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Current Status and Future Prospects on Nuclear Forensics Capability Building and Technology Development by the Integrated Support Center for Nuclear Non-proliferation and Nuclear Security at the Japan Atomic Energy Agency

Any nuclear security event involving nuclear and other radioactive materials outside of regulatory control (MORC) has the potential to have severe consequences for public health, the environment, the economy and society. Each state has a responsibility to develop national nuclear security measures to respond to such an event, and this includes a nuclear forensics capability. In Japan, national nuclear forensics capability building efforts mainly based on research and development (R&D) have been conducted since 2010, in accordance with national statement of Japan at the 1st Nuclear Security Summit. Most of that work is undertaken at the Integrated Support Center for Nuclear Non-proliferation and Nuclear Security (ISCN) of the JAEA in close cooperation with other competent authorities. The ISCN has made increased contributions to the enhancement of international nuclear security by establishing technical capabilities in nuclear forensics and sharing the achievements with the international community.

The ISCN has mainly engaged in R&Ds for establishing and strengthening nuclear forensics technical capability. As for the laboratory capability, several new pieces of analytical equipment have been introduced for nuclear forensics R&D purposes. High-precise analytical techniques that has been proven in the past nuclear forensics cases have been established, and several new techniques that can contribute to the analysis of nuclear forensics signatures have been developed in the laboratory. The ISCN has been also developed a proto-type nuclear forensics library based on the nuclear material data and experience of past research of nuclear fuel cycle in JAEA. These technical capability developments have been conducted based on the international cooperation with a variety of partners such as the U.S. Department of Energy and EC Joint Research Center, and participation in exercises organized by ITWG.

Recent R&Ds activities by the ISCN have been mainly based on the needs of domestic competent authorities, such as first responders and investigators, and aim to develop technologies for the implementation of nuclear forensics covering the entire spectrum of forensics processes from crime scene investigation to laboratory analysis and interpretation. One important key issue is the enhancement of technical capability for post-dispersion nuclear forensics. For instance, the ISCN has carried out the development of mobile radiation measurement equipment coupled with the low-cost, small radiation detectors that use machine-learning algorithms, which enables quick and autonomous radioisotope identification to support first responders in crime scene or post-dispersion crime scene. Signature analysis of samples collected at a post-dispersion crime scene are also among the important technical issues studied at the ISCN. The application of emerging technologies to nuclear forensics has also been studied. This includes the application of deep leaning models analyzing a new signature to nuclear forensics interpretation to enable more confident and objective sample comparison analysis, and the development of instant contamination imaging technology contributing appropriate examination plan development on the seized samples in collaboration with conventional forensics.

Many analytical techniques have been developed and the capability to analyze nuclear and other radioactive materials for nuclear forensics purposes has been matured considerably over the past decade. The challenges of post-dispersion samples, collaboration with conventional forensics and the development of new signatures will be more important in the near future. Therefore, the ISCN will promote the R&Ds to further enhance the technical capabilities solving these issues. In addition, the ISCN is also promoting to expand the nuclear forensics research into universities and other research institutes in Japan. This is expected to contribute to the establishment of a domestic nuclear forensics network that enables to respond quickly and flexibly to the MORC incidents, and to the maturation of nuclear forensics as a new academic field.

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