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Improving Nuclear Safety, Security, and Nonproliferation in Northeast Asia through Multinational Approach

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Abstract

Reviewing recent developments in nuclear energy, it is clear that Northeast Asian countries have become the leading customers and suppliers of nuclear technology worldwide. However, regional cooperation in the nuclear field remains inadequate when compared to the close economic interaction between these states and their need for solutions to pressing issues, such as supply assurance and spent fuel management. At the same time, with events like the Fukushima accident or the ongoing nuclear crisis in North Korea, there is an urgent demand for Northeast Asia to improve the safety, security, and nonproliferation status of the regional nuclear programs as any nuclear-related incident in any regional state will have transnational impact on the economic and social stability of the whole region. Based on the status of nuclear power development and regional nuclear cooperation in Northeast Asia, this paper analyzes the common need for better safety, security, and nonproliferation of nuclear materials and facilities in the region. Just as cooperation in improving these issues can serve as a breakthrough for broader regional cooperation in the nuclear field, several opportunities for the establishment of a regional framework for nuclear cooperation are also identified based on current cooperation mechanisms like the Nuclear Security Summit or the Northeast Asia Peace and Cooperation Initiative (NAPCI). Such cooperative efforts will likely face challenges from the political animosity among Northeast Asian states. But consistent efforts from all parties, with focus on practical issues, will increase its chance of success, thus creating a safer, more secure atmosphere in nuclear Northeast Asian facilities, eliminating any proliferation purpose and serving as the basis for sustainable development of nuclear power, both regionally and globally.

I. Introduction

In the past two decades, countries in the Northeast Asian region, such as China, Japan, and the Republic of Korea (ROK), have emerged as the new engines for the peaceful development of nuclear power worldwide. However currently, there are few regional cooperation activities in the nuclear field between these countries despite the apparent needs and potentials for such cooperation. The following discussion

reviews the status of nuclear power development in Northeast Asia and the position taken by regional states on the idea of multinational nuclear cooperation.

A. Nuclear power in Northeast Asia

Northeast Asia is currently the fastest growing region in the world in terms of nuclear power development. Until the accident at the Fukushima Dai-ichi Nuclear Power Plant (NPP) in March 2011, Japan had been the leading nuclear power country in Asia with 50 operational units. However, the Japanese nuclear power program was mostly halted after the accident, and the restart process has only recently been initiated at the Sendai-1 and Sendai-2 NPPs **[*1*]**. In addition, Japan has signed an agreement with Vietnam on the construction of two nuclear power units and is promoting its technologies in other countries.

Following Japan, ROK has gradually built up its nuclear power fleet since the 1970s. It now has 24 operational units and another four units under construction **[*2*]**. Expert nuclear security analysts project that the nuclear generation capacity in ROK will surpass Japan's by 2035 **[*3*]**. ROK has also succeeded in developing its own nuclear technology, and it made headlines in 2009 by winning the contract to build four APR1400 units for the United Arab Emirates as well as another contract for a research reactor in Jordan.

Despite its status as a nuclear weapon state since 1964, China started its civil nuclear program later than Japan and ROK. However, China has since emerged as a leading country in global nuclear development with 28 operational units and another 24 under construction (IAEA, Power Reactor Information System (PRIS), 2015). China has also exported NPPs to Pakistan, and it has provided financing for nuclear power projects in the United Kingdom, Romania, and Argentina.

Although all three major states in Northeast Asia possess advanced capabilities in nuclear technology, their nuclear industries still depend on out-of-region supply sources for natural uranium and fuel cycle services, like enrichment **[*4*]**.

Not generally considered a Northeast Asian state, Russian is included in this analysis because its territories are geographically located in this region. With 34 operational nuclear units and the current most successful nuclear exporter in the global market, Russia also has a significant nuclear presence in the region. Russia's Northeast Asian presence includes multiple NPP construction projects in China, exploration activities in Mongolia, and enrichment service contracts with Japan **[*5*]**.

Aside from these four major nuclear power states, the territory of Taiwan has a considerable nuclear fleet with 6 operational units and 2 units under construction. North Korea (DPRK), on the other hand, once had a civilian nuclear program, which mostly served as a cover for its proliferation attempts **[*6*]**. Lastly, Mongolia, being the only Northeast Asian state without significant nuclear activities, still possesses experience in uranium exploration and has actively participated in regional nonproliferation dialogues.

