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Multilateral approach to the back end of the nuclear fuel cycle in Asia-Pacific?

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ABSTRACT

In spite of the nearly unprecedented scale of the Fukushima Daiichi Nuclear Accident which caused countries around the world to review their nuclear power systems and to rethink their nuclear power expansion plans, nuclear power capacity continues to grow, spearheaded by the Asia-Pacific region. The Asia-Pacific has become a major emerging market for nuclear energy industry, which indicates that the management of spent nuclear fuel is likely to be a nuisance for the countries in this region in the coming decades. By reviewing the history of discussions on multilateral approaches to the back end of the nuclear fuel cycle and examining relevant empirical cases, this article aims to explore the feasibility of a multilateral approach to the back end of the nuclear fuel cycle in this region and provide some policy suggestions to enhance nuclear governance in the Asia-Pacific.

1. Introduction

It has been more than five years since the Fukushima Daiichi Nuclear Accident, but its afterimages remain vivid. Photos of damaged reactor buildings with exposed nuclear fuel (SNF) pools were particularly poignant, since they indicated that the current methods of temporarily storing SNF in pools with high-density can be incompatible with the 2S principle — safety and security — of nuclear governance.

In spite of the nearly unprecedented scale of the Fukushima Accident which caused countries around the world to review their nuclear power systems and rethink their nuclear power expansion plans, nuclear power capacity continues to grow, a trend spearheaded by the Asia-Pacific[1] region. The Asia-Pacific has become a major emerging market for the nuclear energy industry,[2] which indicates that the management of SNF is likely to be a nuisance for the countries in this region in the coming decades.

There are three different options to manage SNF. The first one is the open fuel cycle: in this option, SNF is considered to be High-level Radioactive Waste (HLW). SNF will be stored in Away From Reactor (AFR) storage facilities, either in wet (pools) or dry types, but the final disposal of SNF needs to be done in Deep Geological Repositories (DGR). Secondly, in the closed fuel cycle option, SNF is reprocessed. Arguable benefits from reprocessing can be to reduce the whole volumes of nuclear waste and to recycle some fissile materials such as fission-generated plutonium, but reprocessing also produces HLW that requires disposal in DGR. In the wait-and-see option, SNF can be stored at AFR facilities for uncertain years after a period of at-reactor storage for cool down (IAEA, 2009). As of now, the disposal of SNF and HLW in DGR is understood as the best solution for the permanent management of SNF and HLW (IAEA, 1998, 2003).

However, building a national DGR is a tremendously difficult challenge to many countries, and accordingly, a multilateral approach to the back end of Nuclear Fuel Cycle (NFC) has been regarded as an attractive option in spite of corresponding skepticism. In this respect, this article aims to answer the following question: "how feasible is a multilateral approach, exemplified by the 'Regional Spent Fuel Storage Facilities (RSFSF)'[3] in the Asia-Pacific?" By reviewing the history of

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[1] In this article, the Asia-Pacific region refers to countries that are located in Continent of Asia – East Asia, Southeast Asia, South Asia, Middle East, Central Asia, and Far East Russia –, Oceania, and West Rim of Americas. Some critics would point out that the regional scope I deal with in this article is too broad to be analyzed together, but I deliberately extended it because it is necessary to comprehend the Asia-Pacific energy market more holistically, especially from the perspective of nuclear industry for the purposes of this article.

[2] As of March 2016, 440 nuclear reactors are in operation in thirty countries, and 65 reactors are under construction in fourteen countries. Thirteen out of seventeen countries to newly construct, plan, and/or propose nuclear reactors belong to the Asia-Pacific, and more than half of the reactors currently under construction are located in China, India, and Russia. For detailed data of nuclear reactors in the world, refer to World Nuclear Association's website, http://www.world-nuclear.org/.

[3] There can be three options for RSFSF: first, the hosting country offers a temporary storage service of SNF for a specified period and the customer country should retrieve the SNF at the end of the period; second, SNF will be stored in the regional repository and it will be reprocessed after a certain period of time. HLW produced by reprocessing is not regarded as a part of this management; third, SNF will be disposed in a regional disposal facility after the storage service is completed (IAEA, 2005a, 2005b, 2011a, 2011b, 2011c).

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discussions on multilateral approach to the back end of NFC and examining relevant empirical cases, I will try to answer this question and provide some policy suggestions to enhance nuclear governance in the Asia-Pacific.

2. Advantages and disadvantages of multilateral approach

Firstly, the advantages of a multilateral approach to the back end of NFC can be summarized as follows: if SNF and/or HLW can be collectively stored or disposed in RSFSF to be intensively monitored and well protected, the so-called '2S' concerns about nuclear materials can largely be reduced. The current situation in a number of countries, in which temporary pools are used for SNF, leaves the pools much more vulnerable to external shocks such as natural disasters and terrorist attacks. Secondly, the collective management of SNF and/or HLW can enhance transparency and reduce the risk of unnecessary accumulation and proliferation of plutonium, a weapon-usable material. Thirdly, RSFSF located in a geologically and physically suitable location can be environmentally more affordable than having scattered environmental risks in countries that have physical and geological limitations. Fourth, an economy of scale can work both for the host and customer countries: with a large-scale RSFSF, the customer countries can decrease the costs of domestic nuclear waste management while the host country can earn economic benefits through services it can offer (Bunn et al., 2001; IAEA, 2004, 2005b).

