International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: SJIF: 5.995
Available Online at www.journalijcar.org
Volume 6; Issue 11; November 2017; Page No. 7140-7144
DOI: http://dx.doi.org/10.24327/ijcar.2017.7144.1088

Research Article

NUCLEAR FORENSICS; AN ADVANCEMENT FOR ESTABLISHMENT OF INDIVIDUALIZATION AND ITS ROLE IN INVESTIGATION

Amit Chauhan* ., Manisha and Shukla S. K

Amity Institute of Forensic Sciences, Amity University; Sec-125 (Noida), Uttar Pradesh, India-201313

A R T I C L E I N F O

Article History:
Received 20th August, 2017
Received in revised form 29th September, 2017
Accepted 30th October, 2017
Published online 28th November, 2017

Key words:

Investigation, nuclear forensics, substances, radioactive, security etc.

A B S T R A C T

Forensic science revered it as forensics, is about to discover, linkages among the people, places, evidences and events. It involves the examination of biological, behavioral, documentary evidence in the ambience of national and international law. Nuclear forensic sciences serve as a sub-discipline of forensic science that focuses on answering the questions related to any injected or smuggled substantial. These substantial's include the exploration of nuclear and other revealed radioactive or any evidences that have been contaminated with radionuclides and will provide as potent in the legal proceedings. Given and across above the board, the important use of nuclear forensics can assist in investigation of nuclear security events as well as help to identify and remedy vulnerabilities in security infrastructure. As a preventive measure, nuclear forensics is capable and effective because its support both the identification of deficiencies in substantial as well as in the prosecution of criminal offences related to it. It establishes an important diameter in other aspects such as, smuggled substantial and its source, determination of age and to determine the diameter of radiations (chemical, biological, radioactive, explosives, etc.). Accumulation of these materials in even extreme low doses is also detectable in various biological and environmental samples that can aid to investigate the crime scene, illegal dumping, elicit trafficking, unauthorized misuse of radioactive materials at the sight of international linkage.

*Copyright©2017 **Amit Chauhan*., Manisha and Shukla S. K.** This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.*

INTRODUCTION

Whenever we talk about the advancement in forensic Sciences, a series of modern technologies that have been evented in the present era comes up. These technologies have modified the approach of investigation to the crime scene and collection of the evidences in respect of their establishment with crime. The forensic examination always considers the needs of investigation, perceived value of result to the investigation. Traditional forensics comprises the analysis of traditional evidences such as fingerprints, genetic markers (DNA), physical evidences, explosives, fibers, hairs, pollens, paints and other chemical substances etc. These types of evidences lose their creditability of their essential features with time if the examination is delayed[1,2].But now a day; rapid advancement has changed the mean of investigation in which the amount of evidences to be needed to conclude a result is being dragged down to even Nano grams to make the experiments cost and time effective[3]. To extract information from the latent prints about the use of toxicological substances by individual and DNA has become easy now.

Corresponding author:* **Amit Chauhan
Amity Institute of Forensic Sciences, Amity University; Sec-125 (Noida), Uttar Pradesh, India-201313

A forensic examination always needs a plan prepared by authority and identification of category. 3D facial reconstruction, digital surveillance XFT device and DNA sequencing are the few well known advancements which have not got any demerits in their techniques and the accurately reliable for the analysis[4].

In the recent era, Forensic Science has grown up drastically and so its advancement in the technologies and digital enhancement. The Forensic is no more a subject to put the culprits behind the bars but now it has grown to such an extent that it helps in maintaining the national security as well. The advancement has taken place in many a way. The best example of the advancement in Forensic Science is the usage of magnetic fingerprint, this is the technique which has been used by almost each person in the world now a day[5]. The person just need to put his/her finger over the device to get the access to the restricted area, looking at the usage it has become so handy in day to day life that people have this technique in their cellphones as well. Laser ablation inductively coupled plasma is an advanced device which allows an investigator to link a suspect to a crime scene quickly, this device take the physical evidence and breaks it down in particular pieces using laser light which are then being digested and ionized and finally being put into the spectrometer which directly evaluates the

material and relate it with the matter encountered with the suspect[6].

One challenge encountered in conducting forensic examinations is establishing the sequence in which these examinations are to be performed. The sequencing of examinations conducted in both traditional forensic disciplines and nuclear forensics should ensure that critical information is obtained without unnecessary delay, and that the amount and quality of data derived from each sample are consistent with the request of the lead investigative authority. The presence of radionuclides adds to this challenge, since it may constrain the types of examination that can be undertaken and the locations where the examinations can occur. Nuclear forensic provides assistance to help to develop capabilities or as part of an investigation of a nuclear security event. A few of analytical tools to portray nuclear and other substances such as radioactive material may or may not be available in few of the forensic laboratories worldwide[7]. These techniques may only be required to investigate of a splinter group of nuclear security appearance.