The current and future development of nuclear power in Northeast Asian states is summarized in Figure 1.

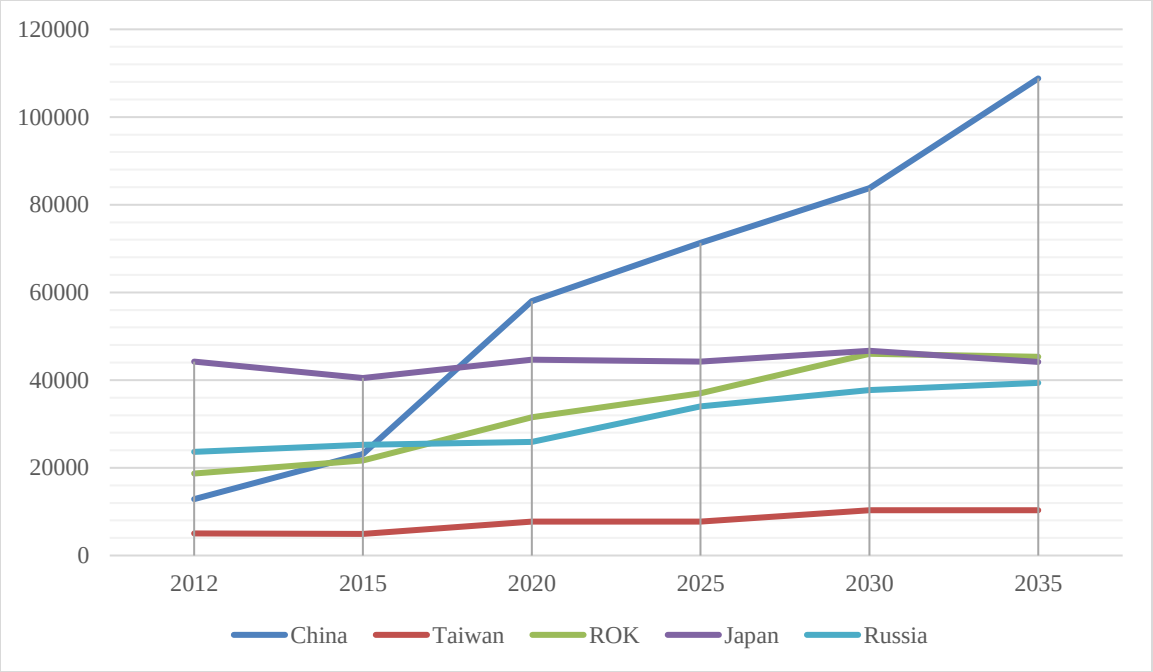

Figure 1.Current nuclear installed capacities (unit: MWe) and projections (high scenario) through 2035 in Northeast Asian states [3, 7]

B. Multinational approach in nuclear cooperation

One solution to balance the demand for peaceful utilization of nuclear energy and the need to prevent the proliferation of the technology for military purposes is known as a multinational approach (MNA). This model has been proposed since the early days of nuclear energy on the basis that the technology should be managed not by individual countries, but by a community of state-level technology users. This kind of cooperation mechanism ensures that individual countries can access the benefits of peaceful applications of nuclear technology while the community would collectively eliminate any proliferation intention. After World War II, the United States (U.S.) proposed the Baruch Plan (1946), intending to establish an international regime to control the application of atomic energy. Since then, numerous MNAs have been proposed at the international and regional levels, focusing on nonproliferation, which has led to the establishment of nuclear weapon-free zones in Latin America, Africa, Central Asia, Southeast Asia, and Oceania. Born out of the need for a sustainable and economic supply of fuel cycle services, several fuel cycle-related MNAs have also operated successfully in Europe. These include the EURATOM nuclear community to ensure safeguards and fuel supply in European states, the multinational corporations URENCO and EURODIF in uranium enrichment, and the EUROCHEMIC consortium in spent fuel reprocessing.

