Role of Nuclear Forensics in Preventing N-Terrorism

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The increasing incidents of trafficking in nuclear and radiological materials each year are worrisome; these cases also provide valuable insight to the movement of these materials worldwide. After all, the most likely early warning of an antagonist- planned nuclear attack will be previous involvement in illicit transfer of nuclear materials. Nuclear Forensic Science is a fairly young discipline and mainly used in the following area globally.

Application of Nuclear and Radiochemistry in Forensic science

In illicit trafficking of Nuclear materials to identify the origin of the nuclear materials and to identify the source.
Confirmed incidents of illicit trafficking of nuclear materials 2005--103, 2006150, 2007250, etc.
This persistent problem is handled by 25 Project at the Joint research centre----IAEA.
Nuclear Terrorism:- Preventive measures and strict monitoring system formulated to avert such incidents.
Analytical Nuclear Techniques for the identification of trace materials by non-destructive methods in crime articles.

Application of Nuclear Analytical Techniques

Nuclear analytical techniques have many advantages over other techniques, because of their high sensitivity and precision. They couple powerful selective separation with sensitive element- specific detection.

Medical and Healthcare.
Life Sciences.
Medical and Healthcare.
Life Sciences.
Environmental Sciences.
Materials Science.
Archaeology.
Geology.
Forensic Science.
Provide useful information for structural characterization.
Nutritional and clinical researchers and drug developers.

Application of Analytical Nuclear Techniques in Forensic Science

High neutron flux reactor at BARC, Trombay:- Neutro Activation Analysis (NAA) unit of Central Forensic Science Lab, Hyderabad, MHA, GOI which is housed at the Analytical Chemistry p. BARC (1974).
NAA unit has provided important scientific reports in many crime cases by the analysis of trace elements in forensic samples.
The process consists of bombardment of test sample and standard by an intense beam of neutrons from a research reactor. The neutrons interact with the radioactive nuclei of atoms in the samples. The resulting radioactivity is proportional to the amount of the element present.
The compound spectrum of mix of radionuclides after irradiation is resolved instrumentally by high resolution spectrometer with a HPGe detector system or by radiochemical separation of the elements.
The amount of the sample is obtained by measuring the induced radioactivity of the standard and the test sample under the same conditions.

Advantages of NAA Technique Forensic Application

NAA Technique is sensitive, very specific and accurate.
NAA Technique can operate multi elements simultaneously.
NAA Technique is non-destructive technique.
NAA Technique allows re- examination of crime exhibits.
NAA Technique's unique advantage is it operates in absence of reagent blank which is an edge over other analytical techniques.
NAA Technique reports can be presented as scientific report in the Court of Law.
NAA Technique application has been recognized by law enforcement agencies in major crimes.

Specific Forensic Application of NAA Technique

Forensic ballistics (known group of elements)
Determination of gunshot residues (GSR) opine whether a hole is really due to the passage of a bullet.
Firearm discharge residue detection in the hands of a suspect shooter to differentiate homicide/suicide cases and/or to identity the shooter.
Estimation of the range of firing and to differentiate entry and exit shot hole.
Matching of bullet specimen with metal piece obtained from the scene of crime.
Forensic Toxicology (known specific elements)
Analysis of biological materials to confirm toxic metals mainly As, Hg etc. in poisoning crime cases.
Differentiation between slow and acute poisoning.
To assess environmental pollution which causes great concern in internal toxicity.
Source Correspondence - commonness of origin (multi element analysis may not be known before hand)
To identify evidence materials [which might have originated from the suspect] left at the scene of crime.
Matching of specimens of different varieties to connect the crime with the criminal.
Customs and other related cases of white collar crime (one or two specific elements at low level)
To detect a particular element, the presence of which can help solve the problem i.e. transfer of traces due to contacts.

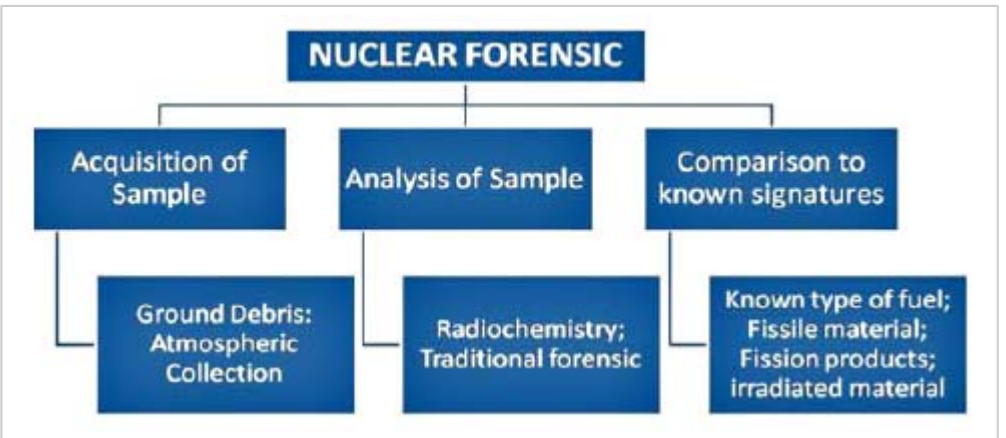
Nuclear smuggling is an international problem; identified smuggling routes do not neatly coincide with state borders. An informal and unaffiliated group that assembles the world's leading experts in nuclear forensics, the Nuclear Smuggling International Technical Working Group (ITWG), has been working toward just that end since 1995. After every terror attack, one has to check whether there was any radioactivity present in the blast or not. This is especially true for a country like India which is prone to the terror attacks.

