Regional Nuclear Fuel Cycle and Energy Security Cooperation in Support of a Regional NWFZ

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I. INTRODUCTION

David von Hippel writes: "A regional approach to nuclear materials security could have positive spillover effects beyond a NWFZ. Creating and monitoring a regional nuclear materials regime could be a core function of a permanent council on security established as part of a comprehensive Treaty on Peace and Security in Northeast Asia."

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II. POLICY FORUM BY DAVID VON HIPPEL

Regional Nuclear Fuel Cycle and Energy Security Cooperation in Support of a Regional NWFZ

A durable nuclear weapons free zone (NWFZ) in Northeast Asia (NEA) requires securing not only nuclear weapons-related fissile materials but also those in spent fuel from nuclear power reactors. Management of nuclear spent fuel is closely associated with energy security in all NEA countries, particularly the Democratic People's Republic of Korea (DPRK). A regional approach to nuclear materials security could have positive spillover effects beyond a NWFZ. Creating and monitoring a regional nuclear materials regime could be a core function of a permanent council on security established as part of a comprehensive Treaty on Peace and Security in Northeast Asia. [1]

1. Regional Cooperation on Nuclear Fuel Cycle Issues: "Front End", Technology, and Reprocessing

The Republic of Korea (ROK) and Japan depend heavily on nuclear power. Most of the anticipated global growth of nuclear power use will occur in NEA, particularly China. The ROK and Japan have accumulated thousands of tons of spent fuel containing plutonium (Pu) and other materials potentially usable in nuclear weapons. Japan's reprocessing program contains more than 50 tons of separated Pu. Japan and China enrich uranium for use in nuclear reactors, and the DPRK says it intends to do so. Cooperation on nuclear issues in NEA has been discussed for years, but have not moved forward.

How fissile materials are managed and tracked—through enrichment, storage, reprocessing, and final disposal—affects the viability of a NEA-NWFZ. Increased transparency, including possibly a regional monitoring and verification scheme, as well as shared fuel cycle activities or facilities, could serve the ROK and Japans' energy security goals while offering both sufficient confidence in the others' nuclear activities to allow a NWFZ to be sustained. These arrangements could be extended to other non-nuclear states as might join a NWFZ such as a denuclearized DPRK, Canada and Mongolia.

Japan's reprocessing program aims to increase energy security by "recycling" plutonium in nuclear fuels for use in current and next-generation reactors. The ROK wishes to pursue a similar path for similar reasons--but also to be treated equally as Japan. However, the DPRK is unlikely to give up its weapons so long as the programs persist because they represent a fast-track for the ROK and Japan to develop nuclear weapons, especially as the benefits of reprocessing are dubious. [2]

Option 1.1: Establish a regional consortium on nuclear fuel enrichment;
Option 1.2: Limit, forego, or end reprocessing and/or "pyro-processing" in non-nuclear states in a NEA-NWFZ; [3]
Option 1.3: Create regional emergency enriched "fuel banks" or leasing arrangements; and/or
Option 1.4: Collaborate on nuclear equipment manufacturing/export, and a nuclear vendor code of conduct [4].

2. Regional Cooperation on Nuclear Fuel Cycle Issues: "Back End", Spent Fuel Storage and Disposal

Spent fuel pools at reactor sites and the few existing intermediate storage facilities are rapidly filling up in the ROK, Japan and Taiwan. China's younger reactor fleet has more spent fuel space, and an

interim storage facility is under construction. Preliminary discussions and design of permanent disposal facilities in Japan, the ROK, and China are underway, but siting of such facilities, particularly in the ROK and Japan, will be difficult. The focus has been on retrievability and shallow subterranean storage sites.

Option 2.1: Establish regional intermediate spent fuel storage and disposal facilities such as centralized repositories located in NWFZ countries, with international management combined with a regional monitoring and verification system on fuel inventories in such schemes to assure participants that no nuclear materials are diverted. International monitoring of dispersed intermediate storage facilities is also possible, although current laws in the ROK and Japan impede siting and construction of intermediate storage; and/or

Option 2.2: After 2030 (that is, when spent fuels are sufficiently cooled and disposal technologies sufficiently advanced), establish permanent regional waste disposal sites, including "deep borehole disposal" whereby spent fuel, high-level wastes, and possibly separated Pu, diluted and immobilized in inert material, would be placed in holes drilled 3 to 5 km into stable rock strata [5].