Recently, there has been a new wave of MNA proposals in the nuclear field aiming at the assurance of nuclear fuel supply, thus discouraging individual states from developing sensitive technologies like enrichment and nuclear reprocessing (ENR). Among these proposals, the International Atomic Energy Agency's (IAEA) recent collaborations with Russia (the International Uranium Enrichment Centre – IUEC), and Kazakhstan (the Nuclear Fuel Bank) can be considered the most successful **[*8, 9*]**.

As mentioned previously, none of the Northeast Asian states have totally self-sustainable nuclear programs. In addition, countries with limited landmass and considerable public opposition to nuclear power and disposal facility siting, such as ROK and Taiwan, have grappled with the question of spent fuel management. Furthermore, the region has been marred by the DPRK nuclear crisis since the early 1990s.

Various MNA schemes have been proposed by regional parties to resolve these issues, including nonproliferation and export control regimes (like ASIATOM, or PACATOM) and fuel supply assurance and spent fuel management entities (like the Nuclear Fuel Cycle Centre). However, no proposal has been successfully realized, partly due to both the lack of concrete interests by countries in the region and due to their enduring political and social animosities **[*10*]**.

Considering the highly integrated economies of the region and the urgent demand for fuel supply and spent fuel management solutions, the lack of progress in implementing a nuclear MNA in Northeast Asia needs to become a central focus. The following Sections address the current status of safety, security, and nonproliferation in Northeast Asia. It also addresses how an MNA in these areas can resolve cooperation dilemmas.

II. Status of nuclear safety, security, and nonproliferation in Northeast Asian states

A. Nuclear safety

After the Fukushima accident in 2011, numerous nuclear safety issues in Japan have been revealed, such as its defective regulatory structure and the lack of a proper safety culture **[*11*]**. As a result, the IAEA has strongly recommended its Member States provide their safety regulators with an effective independence from the nuclear operators. However, in Northeast Asia only the Korean and Russian safety regulatory bodies (the Nuclear Safety and Security Commission – NSSC in ROK and the Federal Environmental, Industrial and Nuclear Supervision Service – Rostechnadzor in Russia) have operated independently since 2011 and 2012, respectively. Their Chinese and Japanese counterparts (the National Nuclear Safety Administration – NNSA in China, and the Nuclear Regulation Authority – NRA in Japan) are not totally independent as they still belong to the environmental protection ministries in these countries.

In addition, ROK has recently experienced some serious incidents related to nuclear safety and safety culture, such as the concealment of a station black-out at the Kori-1 NPP in 2012 and the falsification of quality certificates for equipment at numerous NPPs **[*12*]**. These incidents have not only altered the operation of ROK's nuclear fleet but have also caused strong negative reactions from the public.

The rapid expansion of the Chinese nuclear power program has also created concerns regarding the construction quality of the new NPPs in China, the plants' technologies being supplied by different countries. Such use of different technologies for different NPPs can create a disparity between the tight construction schedule and the inspection capabilities of the competent authorities **[*13*]**.

The accident at the Fukushima Dai-ichi NPP has shown once again that "a nuclear accident anywhere is a nuclear accident everywhere" **[*14*]**. As the number of NPPs in Northeast Asia is still growing rapidly, even after the accident, maintaining the safety of the nuclear fleet in each state is a pressing issue not only to that country, but also for the whole region.

B. Nuclear security

The status of nuclear security in Northeast Asian states is summarized in Table 1. Except for DPRK, all regional states have actively participated in the international efforts to enhance nuclear security and to prevent nuclear terrorism. However, Russia and China have been exposed to significantly higher risks of terrorist attacks than other countries in the region. In China, terrorist activities have even increased noticeably in recent years **[*15*]**.

Table 1. Terrorism risk, nuclear security status, and adherence to international regimes related to nuclear security of Northeast Asian states.

