5th International Symposium on Innovative Nuclear Energy Systems, INES-5, 31 October – 2 November, 2016, Ookayama Campus, Tokyo Institute of Technology, JAPAN

Development of prototype nuclear forensics library for nuclear materials and radioisotopes in Japan Atomic Energy Agency

Yoshiki Kimura[a]*, Nobuo Shinohara[a], Yoshio Funatake[a]

[a] Integrated Support Center for Nuclear Non-proliferation and Nuclear Security, Japan Atomic Energy Agency, 2-4, Shirane, Shirakata, Tokai-mura, Naka-gun, Ibaraki 3191195, Japan

Abstract

In 2010, the Japanese Government issued the national statement at Nuclear Security Summit (Washington D.C., USA) to develop technologies related to measurement and detection of nuclear materials for nuclear forensics, and to share them with the international community, in order to contribute to strengthening the nuclear security system. In response to this statement, Integrated Support Center for Nuclear Non-proliferation and Nuclear Security (ISCN) of Japan Atomic Energy Agency (JAEA) has initiated R&Ds on nuclear forensics technical capabilities since Japanese Fiscal Year of 2011. One of the main R&D topics of this project is to develop prototype nuclear forensics library (NFL), which is an organized collection of data and information about nuclear and other radioactive materials.

In this paper, the development of prototype NFL for nuclear materials and radioisotopes will be presented. An NFL plays an important role to compare the seized materials with the characteristics of known materials to provide information about a material's origin and history. Recently, the development of nuclear forensics library has been carried out in some countries and the concept of national NFL to collect all target material in the country is the most popular in current international society. The prototype NFL in JAEA also follows this concept. The design of database in an NFL depends strongly on the scale of nuclear fuel cycle in one country, which refers to the amount and variety of the materials available. The database and its structure of the prototype library were studied and designed based on data of target materials possessed in JAEA. This is because the target materials and fuel cycle facilities in JAEA can cover almost all stages of nuclear fuel cycle. The prototype library developed in JAEA and its experiences could contribute to future national library in our country and also for other countries which intends to develop NFLs as a model of NFL development.

* Corresponding author. Tel.: +81-29-284-3476; fax: +81-29-282-5545.
  E-mail address: kimura.yoshiki@jaea.go.jp

1. Introduction

Since the early 1990s, there has been increasing international concerns regarding the illicit trafficking of nuclear or radioactive materials. By 2011, over two thousands illicit trafficking cases of nuclear and other radioactive materials had been reported to the International Atomic Energy Agency (IAEA) [1]. Once a nuclear or radioactive material out of regulatory control is found and seized from a crime scene, questions regarding its origin, history, and intended use must be addressed. These questions can be answered by nuclear forensic activities and they also help to identify deficiencies in the national nuclear security system [2]. Recently, the consolidation of nuclear forensic capabilities such as analysis technologies and national frameworks has become a significant issue for many countries that wish to strengthen their national nuclear security measures through the development of their national capabilities.

In November 2009, the Japanese and United States governments signed the "Japan-US Joint Statement Toward a World Without Nuclear Weapons" at the US-Japan summit meeting [3]. In this statement, it was declared that both governments agreed to nuclear non-proliferation, the adoption of safeguards, and security cooperation. Such an endeavor involves the use of nuclear forensics in addition to measurement and detection technologies, human resource development, training, and infrastructure assistance for countries interested in nuclear energy, and the coordination of respective Member States support programs for IAEA safeguards. Furthermore, at the Nuclear Security Summit in 2010 (Washington D.C., USA), the Japanese government issued a national statement encouraging the development of forensic technologies related to the measurement and detection of nuclear materials within a three-year timeframe. The technologies developed as a result of this effort were to be shared with the international community as a means of strengthening the global nuclear security system [4]. In response to these two statements given by the Japanese Government, the Integrated Support Center for Nuclear Non-proliferation and Nuclear Security (ISCN) of Japan Atomic Energy Agency (JAEA) has initiated R&Ds on nuclear forensic technical capabilities since Japanese Fiscal Year of 2011.

The R&Ds at JAEA covers two major topics, measurement technologies such as isotope, trace elements, "age" determination and particle/microstructure analysis to characterize nuclear materials; and nuclear forensics library (NFL). The goal of the NFL project in JAEA-ISCN is to study basic concept of an NFL and, subsequently, to develop a prototype NFL system, which is including databases of nuclear materials and radioisotopes with basic data query functions [5, 6], and associated computational tools for data analysis [7]. JAEA also joined the international virtual table-top exercises for NFL, named as "*Galaxy Serpent*," held by the Library Task Group of International Technical Working Group for Nuclear Forensics (ITWG). The lessons learned from these exercises have been applied to the prototype NFL development in JAEA [8]. In this paper, the general concept of an NFL will be discussed, and the important view point for data fields study and data structure design of the NFL material databases will be summarized based on the experiences on the prototype NFL development. The approaches and procedures to design and develop an NFL summarized based on the experiences of prototype library in JAEA could contribute to future national nuclear forensics library in Japan and also for other countries.

2. General concept of an NFL and prototype development in JAEA

An NFL is an organized collection of data and information about nuclear and other radioactive materials produced, used, or stored in the past (and in some cases, an NFL includes sample archives of the target materials) [9]. The purpose of nuclear forensics activities is to identify the origin, history and intended uses of nuclear and other radioactive materials found and seized from outside of regulatory control. In this context, an NFL enables to compare