and secure management of spent fuel, claiming that the implementation of such insurance-oriented arrangements is essential to overcoming the challenges posed by the advent of a new nuclear renaissance.

2. NPT Regime to NNWS's Nuclear Energy Program

Robert Keohane categorizes the international regime into two types: control-oriented and insurance-oriented. The former is to "maintain some degree of control over each other's behavior, thus decreasing harmful externalities arising from independent action as well as reducing uncertainty stemming from uncoordinated activity" while the latter is to insure against "unlikely but costly contingencies."[10] Though the former is more common, the latter emerges to co-exist with or replace the former in a situation where "actors cannot exercise control over their environment at reasonable cost."[11]

With respect to the peaceful use of nuclear energy, the NPT regime has been functioning mainly as a control-oriented regime. The NPT requires NNWS to observe a safeguards program monitored by the IAEA in order to access peaceful nuclear technologies.[12] It is a

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[10] – Robert Keohane, "The Demand for International Regimes," *International Organization*, Vol. 36, No. 2 (1982), pp. 351－352.

[11] – *Ibid*., p. 352.

[12] – According to paragraph four of Article III of the NPT, safeguards agreements must be in force "not later than eighteen months after the initiation of negotiation" between the Agency and the NNWS.

prerequisite to the transfer of nuclear technologies under the NPT. The IAEA is not the secretariat of the NPT but an independent institution which was created in 1957. Nevertheless, while providing assistance on the peaceful usage of nuclear energy, it monitors NPT member states' nuclear energy programs through the safeguard system based on surveillance measures and on-site inspections, to insure that the assistance is not used for any military purpose.[13] Through these mechanisms, the IAEA oversees whether NNWS diverts peaceful nuclear technologies "from peaceful uses to military weapons or other nuclear explosive devices."[14]

However, while the NPT assigns the role of providing a verification mechanism to the IAEA, it does not stipulate any embedded enforcement mechanism for ensuring the safeguards.[15] Article VI of the NPT reads: "each of the parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race."[16] In other words, compliance with the safeguards agreements is dependent on the good will of member states, and sanctions for non-compliance are very limited. Rather, Article XII of the IAEA Statute stipulates that its Board of Governors may report non-compliance to the Security Council and the General Assembly of

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13– IAEA, "Statute of the International Atomic Energy Agency," at <http://www.iaea.org/About/statute_text.html>.

14– United Nations, "The Treaty on the Non-Proliferation the Nuclear Weapons (NPT)."

15– Chan-Gyu Kim, "*Haeg Hwagsangeumji Lejim-e Gwanhan Yeongu* (*Study on the Nuclear Nonproliferation Regime*)," (Ph. D. dissertation, Dongguk University, 2001), pp. 56－100.

16– United Nations, "The Treaty on the Non-Proliferation the Nuclear Weapons (NPT)."

the United Nations.[17] It is on the basis of this legal grounding that the UN Security Council (UNSC) can be considered to be the only institution mandated to compel a non-compliant NPT member state to fulfill its obligation to move toward renewed compliance.

To support the working of the NPT regime (comprised of the Non-proliferation Treaty, the IAEA and the UNSC[18]), in controlling NNWS's peaceful usage of nuclear power, several other control- oriented arrangements have been set up. For example, the Non-proliferation Treaty Exporters Committee (more commonly known as the Zangger Committee) was formed in 1971, and the Nuclear Suppliers Group (NSG) was formed in 1975, in order to prevent the spread of sensitive nuclear materials and technology to states not in compliance with safeguards agreements.

The NPT regime has been mostly successful in promoting the peaceful use of nuclear energy and in discouraging NNWS from developing nuclear weapons. Notable examples include the fact that Argentina, Brazil, and South Africa, all of which conducted secret nuclear weapons programs in the 1970s and 1980s, have pledged to cancel their programs and have opened their nuclear installations to international inspection.[19]

However, the NPT regime has had inherent limitations in discouraging NNWS from diverting nuclear energy programs to nuclear weapons programs in several cases. The primary limitation lies in the fact that

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17– IAEA, "Statute of the International Atomic Energy Agency."