Country	Terror casualty 2014[1]	GTI 2014[2]	NTI 2014[3]	CPPNM[4] and CPPNM Amend[5]	ICSANT[6]	CoC[7]
China	1068	5.21	64	*yes*	*yes*	*yes*
Taiwan[8]	0	0.31	63	-	-	-
ROK	0	0	82	*yes*	*yes*	*yes*
DPRK	0	0	30	*no*	*no*	*no*
Japan	0	0.01	76	*yes*	*yes*	*yes*
Mongolia	0	0	69	*yes*	*yes*	*no*
Russia	2443	6.76	66	*yes*	*yes*	*yes*

In the case of nuclear terrorism, Russia was once a hot spot of nuclear security concerns after the break-up of the Soviet Union, but its situation has been improved significantly, partly due to its active collaboration with the U.S. and other international organizations. However, the risk of illicit transfers of nuclear materials remains a critical concern to Russia, whereas the recent political rift between Russia and the U.S. has the potential to negatively affect the progress in improving Russian nuclear security **[*16*]**. In China, experts have assessed that the threat from nuclear terrorism is low; however, the recent terrorist activities by separatist groups have also created some concerns about the security of the Chinese nuclear facilities **[*17*]**.

In other regional states with lower risks of terrorism like Japan and ROK, there still exist numerous nuclear security issues. In the early 1990s, the cult Aum Shinrikyo threatened Japan's security; Japan's plutonium stockpile, which will likely grow larger in the near future given the stagnancy of the Japanese nuclear program, may become a target of nuclear terrorism **[*18*]**. As for ROK, the recent cyber-attack on the computer system of the South Korean nuclear operator KHNP, which was possibly initiated by DPRK, its main security threat, also raises concern about the security of the country's growing nuclear power program in case of further attacks by state or non-state actors **[*19*]**.

Given the transnational characteristics of terrorism and the devastating impact of potential nuclear terrorist attacks on the economy and society of regional states, nuclear security should be considered a priority in the cooperation agenda in Northeast Asia.

[1] Five-year total casualties as of 2014, including both deaths and injuries, due to acts of terrorism. Data taken from the Global Terrorism Database **[*15*]** (START, 2015).
[2] 2014 Global Terrorism Index. Country is scored on a scale of 0-10 with 0 being "*no impact of terrorism"* and 10 being "*highest impact of terrorism*".
[33] 2014 NTI Nuclear Materials Security Index. Country is scored on a scale of 0-100 with 100 being "*most favorable nuclear materials security conditions*".
[4] Convention on Physical Protection of Nuclear Material. Country is noted "*yes*" if it is a signatory to the Convention and has put it into force.
[5] Amendment to the Convention on the Physical Protection of Nuclear Material (CPPNM Amendment). Country is noted "*yes*" if it has put into force this Amendment.
[6] International Convention for the Suppression of Acts of Nuclear Terrorism. Country is noted "*yes*" if it is a signatory to the Convention and has put it into force.
[7] IAEA's Code of Conduct on the Safety and Security of Radioactive Sources (Resolution No. GC(47)/RES/7.B). Country is noted "*yes*" if it has official announcement on the commitment to the Code of Conduct.
[8] Due to the "One China" policy, Taiwan is not recognized as a sovereign state by the United Nations and the IAEA, and thus cannot become a party to the CPPNM or join the CoC.

C. Nuclear nonproliferation

Not only a focal point of nuclear power development, Northeast Asia is also one of the most critical regions of the nonproliferation regime with two *de jure* nuclear weapon states (Russia and China), one *de facto* nuclear weapon state (DPRK), and five states/sovereign with active civil nuclear program. Three of these (Russia, China, and Japan) have complete nuclear fuel cycles. In particular, the nuclear weapons program of DPRK has undermined both the safeguards efforts by the IAEA and the effectiveness of the Non-Proliferation Treaty. DPRK has also defied, numerous times, the international efforts on denuclearization, among which the KEDO project (Korean Peninsula Energy Development Organization) was once considered a promising case for MNA for nuclear fuel cycle in the region. Given the DPRK's heavy reliance on nuclear weapons as a security assurance measure and its political isolation, the nuclear crisis here will likely remain a critical issue in the region for some time.

Besides, there are other regional nonproliferation issues, such as the Japanese inventory of plutonium from reprocessing, which has been considered a regional concern by its neighbors despite the strong commitment of Japan to IAEA safeguards **[*20*]**. Northeast Asia is also one of the few regions in the world that do not have a functional nuclear-weapon-free-zone treaty similar to the Semei Treaty for Central Asia or the Rarotonga Treaty for the Oceanic states. Moreover, one can see that the tensions over the territorial and maritime disputes between Japan and China, or between ROK and Japan, have increased in recent years. Such intense rivalries and the unresolved nuclear crisis in DPRK can be catalyst for a regional arm race and even proliferation intentions in Northeast Asia. Therefore, it is essential for Northeast Asian countries to enhance the nonproliferation status of the region, including improving the transparency of each country's nuclear program, coordinating in the DPRK nuclear issue, and soon establishing a treaty on nuclear weapon-free zone. The only visible solution is an effective MNA.