Thus the upcoming field of nuclear forensics, which helps to determine the presence of the radioactivity in the attack, is of great significance for India. Nuclear forensics is the need of the hour and had widespread applications in crime detection.

What is Nuclear Forensics?

The ability to analyze nuclear materials, atomic detonations and debris from a radiological event could aid efforts to identify and potentially retaliate against any party that provides nuclear substances to terrorists. Nonproliferation specialists hope a robust nuclear forensic capability would deter potential suppliers from selling atomic material.

Nuclear forensics allows chemists to work out the origins and attributes of an inpidual radioactive sample. The specimens are often gathered from accidents, illegal dumping, and traces from declared activities, abandoned nuclear material or illicit trafficking.



In particular, a nuclear forensics investigation might help answer such questions as: Is there a leak in one of the known holdings of nuclear material? Where was legitimate control lost? How did the material come to be where we found it? Can we link this material to the perpetrators? Is this case connected to previous cases? Nuclear Forensics analyzes the nature, use and origin of nuclear materials. Nuclear materials have a "nuclear fingerprint" defined by radioisotopes, isotopic and mass ratios, material age, impurity content, chemical form and physical parameters. Identifying this nuclear fingerprint can help investigators track nuclear materials back to their origin.

Sample acquisition

Nuclear forensic analysis involves both laboratory analyses and computer modeling. The results are compared with databases that contain empirical data from previous analyses of materials or numerical simulations of how a nuclear device performs, or both. Analysis requires a combination of technical data; relevant databases and specialized skills and knowledge to retrieve analyze and interpret the data. A case becomes more significant if it can be linked to other instances demonstrating a sustained effort to sell or obtain nuclear material. Once the difficult task of detection and interdiction has been accomplished, Nuclear Forensics should be used to understand the history of the interdicted material. If the source of the leak can be identified, steps can be taken to close that leak. ***The attacks of 11 September, 2001, taught us that if a group of terrorists possess sufficient material, they might well attack multiple targets. Nuclear forensics, applied in time, can be the key to thwarting such a coordinated, multi-pronged attack.***

Indeed, the use of Nuclear Forensics in a pre-detonation scenario may prove more effective as a preventative measure and deterrent than the more acknowledged scenario of using such techniques in the aftermath a nuclear attack.

Case Studies

In one instance, a man in Bulgaria was found with a 2.4 kg lead case with several grams of a fine black powder. Documents with it described it as 99.99 percent Uranium 235. It was in a glass ampoule wrapped in paper and wax. Analysis on the wood on the outside of the container could be traced to a certain species of tree found in small areas of Eastern Europe. The wax was identified as paraffin, and the yellow color was due to barium chromate which is an additive rarely used in Western countries: mainly in Brazil, China, India and Eastern Europe.

In Ulm, Germany, 202 pellets of radioactive substance were discovered in a bank safe by the police. The shape suggested that they were nuclear fuel from a light water reactor. The tests showed that the substance was 4.8 percent Uranium-235. Two nuclear fuel plants were found to use such pellets; however the texture of the fuel's surface allowed the correct plant to be identified.

In America, a piece of metal found in a scrap yard, was found to be radioactive stainless steel. It could be identified as part of a reactor. However, it had 87.8 percent Uranium-235, instead of the normal 19 percent. Over 85 percent can be used for nuclear weapons - the material found was, therefore, potentially weapons grade uranium that had been illegally dumped.

Developments of Nuclear Forensics in India

Indian government scientists have drafted a proposal to construct a national nuclear forensic laboratory as part of international efforts to reduce the threat of nuclear terrorism.

The plan calls for the nuclear forensic center to be built in Karnataka in southwest India no later than 2018 or 2019, and it seeks approximately $4.7 million to support the laboratory's establishment and the acquisition of internationally developed sequencing technology.

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Conclusion

In today's society, the misuse of nuclear weapons by nations or - in rare circumstances - inpiduals has become more of a serious possibility. Advancing and refining the techniques used in nuclear forensics can be seen as critical as this will allow the origins of radioactive materials to be determined with even greater accuracy. Increased detection may eventually restrict the smuggling, dumping and illegal sale of uranium (of various grades) which would help to increase security.

Conclusions Conducting thorough investigations that utilize nuclear forensics techniques to determine the source of interdicted nuclear materials can help prevent additional trafficking and ultimately terrorist use of nuclear weapons. Upgradation of scientific

inputs at Global level can be achieved by conducting nuclear conference for interaction and exchange of views of the nuclear scientists.