18– Chan-Gyu Kim, "*Haeg Hwagsangeumji Lejim-e Gwanhan Yeongu*."

19– Jose Goldemberg, "Nuclear Energy in Developing Countries," p. 75.

it is difficult to tell the purpose of a country's nuclear program due to the overlap typical among nuclear power programs, nuclear research programs and nuclear weapons programs. A country whose nuclear activities need to be verified may deny the necessity of verification, arguing that its nuclear programs are being conducted for peaceful purposes. For example, North Korea has often refused inspections of some of its suspected nuclear facilities by the IAEA, insisting that those facilities were only non-nuclear military sites. Iran has been rejecting inspections, insisting that its uranium enrichment sites are for medical purposes not subject to IAEA inspections, and that IAEA inspection would violate Iran's sovereignty. Iran's bottom line is the belief that whatever safeguards agreements are signed, the customary law of territorial sovereignty is viable and takes precedence. Against such a backdrop, the IAEA is neither authorized nor equipped to impose any coercive measures to enforce inspections. That is, as mentioned above, Article Ⅲ of the NPT does not provide the Agency with any positive mechanism for enforcing safeguards agreements.

Also, the veto provision of the five permanent members (China, France, Russia, the U.S., the U.K.) prevents the UNSC from taking any meaningful action against the interests of any of the major powers. For example, the threat of a Chinese veto has thwarted various attempts to impose military sanctions against North Korea's and Iran's nuclear activities. The economic sanctions imposed by the UNSC have not been effective in curbing suspected nuclear weapons programs. As has been the case with North Korea in relation to its plutonium facilities, Iran continues to develop its uranium enrichment program

despite economic sanctions imposed by the international community.

Moreover, Article X of the NPT states that "[e]ach party shall in exercising its national sovereignty have the right to withdraw from the Treaty if it decides that extraordinary events, related to the subject matter of the Treaty, have jeopardized the supreme interests of its country."[20] The existence of this article highlights the fact that the NPT operation depends on the good will of member states. Taking advantage of this provision, North Korea joined the NPT in 1985, but withdrew from it in 2003 and conducted nuclear tests in 2006 and 2009.

Considering such limitations, the following section predicts that the NPT regime would face more serious challenges upon the advent of a new nuclear renaissance. That is because, as explained below, with the increase of (potential) nuclear reactor states, more states have been [and would be] interested in uranium enrichment and plutonium reprocessing.

3. New Nuclear Renaissance and Challenges to the NPT Regime

Currently about 90% of the world's reactors are using enriched uranium fuel, with the U.S., Russia, France, the U.K. and the Netherlands being the main suppliers, whereas Japan, China and Pakistan are operating rather small-scale enrichment facilities.[21] This

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[20]– United Nations, "The Treaty on the Non-Proliferation the Nuclear Weapons (NPT)."

[21]– Nikitin, *et al*., "Managing the Nuclear Fuel Cycle," p. 13.

implies that the majority of the 31 countries which currently operate commercial nuclear reactors rely on foreign countries' uranium enrichment facilities.[22] In fact, it is indeed more economical for most countries to import low-enriched uranium(LEU) than it is to construct and manage highly expensive uranium enrichment facilities of their own.[23] However, some of them are (would be) aiming at obtaining uranium enrichment facilities and related technology in order to prepare for the possibility that applying non-economic logic affecting the market, such as military and political, could generate substantial instability in the world market for enriched uranium.[24] To note, many (potential) nuclear reactors are concentrated in politically and militarily volatile Asia and the Middle East, so that such efforts are connected with their desire to achieve greater energy security.[25]

The increased concern over an unstable supply of nuclear fuel would also bring about NNWS's increased interest in plutonium reprocessing. Currently, both official and unofficial nuclear weapons states have military reprocessing plants, and Russia, the U.K., France, Japan, and India are operating commercial or laboratory reprocessing plants.[26] Unlike them, the majority of countries store the spent nuclear fuel in at-reactor spent fuel storage pools temporarily or in an

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22– Nikitin, *et al*., "Managing the Nuclear Fuel Cycle," p. 13.

