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IAEA Coordinated Research Project: Application of Nuclear Forensics in Combating Illicit Trafficking of Nuclear and Other Radioactive Material

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Nuclear forensics, as a sub discipline of forensic science, utilizes measurements of physical characteristics, chemical and elemental composition, and isotopic ratios of nuclear and other radioactive material, together with associated traditional evidence to provide information about material origin and history. By analyzing inherent signatures that are intrinsic or imparted during manufacturing and use, materials may be linked to people, places, and events important to a law enforcement investigation, a criminal prosecution and nuclear security vulnerability assessments.

The challenges posed by illicit trafficking of nuclear and other radioactive materials demands scientific innovation to ensure state of practice methods and techniques are being developed and implemented as a component of response. Because nuclear forensic examinations may involve analysis and interpretation of a range of nuclear and other radioactive material, appropriate methodologies together with high confidence measurements are essential. In addition, the ability to examine traditional evidence (e.g., DNA, fingermarks, hair, and fibers) contaminated with radionuclides may be required as part of an investigation of a nuclear security event.

The strength of nuclear forensic findings relies upon existing, proven analytical techniques together with the development and validation of novel techniques and applications for nuclear forensic methodologies. Research and development is a means to foster innovation applicable to nuclear forensic examinations as well as demonstrate the validity of nuclear forensic methodologies.

The IAEA promotes research and development to support effective nuclear security through coordinated research projects (CRPs) that involve a broad range of experts and institutions of a broad range of States. In this regard the IAEA has organized two CRPs in nuclear forensics. The first CRP ran from 2008 to 2012 and focused on the requirements of state of practice measurements of seized materials, techniques to collect and preserve evidence, and improvements to interpretative capacities for law enforcement and nuclear security purposes.

Conclusions of the first CRP focused on the areas of 1) instrumentation and field collections, 2) laboratory methods and techniques and 3) modeling and interpretation and demonstrated that the CRP provided a forum for sharing improved techniques and procedures (to include radiation detection and mass spectrometry techniques), the importance of a staged nuclear forensics analytical plan with nondestructive analysis proceeding destructive analysis, the value of predictive signatures in the analysis of irradiated materials, the considerations to preserve evidence contaminated with radionuclides, and the necessity for research activities to be commensurate with State's requirements for nuclear forensics.

The second CRP entitled 'Identification of high confidence nuclear forensic signatures for the development of a national nuclear forensics library'commenced in 2013. This project recognizes a national nuclear forensics library as one possible tool for interpretation through enabling the comparison of material characteristics and signatures with materials used, produced or stored within a State.

The project also recognizes that the comparison of material characteristics and signatures would benefit from the identification of peer reviewed and validated signatures across the nuclear fuel cycle and the manufacture of radioactive sources.

The objectives of this CRP seek to address the data requirements of a national nuclear forensics library for stages of the nuclear fuel cycle and for the manufacture of radioactive sources, as well as promote research into novel signatures that are indicative of nuclear processing and important to high confidence interpretation and nuclear forensics findings. Of interest, for example are resolving intrinsic signatures of natural uranium from those that are introduced as a result of production and manufacturing processes during milling, isotopic enrichment, fuel manufacture and reactor operations.

A fundamental question to be considered by this CRP is how signatures are imparted and how they persist. The outcomes of this project will be used to provide technical guidance to States for the development of a national nuclear forensics library and the measurement of material characteristics and signatures.

The premise of IAEA coordinated research projects, to include those in nuclear forensics, is to promote improvements in current technology, encourage international best practice, stimulate confidence building via peer-to-peer networking and increase competence among nuclear security practitioners.

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