

## **Further Considerations for Development of the Comprehensive Fuel Services**

Dong Hoon Lee\*, Jae Soo Ryu, Eunju Jun, Han-Myung Lee and Kwang Seok Lee

*Korea Atomic Energy Research Institute, Daejeon, 305-353, Korea*

*\*Corresponding author: dhlee@kaeri.re.kr*

### **1. Introduction**

For sustainable utilization of nuclear energy, it is essential to ensure the availability of reliable nuclear fuel cycle service, not only for the front-end fuel cycle including enrichment, but also for the back-end fuel cycle including the long-term management and reprocessing or recycling of used fuel. Currently, the front-end fuel cycle services are reliably provided by commercial suppliers, and some multilateral approaches related on front-end fuel cycle including fuel bank are implemented as well [1,3]. However in case of the back-end fuel cycle services, reprocessing services are provided by limited number of companies and disposal services are not currently provided in commercial market. In addition, multilateral fuel cycle mechanisms focused on the back-end fuel cycle are not being actively discussed [2,3]. Recently, multilateral mechanism related to the back-end fuel cycle, called 'Comprehensive Fuel Service (CFS)' was suggested by United States in the International Framework for Nuclear Energy Cooperation (IFNEC) [4].

This study provides an overview of the CFS, opportunities and challenges for its implementation. It also provides considerations to encourage development of the multilateral and commercial-based CFS for the back-end fuel cycle.

### **2. Opportunities and Challenges of CFS approach**

#### *2.1 Opportunities for CFS*

The concept of a CFS is multilateral and optional fuel cycle services that provide an economic alternative to development of long-term storage and disposal facilities and sensitive nuclear facilities such as enrichment and recycling plants, particularly to those countries with small nuclear fleets by providing assurance of fuel supply and a reliable used fuel and ultimate waste management mechanisms through commercial market [3]. The CFS is differentiated from existing proposals or mechanisms on multilateral fuel cycle services such as IAEA fuel bank, US fuel reserve, Nuclear Fuel Assurance (NFA) etc because CFS focused on the back-end fuel cycle service. Therefore the multinational repository for disposal of used fuel and ultimate waste from reprocessing are essential to achieve a full implementation of CFS. The multinational disposal facilities could offer any technical, economical benefits compared with national approach for domestic disposal. The multilateral approach could give a chance to secure

the most suitable geologic repository through multiple reviews of potential site and geology with several partner countries. The multiple reviews by specialized technical experts provide opportunities to enhance safety of repository [3]. The multinational approach provide more economical advantages than the national approach by sharing the fixed cost with participating countries while the geologic repository needs high up-front fixed cost for siting studies, licensing, groundwork, etc. [3]. Also CFS approach has opportunities for proliferation and security issue. CFS could help reduce proliferation and security risk by discouraging the spread of sensitive facilities and by providing the front- and back-end fuel service including take back of used fuel and reprocessing service through centralized facilities [3,5].

#### *2.2 Challenges to CFS implementation*

In spite of the benefit described above, there are several challenges to implement CFS. Above all the development of an international disposal facility has been faced with significant challenges such as the difficulty in obtaining national public support and political and public acceptance about siting and construction of such facility and lack of incentives associated with hosting a disposal facility [3]. In addition, some countries' legislations and international conventions which prohibit or restrict the trade of used fuel and radioactive waste make it difficult to transport used fuel and ultimate waste across international borders for back-end service [3]. Needless to say, it is not clear the responsibilities, the ownership of used fuel and associated liabilities and the financial provisions for unexpected events between the exporting country and the disposal facility country [3]. Also, the exporting country can be difficult to secure consent by supplier country for the transfer of used fuel or radioactive waste if nuclear materials and equipments are supplied from different countries. This is because each supplier country controls retransfer of nuclear material and equipment through consent right in arrangement and has different condition on the approval of retransfers [3]. In addition, the satisfactory safety standard which addresses the safety of the facility has not developed. Finally, there is the potential to impact competitiveness in nuclear fuel cycle service market because the development of CFS is conducted by only a few companies [3].

### **3. Further Considerations for CFS implementation**

To encourage development of CFS, there is need of confidence building among the IFNEC member states based on common understanding about CFS concept. To achieve this, studies on economical and political benefits associated with developing an international facility and CFS's impact to existing commercial fuel cycle market with stakeholders including government and private company are required prior to beginning CFS development first. These studies should include cost assessment on the development of national disposal facility with countries' status such as political, economical and social environments and nuclear capacity in order to verify economical advantages of CFS. It can help secure public understanding and mitigate public opposition associated with developing international disposal facility. The profit sharing plan of CFS that how to distribute operating income of CFS to country hosted international disposal facility and nuclear industry invested in development of CFS should be sufficiently clear in order to attract voluntary participation in multilateral nuclear fuel service mechanism from existing nuclear industries and to minimize negative impact to existing commercial market by CFS.

Second, the international oversight system for the safe management, transportation, storage of exported used fuel and ultimate waste and its disposal in CFS approach should be developed. This oversight system can be international body having authority to assess safety of facility operation, or be international guidance and standards that include provision for oversight of CFS. The system needs to be able to assess the adequacy of countries that want to host multinational disposal facility, and to provide unified safety requirements of international disposal facility for effective assessment and oversight. As a result, the oversight system can help obtain public acceptance about development of multinational disposal facility by enhancing confidence in this facility.

Third, the development of CFS should be linked to research and development of advanced nuclear fuel cycle technology that can reduce the volume and radiotoxicity of spent fuel by connecting to a compatible GEN-IV reactor system. Used fuel management cost will be lowered by reduction in both the amount of high level waste and time spent on its management through advanced fuel cycle technology therefore it can make CFS more attractive in the economic point of view. Also the CFS should not affect right for peaceful use of nuclear technology under NPT for voluntary participation in CFS of potential partner state.

Finally, development of model bi-lateral or multilateral international agreement is needed to support commercial-based CFS. The model agreement should cover responsibilities of participating countries including long-term reliability and safe operation of multinational disposal facility, the financial liability related on potential risk and the legal mechanism for

transfer, storage and disposal of used fuel and ultimate waste. The agreement needs to be able to clarify and specify responsibilities of participating countries in order to ensure long term operation of the multinational disposal facility and to reduce concern about all risk and potential uncertainties.

### **4. Conclusions**

CFS suggested by U.S in IFNEC is commercially-based new nuclear fuel management system and expected to provide an economic alternative to development of long-term storage and disposal facilities and sensitive nuclear facilities. However, the CFS approach is faced with several challenges such as the development of multinational disposal facility. Above all, confidence building among the IFNEC member states based on common understanding is crucial to overcome these challenges. To achieve this, international communities should continually cooperate with stakeholders and discuss the consideration that suggested by this study. And we need to monitor progress of CFS concept that remains under development, and to prepare for multilateral discussion on CFS.

### **REFERENCES**

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