23– *Ibid*.

24– *Ibid*., p. 18.

25– Seven Miller and Scott Sagan, "Nuclear Power without Nuclear proliferation?" *Daedalus*, Vol. 138, No. 4 (Fall 2009), p. 9.

26– Data Compiled from IAEA, Power Reactor Information System, at <http://www.iaea.org/programmes/a2/>.

interim storage facility.[27] The countries which store the spent nuclear fuel can be categorized into three groups.[28] The first consists of countries, such as the U.S. and Canada, which prefer the option of permanent disposal of the spent nuclear fuel instead of reprocessing it. The second includes countries which haven't reached a decision on whether to reprocess the spent nuclear fuel or permanently to dispose of it. The last group is currently facing restrictions on reprocessing fuel on account of individual nuclear agreements signed with other countries, especially the U.S.

With the advent of the nuclear renaissance and consequent concern over an unstable supply of nuclear fuel, more states, especially those belonging to the second and third groups, would be interested in reprocessing. This is mainly due to the fact that reprocessing of spent nuclear fuel will lead to contributing to the extraction of uranium and plutonium, which then can be used, once again, in generating electricity. However, although the IAEA is positioned to carry out supervision and control of reprocessing facilities of NNWS under the safeguards agreement or the Additional Protocol signed by its member states, the threat of nuclear proliferation will always remain as long as countries developing nuclear energy operate reprocessing facilities. If countries

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27– The majority of reprocessing countries do not reprocess all of the spent nuclear fuel, and they store non-reprocessed spent nuclear fuel or high-level radioactive waste after reprocessing.

28– Hotaeg Yun, "*Haeoe Juyogukui Sayonghuhaegyeonlyo Gwanlijeongchaeg Hyeonhwang* (The Current Spent Fuel Management Policies of Major States)," *Wonjalyeong Saneob* (The Nuclear Industry) (November/December 2009), pp. 48－57.

are not able to develop and commercialize the proliferation-resistant recycling technologies with economic feasibility, concerns toward nuclear proliferation are likely to be intensified as a result of those countries' greater attention to reprocessing.

Another challenge in relation to spent nuclear fuel comes from the fact that the capacity of each NNWS's temporary or interim storage facilities would reach their saturation point sooner or later.[29] As an example, in the case of South Korea, the storage capacity of nuclear power plants in Kori, Yonggwang, Ulchin, and Wolsong are expected to reach the saturation point by 2018.[30]

As nuclear power generation continues to develop, countries using nuclear-generated electricity would eventually require deep geological repositories in order to permanently dispose of the spent nuclear fuel. However, only a few countries, such as Finland and Sweden, have selected repository sites, whereas a majority of countries are still struggling to secure potential repository sites as they face opposition from local populations near the sites being considered.[31] Also, considering geographical characteristics and costs of building repository sites, not all countries are capable of building such sites. This leads to the expectation that (potential) nuclear reactor states will be interested in building reprocessing (or recycling) facilities which

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[29]– Charles McCombie and Neil Chapman, "A Nuclear Renaissance without Disposal?" *Radwaste Solutions* (July/August 2009), pp. 19－21.

[30]– Miles Pomper, Ferenc dalnoki-Veress, Stephanie Lieggi and Lawrence Scheinman, "Nuclear Power and Spent Fuel in East Asia: Balancing Energy, Politics and Nonproliferation," *Policy Forum* 10-042 (4 August, 2010).

[31]– Charles McCombie and Neil Chapman, "A Nuclear Renaissance without Disposal?"

would eventually reduce the volume of the spent nuclear fuel as well as its radioactive toxicity.