Based on the conditions and needs in the region regarding nuclear safety, security, and nonproliferation as outlined by this discussion, opportunities for a functional multinational framework in Northeast Asia and challenges that may lie ahead are identified in the next Section. Also included are some suggestions on practical measures for its implementation.

III. Nuclear multinational approach in Northeast Asia revisited

A. Challenges and opportunities for a nuclear multinational framework in Northeast Asia

As discussed in the previous Sections, the political and social tension between regional states has impeded attempts to realize a nuclear MNA scheme in Northeast Asia. Given the recently heightened territorial disputes and unresolved historical issues over the Japanese legacy during the World War II, it will be very difficult for regional countries to find a common voice in such a sensitive issue as nonproliferation. Therefore, limiting a nuclear multinational framework to nuclear safety and security cooperation should be a feasible starting point.

The cooperation platform Northeast Asia Peace and Cooperation Initiative (NAPCI), which has been advocated by the Korea Government since 2014, can be used as a springboard for such a nuclear MNA. The basis of this regional initiative, in the words of the President of Korea Park Geun-hye, is cooperation in practical areas such as climate change, disaster relief, nuclear safety, and transnational crime, following the cooperation model of the European Union **[*21*]**. Given the political and social sensitivity of any nuclear-related issue, government-to-government nuclear cooperation in Northeast Asia that is similar to the European nuclear community EURATOM may be unlikely at the moment. However, nuclear safety

and security cooperation in the form of a working group under NAPCI is not an unrealistic option, as seen by the Northeast Asian Top Regulators Meeting (TRM) of the trio China-Japan-ROK that has taken place annually since 2008. The working-group level at the beginning of the process would also allow the participation of Taiwan, a considerable nuclear user in the region, as contributor and benefactor of regional efforts to enhance nuclear safety and security, all the while maintaining the "One China" policy, thus fostering the essential support from China.

It is necessary that such a nuclear cooperation mechanism is incrementally built, which will ensure a higher level of participation from regional governments as the MNA is developed. Any nuclear-related cooperation can only achieve sustaining effectiveness with government endorsement from regional states. Such a cooperation mechanism will be likely supported by the U.S., which has actively called for global efforts to improve nuclear safety and security. The U.S. also desires a cooperative and stable climate in Northeast Asia between two of its closest allies, ROK and Japan, and its major commercial partner, China.

The area most in need of an MNA cooperation framework in Northeast Asia, however, is nuclear nonproliferation. Regional rivalries and the dispute over a solution for the DPRK nuclear crisis have prevented Northeast Asian states from establishing a consensus on this subject. Here the breakthrough may only come from gradual rapprochement driven by the top leaders' willingness to cooperate, as was shown in the case of the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC). This mutual safeguards mechanism between the rivals Argentina and Brazil was successfully developed by increasing nuclear cooperation, improving security and cooperation climate, and building mutual confidence **[*22*]**. Another good example for Northeast Asia is the success achieved by the U.S.-Russia cooperation to remove highly enriched uranium (HEU) fuels from research reactors around the world. This program has helped eliminating the risk of these weapon-usable materials being taken by terrorists. Such collaboration prevailed despite the increasing political differences between the U.S. and Russia, proving that the interest in finding solutions for practical nuclear issues can help countries overcome political tensions and cooperates with each other.

This type of cooperative framework in nonproliferation can also involve DPRK through conditional security and economic benefits based on its gradual steps towards abandoning the nuclear weapons program. Again, the support from the U.S. for such MNA is necessary, and achievable, as it can provide an alternative for the U.S. to indirectly deal with the DPRK nuclear crisis. Furthermore, this nonproliferation-based MNA can be expanded to encompass cooperation in nuclear fuel supply and services, which are much needed by regional players.