On the other hand, reasonable concerns towards a multilateral approach still remain: first, there are risk of nuclear material trafficking and unexpected radioactive release accidents during international transportation of nuclear materials. In addition, technical challenges can be greater because of the larger scale of RSFSF. With regards to social licenses, the toughest challenge is likely to be gaining the public acceptance of the host country. Specifically, the 'Not-In-My-Backyard (NIMBY)' phenomena may apply on an interstate scale: dumping nuclear waste in another country that does not actually produce radioactive materials can raise ethical issues among the international community and cast serious doubts on nuclear energy's moral legitimacy. Resulting roadblocks to negotiations between contentious parties can raise administrative and sociopolitical costs as well. Meanwhile, from the customer countries' point of view, any unpredictable behavior on the part of the host country may be disrupting their long-term policies for the back end of NFC (Bunn et al., 2001; Greenpeace, 2005; IAEA, 2004, 2005b, 2016).

3. History of conceptualizing multilateral approach to nuclear fuel ycle

In spite of controversies, there have been a number of endeavors to undertake a multilateral approach to NFC in the past decades. For instance, in 1975, a year after India's nuclear test, the International Atomic Energy Agency (IAEA) built a study group aimed examining the economic, safety, security, and safeguards aspects of a multilateral approach to NFC. The IAEA study group conducted its first study from 1975 to 1977 and reported its analysis on the key advantages of having Regional Fuel Cycle Centers. After this, IAEA ran other expert study groups on issues such as international spent fuel management and international plutonium storage to assess the benefits and challenges of a multilateral approach; IAEA ultimately concluded that an international management of plutonium would be conducive towards strengthening nuclear governance despite the lack of immediate demand (IAEA, 2004). Since these early efforts, IAEA has continuously been in favor of a multilateral approach to the back end of NFC.

The Organization for Economic Cooperation and Development (OECD) has also been exploring the multilateral approach since the 1970s. The Radioactive Waste Management Committee (RWMC) was created under Nuclear Energy Agency (NEA) of OECD in 1975, and RWMC reported its study on possible international approaches to nuclear waste disposal in 1987. The report concluded that a commercial extension of a national disposal program can enable the construction of an international repository (NEA, 1987). Nonetheless, whereas IAEA has been positive on the multilateral approach, OECD has yet to formulate its official stance on this idea (Di Nucci and Losada, 2015).

For many other cases, specific countries have led the discourse on a multilateral approach. Arguably, the United States has been extensively involved in designing international institutions for nuclear governance ever since Baruch Plan.[4] The International Nuclear Fuel Cycle Evaluation (INFCE, 1980) was an early example that shows American leadership in this field; as a response to growing fears about the increasing use of nuclear energy and the risk of proliferation of fissile materials, President Jimmy Carter introduced the concept of INFCE in April 1977, and it was subsequently inaugurated in October 1977 (INFCE, 1980). In the mid-1990s, the U.S., together with Germany, developed the concept of an International Monitored Retrievable Storage System for SNF and plutonium storage, which ended with no actual negotiations. Later, under the George W. Bush administration, the Global Nuclear Energy Partnership (GNEP) was envisioned in 2006, which included ideas about a 'take back' service of SNF (DOE, 2007).[5]

Meanwhile, Russia, as another key player in the global nuclear arena, has been consistently interested in importing SNF from other countries and involved in several proposals. In 2001, the Russian Parliament approved legislation to allow the importing of foreign SNF for storage and reprocessing in spite of negative public reactions, and it became the only country in the world that imports SNF. Later in 2006, Russian President Vladimir Putin presented the concept of a Global Nuclear Power Infrastructure (GNPI), targeted at countries that will generate nuclear energy without closing NFC (Ruchkin and Loginov, 2006).

Non-governmental players have not been dormant in discussions on this topic. The Pangea Proposal is one good example demonstrating the private sector's initiatives: Pangea Resources, a joint venture of British Nuclear Fuels Limited, Golder Associates, and Swiss radioactive waste management entity Nagra, initiated a research project on multilateral approach in the 1990s and concluded that Australia, southern Africa, Argentina, and western China have suitable conditions for geological disposal of nuclear waste. The company presented its proposals to Australia later in 1999, but it only resulted in further consolidation of Australia's stance of not importing foreign nuclear waste.

Occasionally, key individuals such as politicians, diplomats, and scholars took the initiative on the discourse as well. For instance, Henry Kissinger suggested the creation of a regional center for NFC early in the-1970s (Di Nucci and Losada, 2015). Amata Kabua, the first President of the Marshall Islands, suggested hosting an international storage and disposal facility for nuclear waste in 1995, which became nullified in 1999 (IAEA, 2004). In 2003, Mohamed ElBaradei, the Director-General of IAEA from 1997 to 2009, also called for international cooperation on NFC (ElBaradei, 2003), supported by the IAEA's report in 2005 (IAEA, 2005). Malcolm Turnbull, the incumbent (as of September 2016) Prime Minister of Australia, mentioned that Australia should reconsider its role in nuclear industry from the perspective of technological and economic opportunities through various options, including leasing fuel rods to other countries and storing their waste afterwards (Hurst, 2015). The South Australian Government took its initiative: it established the Nuclear Fuel Cycle Royal Commission on

[4] The U.S. government submitted a proposal to establish the International Atomic Development Authority designed to deal with mining uranium and managing plants to produce fissile materials to the United Nations Atomic Energy Commission (UNAEC) on June 14, 1946, and the proposal is called Baruch Plan.

[5] In 2010, the partner countries of GNEP agreed to transform it into the International Framework for Nuclear Energy Cooperation (IFNEC). For details, refer to IFNEC's website, http://www.ifnec.org.