Under such circumstances, a country's uranium enrichment program and/or reprocessing would increase an adjacent state's interest in setting up such facilities for itself. To reiterate, many (potential) nuclear reactor states are now concentrated in politically and militarily volatile Asia and the Middle East. If a (potential) rival state builds (or plans to build) enrichment or reprocessing facilities of its own, a country may attempt to do the same to prepare against the possibility that its rival state would divert its nuclear energy program into a nuclear weapons program.

This situation can be characterized as a Prisoner's Dilemma game, as <Table Ⅷ-1> illustrates. Let's suppose two rival states (countries A and B) in a politically and militarily volatile region have to decide on whether they should build facilities for uranium enrichment and/or reprocessing or refrain from building them. Both countries find operating their own nuclear fuel cycle to be more expensive than relying on foreign facilities. Nonetheless, each country desires to have its own facilities in order to prepare against the possibility of a political or military disruption of the nuclear fuel cycle, on the condition that the other refrains from pursuing its own. That is because, if both countries build them, it would serve as a catalyst for an intensified military competition out of suspicion of each other's nuclear program. Thus, both countries prefer [Refrain, Refrain] to [Build, Build]. Each considers the situation where it refrains from building the facilities while the other builds them as the worst outcome, as its (building)

rival may then develop nuclear weapons.

The equilibrium outcome for this game is both countries' building uranium enrichment and/or reprocessing facilities. (<Table Ⅷ-1>, upper left cell). This outcome is Pareto deficient because, if they cooperate, they can reach a better outcome: both refraining from building them (<Table Ⅷ-1>, lower right cell). To resolve this "dilemma of common interest," states need a regime through which they can collaborate on their actions.[32] For such a regime to function effectively, it is necessary for it to have effective mechanisms to prevent 'cheating', for each state has an incentive to Build when its rival state's strategy is to Refrain. To illustrate, once Country A and B reached an outcome of [Refrain, Refrain], each country has an incentive to move to Build because 4 is higher than 3.

Table Ⅷ-1

		Country B	
		Build	**Refrain**
Country A	**Build**	2, 2	4, 1
	Refrain	1, 4	3, 3

* The left number in each cell represents country A's preference and the right one country B's preference.
* The numbers are ordinal, with 4 referring to the best preference and with 1, the worst one.

32– For the "dilemma of common interest," refer to Arthur Stein, "Coordination and Collaboration: Regimes in an Anarchic World," *International Organiza- tion*, Vol. 36, No. 2 (1982), pp. 304－308.

However, as examined in the previous section, the NPT regime does not have effective mechanisms to monitor, prevent, and/or punish 'cheating'. The IAEA is not designed to impose any coercive measures to enforce inspections, and the UNSC is constrained by the veto provision of the five permanent members. As the number of states that (plan to) have enrichment and reprocessing facilities increases, the less likely it becomes that the current NPT regime effectively controls NNWS' nuclear energy programs. If this is the case, then the very existence of the NPT regime can be jeopardized upon the advent of a new nuclear renaissance.

4. Arrangements to Insure NNWS' Peaceful Nuclear Energy Program

In light of the concern that enriched uranium and extracted plutonium could be easily diverted to producing nuclear weapons, NWS have remained sensitive toward the NNWS' building of uranium enrichment and reprocessing facilities. Various discussions have taken place with a view to preventing those NNWS which are now operating nuclear power plants or planning to operate them in the future from maintaining or developing such facilities. These discussions go beyond requiring NNWS to observe a safeguards program monitored by the IAEA. Rather than attempting to control peaceful use of nuclear energy, they seek to insure the stable supply of enriched uranium and the safe and secure management of spent fuel.[33] By the NWS pursuing this

strategy, the prisoner's dilemma situation described above could be changed into a "Stag Hunt" situation.[34]

Again, let's suppose two rival states (countries A and B) in a politically and militarily volatile region have to decide on whether they should build facilities for uranium enrichment and/or reprocessing or refrain from building them. Unlike the situation represented in <Table Ⅷ-1>, it is assumed here that each country is guaranteed a stable supply of enriched uranium and the safe and secure disposal of spent fuel. Thus, each country prefers [Refrain, Refrain] to its building the facilities while its rival refrains from building them. That is because both countries find operating their own nuclear fuel cycle more expensive than relying on foreign facilities. This situation can be characterized as a "Stag Hunt Game," as <Table Ⅷ-2> illustrates.