B. First steps for a feasible nuclear MNA in Northeast Asia

From the practical point of view, there are numerous ways to implement a Northeast Asian MNA. In the case of nuclear safety, the European Union (EU) has proven to be a good example of establishing a legally binding and robust regional regulatory framework under the umbrella of EURATOM, which is assisted by the European Nuclear Safety Regulators Group (ENSREG) - an advisory group focusing on cooperation and transparency in nuclear safety, and the Western European Nuclear Regulators' Association (WENRA) - a professional network of nuclear regulators in Europe. The European model has been recently proposed by ROK for Northeast Asia. Its feasibility is considerable given the willingness of the region's leaders and public to support a cooperative measure in nuclear safety.

In case of nuclear security, regional cooperation can start from the commitments made by regional states at the Nuclear Security Summits. Such commitments by China, ROK, and Japan at the 2010 Summit have led to the establishment of the first three regional Centers of Excellence in nuclear security in Northeast Asia. These include the State Nuclear Security Technology Center (SNSTC) of China, the International

Nuclear Nonproliferation and Security Academy (INSA) of ROK, and the Integrated Support Center for Nuclear Nonproliferation and Nuclear Security (ISCN) of Japan. So far these centers have carried out cooperation activities at the organizational level, mainly focusing on human resources development **[*23*]**. If this form of organization-to-organization cooperation is developed further with support from respective governments, it can also serve as the coordination seed for regional cooperation in nuclear security at higher levels.

Finally, a practical opportunity for cooperation in nuclear security and nonproliferation may lie in the management of spent fuel. One of the lessons learned from the Fukushima accident is the vulnerability of the spent fuel pool in case of accident or terrorist attacks and the tremendous environmental and psychological impacts that may follow such incidents. The management of spent fuel is also a nonproliferation question, as reflected through the lengthy negotiation between the U.S. and ROK on their renewed nuclear cooperation agreement related to the issue of pyroprocessing. In Northeast Asia, ROK and Taiwan have already encountered difficulties with the management of spent fuel. Given the growing number of decommissioning NPPs due to the downsizing of the nuclear fleet, Japan will probably have to deal with similar issues in the near future. Therefore, it will be beneficial for regional countries to cooperate in enhancing the security and nonproliferation of the spent fuel management facilities. Efforts should be made to engage DPRK in this type of cooperative approach, as any security-related incident at its nuclear complex will have negative impact on regional states. Such engagement is of interest not only to ROK, which will be directly affected by any nuclear-related incident in DPRK, but also from China, which has particular concerns about the transfer of DPRK's nuclear weapon technology and weapon-usable nuclear materials to non-state actors **[*24*]**.

Regional involvement in the form of information sharing and consultation to ensure the security of the Japanese plutonium inventory may also be a potential MNA scheme. It will help Japan to lower the risk of terrorist attack on or material theft from the outside while alleviating other countries' proliferation concerns, thanks to a higher level of information transparency. Similar information transparency will be essential to the proliferation resistance of the pyroprocessing technology, which has been under development in ROK as a solution for spent fuel management.

IV. Conclusions

As the nuclear industries in the U.S. and Europe have stayed in relative stagnant for over two decades, Northeast Asia has become the locomotive of worldwide nuclear power development. However, the history of nuclear cooperation within the region has proven to be much less successful, partly due to numerous regional rivalries and the lack of tangible interests. A multinational approach (MNA) in the issues of nuclear safety, security, and nonproliferation provides a possible breakthrough in nuclear cooperation for Northeast Asia. As any nuclear-related incident, such as accidents at NPPs, terrorist attacks on nuclear facilities, or the use of nuclear materials for military purposes, would have devastating and transnational impacts on the economy and societies of the Northeast Asian states, the improvement of safety, security, and nonproliferation of the regional nuclear programs is essential and requires collective efforts from regional players. The paper also provides some cooperation mechanisms that may help such MNA effort surpass the existing political barriers in order to create a practical and effective approach. The realization of an MNA in nuclear safety, security, and nonproliferation requires continuous and consistent efforts from and coordination among all countries in Northeast Asia. Once implemented, such an MNA would benefit the region and the international community—not only by enhancing the safety and security of the fastest-growing nuclear market in the world, but also by creating a basis for a broader nuclear MNA in Northeast Asia that can help the region continue to benefit from nuclear energy in a safe, secured, sustainable, and peaceful way.

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