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Nuclear Forensic Science: An Emerging Discipline

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In the early 1990's there was a marked increase in the number of incidents where nuclear materials were found outside of regulatory control, including cases involving the illicit trafficking or possession of nuclear material. A new subdiscipline of nuclear science emerged out of the need to analyze these materials and use the characterization data to support both the prosecution of individuals involved with illegal activity and the investigation into where regulatory control of material was lost. The new discipline of nuclear forensic science was the result of these events.

In many early nuclear forensics cases, the law enforcement officials handed the nuclear materials over to laboratories with expertise in the analysis of these materials without much, if any direction regarding what characterization information was necessary to support the investigation of a case or prosecution of individuals involved. As a result, the inclination of laboratory subject matter experts was to learn as much as possible about the material through a comprehensive characterization, data interpretation, and assessment process to identify the production history and evaluate possible origins for the material. This was not necessarily a bad approach, and ensured a thorough nuclear forensic analysis and assessment regardless of whether that data was ever used to support the investigative or evidentiary needs of law enforcement. It also reinforced the interdisciplinary expertise required to adequately support a nuclear forensic investigation by involving experts in law enforcement, forensic science, radiochemistry, analytical chemistry, geochemistry, nuclear engineering, reactor physics, uranium enrichment, and nuclear material production and processing.

Gradually, the relationship between law enforcement and the technical nuclear forensics communities matured and became better coordinated. Measures were taken to ensure a more graded approach to the nuclear forensic analysis of interdicted materials and other materials found outside of regulatory control. This included adopting standardized protocols for law enforcement to communicate to the analysis laboratory what questions they were trying to answer about a material through a technical nuclear forensic examination, collaborative development of analysis plans designed to answer those questions, and adopting quality assurance standards to ensure forensic data is admissible in a court of law. For example, many nuclear forensics laboratories adopted the ISO 17025 standard used by traditional forensics analysis laboratories. The result of this evolution is that nuclear forensics is no longer simply an ad hoc material analysis exercise. Instead, it is a carefully coordinated effort between investigators, forensic examiners, and nuclear science experts to ensure defensible nuclear forensic evidence is available to support all aspects of a case where nuclear material is found outside of regulatory control.

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