3. Fukushima as a Driver of Change in Nuclear Policy

The March 2011 Fukushima reactor accident led all states to re-examine nuclear plans and nuclear safety. Spent fuel pools are used in almost all reactor designs to store spent nuclear fuel for at least five years (and sometimes much longer) following removal from reactors. The Fukushima disaster suggests that the high-density packing currently used in pools at many plants should be reduced to allow passive cooling of stored spent fuel if power is lost. Also, pools should not be located such that damage to reactors can affect the operation of pools or vice-versa. These changes could reduce greatly the vulnerability of nuclear plants to accident, faulty construction, inept operation, or attack, and thereby, the potential radiological consequences of such events [6].

Option 3.1: Initiate regional dialogue to improve the transparency of spent fuel storage and disposal arrangement, but also to address the urgent issue of spent fuel pool design, de-densification of spent-fuel storage in pools, and retrofitting of reactors to reduce the risk arising from spent fuel pools. Such discussions could include the DPRK and serve as a strong and necessary complement to a NWFZ.

4. DPRK Energy Insecurity and International Assistance Options for the DPRK Energy Sector

Energy insecurity has played an important role in the DPRK's slow motion nuclear proliferation strategy and motivates both its weapons program, and its own aspirations to obtain nuclear power reactors for electricity and prestige. This motivation is also rooted in its lack of key fuels, particularly petroleum (the DPRK military uses 30% of total supplies) and technologies with which to redevelop its economy in the post-Soviet era. Current levels of petroleum products production and imports into the DPRK, even if fully diverted to the military, will not sustain the military in an active war with the ROK for more than a month. Thus, any realistic proposal to remove nuclear weapons from the DPRK must redress its energy insecurity and will entail substantial technical assistance and external investment to reconstruct the DPRK's energy infrastructure.

Option 4.1: Improve the DPRK's coal mining infrastructure, rehabilitate coal-fired power plants and boilers; rebuild its electricity grid; develop small-scale renewable energy systems; rehabilitate rural infrastructure including agriculture, reforestation and soil conservation; and undertake massive energy-efficiency measures. All should start at a small scale, include extensive capacity- and trust-building activities, and include clear plans for follow-up. Absorbable support, at least initially, is

perhaps $200 million per year.

5. Regional Cooperation on Non-nuclear Energy Infrastructure Development and Operation

Regional links between the energy systems of the NEA nations could directly connect the DPRK with China, Russia, ROK, and possibly Japan. Some projects would be commercially viable for private investment; others sufficiently economically justified for only governments to pursue. Such projects could contribute to the viability of a NWFZ and vice versa.

Option 5.1: Initiate inter-governmental investigation into regional electricity grid and gas supply interconnections, plus derivative DPRK demand infrastructure development. [7]

6. Cooperation on the DPRK's Nuclear Energy Program

The DPRK's current light-water reactor (LWR) and uranium enrichment programs offer another opportunity for engagement in the context of denuclearization and a NEA-NWFZ. Possible steps include: deploying a small barge-mounted reactor (possibly Russian) to provide power to a coastal town; helping the DPRK to make or contribute to the production of low-enriched uranium fuel for such a reactor, or assisting with design, financing, and manufacture of small LWRs built to international safety/manufacturing standards, possibly jointly with the ROK [8].

Option 6.1: Create a regional enrichment consortium that incorporates the DPRK's enrichment capacities into a safeguarded, multinational scheme in exchange, for example, for divulging the DPRK's enrichment technology acquisition history.

Option 6.2: Commence power system planning for rational development of a DPRK grid capable of supporting a fleet of small LWRs.

Option 6.3: Provide training and institutional development to support nuclear activities including those related to the DPRK's LWR, those related to other international nuclear materials cooperation involving the DPRK, and those related to nuclear materials handling under NWFZ agreements.9 These assistance activities could be overseen by the proposed Permanent Council on Security for the Northeast Asia region, consistent with the DPRK rejoining/adhering to the provisions of (and enjoying the privileges of) the Nuclear Non-Proliferation Treaty.

III. References

[1] As described by Morton H. Halperin in "A New Approach to Security in Northeast Asia: Breaking the Gridlock," The Asia-Pacific Journal, Vol 10, Issue 34, No. 3, August 20, 2012.