Table Ⅷ-2

		Country B	
		Build	**Refrain**
Country A	**Build**	2, 2	3, 1
	Refrain	1, 3	4, 4

33– Debra Decker and Erwann Michel-Kerjan, "A New Energy Paradigm: Ensuring Nuclear Fuel Supply and Nonproliferation through International Collaboration with Insurance and Financial Markets," *ISP Discussion Paper* 2007-02 (Harvard University, March 2007), pp. 8－9.

34– For "Stag Hunt Game," refer to Kenneth Oye, "Explaining Cooperation under Anarchy," *World Politics*, Vol. 38, No. 1 (1985), pp. 8－9.

There are two pure strategy equilibria in this scenario: [Refrain, Refrain] and [Build, Build]. In such a case, a given regime may help both countries' expectations converge to [Refrain, Refrain] by providing important information to each. Arthur Stein clams that "[t]he proffered information would provide each actor with assurance about the others' preferences, as would be necessary for expectations to converge on the one of the two equilibria that all prefer."[35] The existing NPT regime can assume such a role of information provider.

To note, such regimes do not necessarily need to be equipped with effective verification and/or enforcement mechanisms, because once states reach the better of the two equilibria, they have no incentive to 'cheat'. To illustrate this point using <Table Ⅷ-2>, once each knows that the other's strategy is Refrain, it has no incentive to adopt the strategy of Build, because 4 is higher than 3. It is in this context that the existing NPT regime can serve to encourage states to reach [Refrain, Refrain] and then to manage NNWS's peaceful use of nuclear energy, even though it does not have effective verification and enforcement mechanisms. Therefore, to manage NNWS' (potential) nuclear energy programs within the NPT framework in the era of a new nuclear renaissance, it is essential for states to be insured regarding the stable supply of enriched uranium and the safe and secure disposal of spent fuel. Various discussions have taken place in this regard.

First, there have been efforts toward creating an international

35– Arthur Stein, "Coordination and Collaboration," p. 303.

nuclear fuel bank or related voluntary multilateral mechanisms for assurance of nuclear fuel supply as well as the provision of related services. The U.S., the IAEA, Russia, the "Six-Country Concept" (proposed by France, Germany, the Netherlands, Russia, the U.K., and the U.S.), and the 'Nuclear Threat Initiative(NTI)' have suggested a number of plans through which nuclear reactor states can have access to a stable supply of LEU when political and military logic have brought instability to the enriched uranium market.[36] As a primary example, the NTI proposed to build a multilateral fuel bank under IAEA auspices, which would oversee the stable supply of LEU, and, in this regard, agreed to contribute $50 million to the IAEA under the condition that other countries come up with an additional $100 million. The target has already been reached as a result of the decisions of a number of states (that include the European Union, Kuwait, Norway, the United Arab Emirates, and the U.S.) to make contributions.[37] Kazakhstan informed the IAEA that it would consider hosting the facility in that country if a fuel bank were established. In June 2009, the IAEA Board of Governors reviewed the proposal by the NTI as well as Germany's proposal to build a multilateral enrichment plant. In November of the same year, it approved the Russian proposal to establish a reserve of LEU that would be available to states facing supply disruptions unrelated to technical or commercial reasons. Indeed, the IAEA and Russia signed an agreement in March 2010 to

36– Nikitin, *et al*., "Managing the Nuclear Fuel Cycle," pp. 33－34.

