Prospects for Implementing Multilateral Nuclear Fuel Cycle Mechanism

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1. Introduction

Globally, the interest in nuclear power has been increased because of such factors as increasing energy demands, as well as concerns on climate change and energy security [1]. However, global expansion of nuclear energy has also led to increased concerns about the spread of sensitive nuclear technology relevant to nuclear weapons such as enrichment and reprocessing. To diminish these nuclear proliferation concerns, many states have suggested ways to prevent diffusion of dual-use technology through multilateral nuclear fuel cycle mechanism [2]. These proposals generally aim to persuade countries not to develop own fuel cycle technology by providing assurance of fuel supply and economical incentive and to suppress an increase in the number of states which have capabilities to produce dual use nuclear material [3]. However proposed mechanisms are a subject of considerable debate in the international community because these schemes have compelled states to forgo inalienable right to develop nuclear technology for peaceful purpose [4]. Therefore future of various fuel assurance schemes remains uncertain.

This study provided an overview of proposal on multilateral nuclear fuel cycle mechanism, and analyzed each country's views on these proposals. And we identified some significant challenges and requirements to implement multilateral nuclear fuel cycle mechanism.

2. Overview of Existing Proposals

Proposals on approach to the multilateral nuclear fuel cycle have ranged from addressing front-end fuel cycle issue as assurance of fuel supply, to focusing on the back-end as waste disposal solution. Over the past few years, about a dozen of primary proposals have been put forward by many states and international organization, which intended to suppress the spread sensitive technology, in particular by suggesting means of assuring nuclear fuel supplies and establishing international fuel cycle center.

2.1 Proposals on Front-end fuel cycle

Generally current proposals focused on front-end problem, dealing with fuel supply and production issue based on the supplier guarantees [2].

In 2006, six governments (U.S, France, Germany, the Netherland, Russia and U.K) suggested a 'Concept for a Multilateral Mechanism for Reliable Access to Nuclear Fuel' and this proposal calls for a mechanism including commercial relationship and IAEA's roles to support assurance of nuclear fuel supply [5]. World Nuclear Association (WNA) also proposed the schemes that have more complicated backup supply networks under IAEA's control for the supply assurance in the same year [6].

U.K has proposed a political means, called a nuclear fuel assurance (NFA) that provides recipient countries with advance assurance export approvals for nuclear fuel, NFA would also provide a bilateral agreement between supplier states and the recipient state, with the IAEA as co-signatory [7]. The model agreement of NFA proposal was adopted by IAEA Board of Governors in March 2011.

A fuel reserve (bank) is effective measure to solve problem about a possible interruption in nuclear fuel supply by nonproliferation reasons. Therefore various fuel bank systems have been proposed by IAEA, U.S, and Russia etc. Among them the IAEA approved two fuel banks; Russian-operated 'fuel reserve' and an IAEA owned and managed fuel bank. Also U.S announced a fuel reserve plans called 'Reliable Fuel Supply' that use low enriched uranium down-blended from U.S surplus highly enriched uranium for fuel reserve in 2005. U.S fuel reserve would be kept under national control, and not part of the IAEA fuel bank and the specific operational terms such as the condition for the release of fuel and potential recipients have not yet been determined [4].

Also, establishment of multilateral uranium enrichment center have been proposed to prevent the spread of enrichment technology. Russia has established the International Uranium Enrichment Center (IUEC) at Angarsk and IUEC started operation in 2007 [8]. And other multinational enrichment facility under IAEA's ownership and control was proposed by Germany in 2007. This proposal called as multilateral enrichment sanctuary project (MESP), has not yet been approved by IAEA but is under lively discussion [3].

2.2 Proposals on back-end fuel cycle

Multilateral fuel cycle mechanisms focused on the back-end fuel cycle are not being actively discussed at present. Many states are concerned that multilateral mechanism may force to surrender their inalienable right to develop nuclear technology for peaceful purposes; therefore potential participant countries are hesitant to agree to approach for multilateral fuel cycle. Multilateral solution for back-end fuel cycle generally aimed at establishment of an international spent fuel

repository and international cooperation on development of the proliferation-resistance advanced fuel cycle [9]. The International Framework for Nuclear Energy Cooperation (IFNEC) which initiated by U.S intended to cooperation for advanced back-end fuel cycle such as reprocessing technology and to prevent the spread of reprocessing capability through nuclear fuel management system, called 'Comprehensive Fuel Service (CFS)', is an key element of IFNEC. The IFNEC has continued to discuss issue on a nonproliferation and peaceful use of the nuclear energy and attract additional participant [4]. However the discussions on an international spent fuel repository have been made no progress due to political problem and potential public opposition.

Table I: Comparison of current proposals by scope

	Proposal	Scope
Front-end fuel cycle	6 country concept	Backup fuel supply system, Advanced export approval
	WNA proposal	
	NFA	
	IAEA fuel bank	Establishment of LEU reserve under IAEA's control
	Russia fuel reserve	Establishment of IAEA owned and managed fuel bank
	US fuel reserve	Establishment of national controlled LEU reserve
	IUEC	Establishment of international uranium enrichment center
	MESP	Establishment of an IAEA-controlled international uranium enrichment plant
Back-end fuel cycle	IFNEC	Establishment of a global supply mechanism (Front-end and back-end services)

3. Prospects for Multilateral Fuel Cycle Mechanism

The multilateral fuel cycle mechanisms have been debated in the international communities. The IAEA Board of Governors approved 2 type nuclear fuel banks which would assure international fuel supply system on a non-discriminatory and non-political basis to recipient states, and a political assurance means (NFA) for enrichment services in commercial nuclear contracts. However the supplier states and the recipient states which have not their own fuel production capabilities are taking different position on the effect and expectation from establishment of nuclear fuel banks. The recipient states have constantly expressed concern about their right for peaceful use of nuclear technology under NPT. In these circumstances, the successful implementation of a current proposal will depend on significant supports for the recipient states such as economic incentives and a consistent policy for reliable operation of nuclear power. The multilateral fuel cycle mechanisms should not deprive recipient states of any of their right and the international nonproliferation regimes should induce potential recipient states with market-based decision by offering political and commercial incentive. In that respect, the NFA that recently approved by IAEA has earned positive reviews because it would provide more confidence in the fuel supply reliability by providing backup assurances of supply in addition to the existing commercial uranium market. However to make more attractive system than just backup mechanism, existing mechanism should expand economic motivation of participant states in terms of their participation in ownership, operation and profit-sharing etc.

More efforts are required from international communities for the mechanisms focused on the back-end fuel cycle. To solve the problem on spent fuel accumulated and to prevent the spread of reprocessing technology, the international nonproliferation regimes should actively discuss mechanisms focused on the back-end fuel cycle including an international spent fuel repository.

4. Conclusion

The multilateral nuclear fuel cycle mechanisms have been discussed in the international community, however few have been implemented. The reasons were that existing mechanisms have not given enough incentives to recipient states and forced to surrender their inalienable right. For the successful implementation, current mechanism should have flexibility of its application and the economic benefits should strengthen against current system, thereby voluntary participation from potential participant states should be induced. Also international communities should cooperate to progress the multilateral back-end fuel cycle mechanisms.

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