Study on interface between nuclear material accounting system and national nuclear forensic library

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1. Introduction

The national nuclear forensic library is necessary to deal with nuclear materials out of control to identify their place of origin, distribution process and final management of nuclear material accounting data. By doing so, nuclear security accident investigation can be supported by providing prosecution evidence. Moreover, by strengthening the regulatory control over the vulnerable area to such a loss, radioactivity terrorism can be prevented [1].

The implementation of nuclear forensics requires physical, chemical and radiological characteristics with transport history to unravel properties of seized nuclear materials. For timely assessment provided in the ITWG guideline, development of national response system (e.g., national nuclear forensic library) is strongly recommended.

Nuclear material accounting is essential to obtain basic data in the nuclear forensic implementation phase from the perspective of nuclear non-proliferation related to the IAEA Safeguards and nuclear security. In this study, the nuclear material accounting reports were chosen due to its well-established procedure, and reviewed how to efficiently utilize the existing material accounting system to the nuclear forensic implementation phase In conclusion, limits and improvements in implementing the nuclear forensics were discussed.

2. Discussion

2.1 Nuclear material accountability

ROK joined the IAEA in 1957 as a founding member and ratified the NPT in 1975 to conclude the ROK-IAEA safeguards agreement. Accordingly, the country has to apply the IAEA safeguards to every domestic nuclear activity. Based on this, ROK has implemented overall control over domestic nuclear materials and managed the data related with nuclear material accounting and control with an independent system (so called KSIS; Korea Safeguards Information System) [2][3]. The KSIS supports report activities concerning IAEA Safeguards implementation, inspection, additional protocol details and bilateral annual report. Of them, the general management of nuclear materials is found in the details included in the nuclear material accounting report.

2.2 Nuclear Material Accounting Report

Nuclear material accounting report includes every nuclear material inventory change. To efficiently manage such information, data standardization is necessary to some extent. The CODE 10 in the subsidiary agreements to the Safeguard regulates such documentation preparation forms [4].

There are four types of accountability report according to its purpose of report; ICR (Inventory Change Report) recording nuclear material carry-in and carry-out; PIL (Physical Inventory List) recording the whole list of nuclear materials held by facility as of the material stocktaking date; MBR (Material Balance Report) showing general changes in nuclear materials during the period between material stocktaking dates; and Concise Note or Textual Reports for providing additional information as needed.

In the nuclear forensic implementation phase, information is analyzed in each characteristic per quantity unit prior to detailed ingredient analysis. Therefore, instead of managing the information per unit of weight, quantity-based material accounting works more efficiently in tracing the origin of unknown materials. Amongthe four types of report, the ICR and PIL describe inventory information per quantity unit, and the ICR only manages records of material characteristics. In this regard, the ICR was chosen to investigate each fieldto review their applicability as nuclear forensic discriminators.

2.3 Interface between KSIS and national nuclear forensic library

In the ICR in accordance with the CODE 10, , the fields, ‘Name or Number of Batch’ and ‘Material Description Code’ represent the unique identification code of nuclear material items and characteristics. Therefore, the fields can be utilized as forensics discriminators. The fields, ‘Date of Inventory Change’, ‘MBA/Country’, and ‘KMP Code’, show material transportation history.

‘Name or Number of Batch’ generates 6 to 8 digits including information on ‘loading facility + loading cycle + assembly number’ (Table 1). So long as integrity of assemblies is maintained, the assemblies keep own unique numbers as their IDs. Thus, the unique assembly number and transport history after

nuclear fuel loading are applicable to use in tracing unknown nuclear materials [5][6].

Table 2 shows information contained in 'Material Description Code' such as material physical and chemical characteristics, containment and irradiation status. These also can be utilized as discriminators.

Based on MBA (material balance area) and KMP (key measurement point) information, nuclear material transportation history can be obtained. By utilizing the location information at each point of time, nuclear material storage sites can be traced back. Therefore, it is possible to identify vulnerable areas beyond regulatory control as well as their management officials. On the other hand, Since the ICR is reported only in the event of any inventory change, there exist voids in recording continuity. And the bulk facility does not perform item-specific inventory management. In this situation, an additional means of trace needs to be arranged.

Table 1. Code of Batch Name

	Facility			Cycle			#	
Ex)	K	K	1	A	A		0	8
	Kori #1			27^{th} Cycle			Assembly #8	

Table 2. Material Description Code

	Physical Status	Chemical Status	Containment	Irradiation
Ex)	B	Q	1	G
	Assembly	Dioxide	Uncontained	Irradiated Fuel

3. Conclusions

This study reviewed how to utilize the existing material accounting system for implementing nuclear forensics. Concerning item counting facility, nuclear material properties can be obtained based on nuclear material accounting information. Nuclear fuel assembly data being reported for the IAEA Safeguards can be utilized as unique identifier within the back-end fuel cycle. Depending upon the compulsory accountability report period, there exist time gaps. If national capabilities ensure that history information within the front-end nuclear fuel cycle is traceable particularly for the bulk handling facility, the entire cycle of national nuclear fuel would be managed in the framework of developing a national nuclear forensic library..

ACKNOLEDGEMENT

This work was supported by the Nuclear Safety Research Program through the Korea Radiation Safety Foundation (KORSAFe) and the Nuclear Safety and Security Commission (NSSC), Republic of Korea (Grant No. 1305016)

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