37– Miles Pomper, "IAEA Fuel Bank Advances," *Arms Control Today*, Vol. 39, No. 3 (April 2009), p. 47.

develop a reserve of LEU in Angarsk, Russia.

Secondly, various research projects have been conducted with an aim to develop a new reprocessing method that lacks the capacity to separate out plutonium. For example, the U.S.-Korea joint research on "pyroprocessing" is one of the efforts toward developing a new reprocessing method that better accommodates any concerns rising from reprocessing. Yet, such efforts have been limited to the research stage.

Instead, various suggestions for dealing with spent nuclear fuel have been made as preparatory measures. The most well-known among others is the 'Global Nuclear Energy Partnership' proposed by the U.S. This is aimed at, among others, inducing countries using nuclear-generated electricity to voluntarily give up their ambitions to build reprocessing facilities by having nuclear fuel supplier countries take back the spent nuclear fuel from their client countries and undertake the job of reprocessing the spent fuel themselves.[38] However, considering the relative difficulty of distinguishing supplier states from the recipients as well as the expected opposition from inside the supplier countries, the possibility of realizing this suggestion appears to be rather low.[39]

The more realistic alternative would be for a number of countries to form a partnership and jointly to build a deep geological repository for designated areas. Yet, it is also not easy for any country to overcome domestic opposition and to build a deep geological

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38– Nikitin, *et al*., "Managing the Nuclear Fuel Cycle," pp. 28－32.

39– *Ibid.*

repository on its own soil for serving the interests of the region as a whole. Despite such challenges, however, there is ongoing research in that direction, and in particular, Europe is now engaged in discussions on establishing an institution which would oversee the building of a European deep geological repository on pace with efforts of member countries.[40]

5. Conclusion

This chapter has so far argued that the advent of a new nuclear renaissance would pose serious challenges to nuclear nonproliferation unless (potential) nuclear reactor states are insured for the stable supply of LEU and the safe and secure management of spent fuel. Various efforts have been initiated to induce NNWS to voluntarily give up building uranium enrichment and/or reprocessing facilities, i.e., the attempts to create nuclear fuel banks for the front end of the nuclear fuel cycle and research on proliferation- resistant technologies for reprocessing and on deep geological repositories for the back end of the nuclear fuel cycle.

Such efforts are facing opposition from members of the Non-Aligned movement out of concern that the "peaceful use of nuclear energy" might be restricted. For example, the 8th NPT Review Conference that took place in New York (3－28 May, 2010), revealed tension between

40– The detailed layout of Europe's initiative is represented in the 'Strategic Action Plan for Implementing European Regional Repositories (SAPIERR).' See Charles McCombie and Neil Chapman, "A Nuclear Renaissance without Disposal?" p. 25.

countries which regard securing uranium enrichment and/or reprocessing facilities as their inalienable right based on the peaceful use of nuclear energy and those others which take into account the threat of nuclear proliferation in approaching the issues. Nevertheless, both sides share the concern that, with an increase in the number of (potential) nuclear reactor states, the NPT regime would confront serious challenges. Such concerns have led them to come to a compromise with each other on this issue. Paragraph 58 of the final document of the 8th NPT conference reads:

"The Conference underlines the importance of continuing to discuss in a non-discriminatory and transparent manner under the auspices of IAEA or regional forums, the development of multilateral approaches to the nuclear fuel cycle, including the possibilities to create mechanisms for assurance of nuclear fuel supply, as well as possible schemes dealing with the back-end of the fuel cycle, without affecting rights under the Treaty and without prejudice to national fuel cycle policies, while tackling the technical, legal and economic complexities surrounding these issues, including in this regard the requirement of IAEA full scope safeguards."[41]

To find a way to respond in a mutually satisfactory way to the concerns of the two sides would be a decisive factor on whether the advent of a new nuclear renaissance would prosper without nuclear proliferation.

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[41] For the text of the Final Document of the 2010 NPT Review Conference, see <http://www.un.org/ga/searchview_doc.asp?symbol=NPT/CONF>.

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