[2] A description of this broader concept of energy security is provided in David von Hippel, Tatsujiro Suzuki, James H. Williams, Timothy Savage, and Peter Hayes (2010), "Evaluating the Energy Security Impacts of Energy Policies", Chapter 3 in The Routledge Handbook of Energy Security, edited by Benjamin K. Sovacool.

[3] See, for example, Frank N. von Hippel (2010), "South Korean Reprocessing: An Unnecessary Threat To the Nonproliferation Regime" Arms Control Today, March 2010, pages 22-29.

[4] A number of proposals for East and Northeast Asia nuclear fuel cycle cooperation have been developed. See, for example, Suzuki, T. (1997), "Nuclear Power in Asia: Issues and Implications of

"ASIATOM" Proposals", in United Nations Kanazawa Symposium on Regional Cooperation in Northeast Asia, Kanazawa, Japan. June 2-5, 1997; and
Suzuki, T. and T. Katsuta (2009), "A Proposal of Multilateral Nuclear Fuel Cycle Approach: 'International Nuclear Fuel Management Arrangements (INFA)'", presentation prepared for A-MAD Project Mini Workshop on Policy Recommendations for Nuclear Disarmament and Non-proliferation, September, 2009, and available as
http://a-mad.org/download/MNA_Suzuki_Katsuta_AMAD_090930.pdf.

[5] Suitable locations for deep borehole disposal exist in most of the nations of the region, with the possible exception of Japan. See, for example, von Hippel, D., and P. Hayes (2010), Deep Borehole Disposal of Nuclear Spent Fuel and High Level Waste as a Focus of Regional East Asia Nuclear Fuel Cycle Cooperation, NAPSNet Special Report, December, 2010, available as https://nautilus.org/wp-content/uploads/2012/01/Deep-Borehole-Disposal-von-Hippel---Hayes-Final-Dec11-2010.pdf; and Jungmin KANG (2010), An Initial Exploration of the Potential for Deep Borehole Disposal of Nuclear Wastes in South Korea, Nautilus Institute Report, December, 2010, available as http://nautilus.wpengine.netdna-cdn.com/wp-content/uploads/2011/12/JMK_DBD_in_ROK_Final_with_Exec_Summ_12-14-102.pdf.

[6] The Handbook to Support Assessment of Radiological Risk Arising from Management of Spent Nuclear Fuel, developed for Nautilus by Gordon Thompson of the Institute for Resource and Security Studies, is designed to enable evaluation of the risks of different nuclear infrastructure configurations in the region.

[7] For example, the Russian Far East has long sought opportunities to export power and gas, particularly to the ROK. See, for example, David von Hippel, Ruslan Gulidov, Victor Kalashnikov, and Peter Hayes (2011), "Northeast Asia regional energy infrastructure proposals", Energy Policy, Volume 39, Issue 11, November 2011, Pages 6855–6866, Asian Energy Security Special Section, available as http://dx.doi.org/10.1016/j.enpol.2009.08.011. Cooperation on energy security issues has also been explored in Southeast Asia. See, for example, ASEAN (2009), 2010 ASEAN Plan of Action for Energy Cooperation 2010 – 2015 Bringing Policies to Actions: Towards A Cleaner, More Efficient And Sustainable ASEAN Energy Community, adopted by Energy Ministers in Mandalay, Myanmar on 29 July 2009, available as
http://cil.nus.edu.sg/rp/pdf/2010%20ASEAN%20Plan%20of%20Action%20on%20Energy%20Cooperation%20%28APAEC%29%202010-2015-pdf.

[8] The ROK's involvement in such activities is particular apt, given both its demonstrated nuclear expertise and its nuclear infrastructure export ambitions. The ROK has a 100 MWe "SMART" reactor that could be the "reunification reactor."

[9] See, for example, von Hippel, D., and P. Hayes (2010), Engaging the DPRK Enrichment and Small LWR Program: What Would it Take?, Nautilus Institute Special Report, dated December 23, 2010, and available as https://nautilus.org/wp-content/uploads/2012/01/vonHippelHayesLWR.pdf; and Siegfried S. Hecker (2010), A Return Trip to North Korea's Yongbyon Nuclear Complex. NAPSNet Special Report, dated November 22, 2010, and available as https://nautilus.org/napsnet/napsnet-special-reports/a-return-trip-to-north-koreas-yongbyon-nuclear-complex

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