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Nuclear Forensic Analysis Laboratory Capability in the Integrated Support Center for Nuclear Non-proliferation and Nuclear Security at the Japan Atomic Energy Agency

Nuclear and other radioactive materials outside of regulatory control (MORC) can trigger nuclear security events with severe environmental and economic consequences. In order to deal with such threats, it is necessary to strengthen international nuclear security measures, including nuclear forensics. Based on the national statement at the first Nuclear Security Summit, Japan has been conducting research and development on nuclear forensics and improving its capabilities since 2011. The development of nuclear forensics technology in Japan is led by the Integrated Support Center for Nuclear Non-proliferation and Nuclear Security (ISCN) of the Japan Atomic Energy agency (JAEA) and is being carried out under domestic and international cooperation. By actively disseminating the results of its technology development to the domestic and international communities, ISCN is contributing to the improvement of nuclear forensics capabilities not only in Japan but also internationally. The present paper has discussed the status of the nuclear forensic laboratory capability in the ISCN.

ISCN has been mainly focusing on the development of nuclear forensic analysis technology targeting uranium samples. ISCN possesses a variety of analytical instruments to analyze the physical and chemical characteristics (i.e., nuclear forensics signature) of uranium samples. For example, electron microscopes and mass spectrometers such as SEM and TIMS have been introduced in the laboratory, and high-precision analytical capabilities have been developed using them. In morphology analysis, the consistency of samples can be analyzed by evaluating the particle size and shape distributions based on the SEM images. ISCN has also developed the procedure for uranium isotope ratio analysis and age dating by using TIMS that can contribute to the determination of the origins and history of the uranium samples. These laboratory capability of ISCN have been validated by the joint analysis project under bilateral and multi-lateral cooperation, and by participation in collaborative material exercises (CMX) organized by the ITWG. The ISCN has recently introduced several instruments to enhance the laboratory capability, such as inductively coupled plasma mass spectrometer (ICP-MS) and X-ray fluorescence spectrometer (XRF) for trace element analysis. By using both of the ICP-MS and XRF, it becomes possible to improve flexibility of analysis that meet the needs from criminal investigators. For example, the ICP -MS is capable of highly accurate analysis, but it requires complex and time-consuming sample pretreatment. On the other hand, the XRF is a non-destructive assay method has the great advantage in measurement time, but less accurate compared to the ICP-MS. It is important to use both instruments properly based on the investigators'needs and the combination of the instruments would contribute to optimize analytical process for nuclear forensics purposes.

The ISCN has recently re-evaluated the laboratory capability with the new instruments using certified reference materials. This paper also discusses the results of that reassessment. As a future activities ISCN is going to participate next CMX. This would be helpful to evaluate our capability with new laboratory configuration. It is also planned to initiate the development of analytical techniques for new signatures with international partners.

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