In order to establish the identify and characterized the nuclear security implications, the risk of the annexed substances by the law enforcement personnel or by any other first responder; the forensic examination arrangement should describe the requirement needed to be conducted in support of potential criminal proceedings[8]. Nuclear Forensics questionnaire have been successfully employed to a statistics of reported cases involving in the illicit trafficking of high enriched uranium and plutonium, as well as events involving nuclear and other radioactive material out of regulatory control[9]. The nuclear forensic examinations and the examinations in the traditional forensic disciplines should work in the way that they complement each other and combinational help to determine the existing linkage between the various crime scenes and people involved in them.

Physical studies are done to examine the color, size, shape, weight, density, specific markings and logos etc. chemical and elemental measurements identifies the form of nuclear/ radioactive substance with its percent composition (if it is found to be heterogeneous in nature). Contaminated evidences, i.e. the evidences that are contaminated with radionuclides can be analyzed either by decontaminating the evidence (removing radionuclides from the evidence for conducting examinations) by various physical and chemical processes or can be examined without decontamination[11]. This should purely occur in the assigned/ designated nuclear forensic laboratory by the Country/ State that is potent and capable of accepting and analyzing the samples and interpreting the consecutive results.These analysis and interpretation of data help to gain associations between materials, people, places, events etc. For this, a well-organized nuclear forensic model action plan should be incorporated in the National Responsibility plan to the maximum extent possible[12].

Utilization of Nuclear Science In Forensic Sciences

Nuclear forensics involves a comprehensive strategy commenced by States to regulate the origin and history of nuclear or other radioactive material in support of law enforcement or nuclear security investigations. Such investigations may comprise, but are not limited to, illicit trafficking incidents or other encounters with nuclear and additional radioactive material. While al the substances present in the universe are enthusiastically responding towards the radioactive factual and all the substances tends to bind up with radionuclides which represents a precise individual feature. Nuclear forensic examination can be conducted to provide the detailed guidance on radiological crime scene management, security, traditional forensic examination.

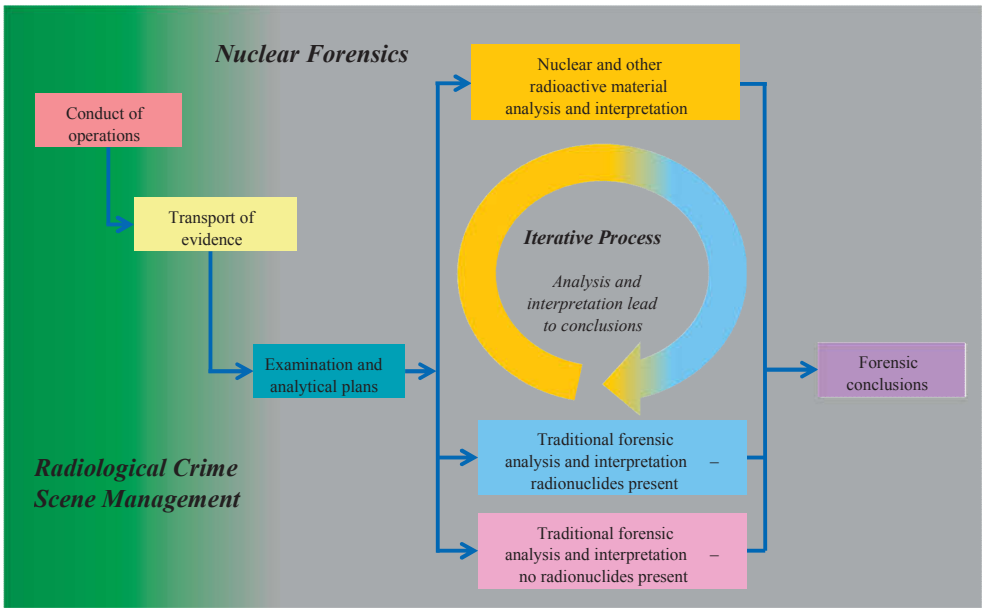

Figure 1 It represents the transition from radiological crime scene management to nuclear forensics.

During the nuclear forensic laboratory analysis, the major goal is to achieve the Characterization of the nuclear/radioactive substance. The goal of Characterization is to determine the physical and chemical properties of the nuclear/ radioactive material, its chemical compositions and the isotopic ratios[10].

These traditional forensics include the analysis of various forms of evidences such as; physical, chemical and biological, documentary evidences etc. Other disciplines where the nuclear forensic can be utilized may include fingerprints, genetic markers, nDNA, mt-DNA, Tool marks, Explosives,

paints, tyre marks and other impressions, metallurgy, fibers, hairs, pollens, etc. Human biological evidences containing nuclear DNA (nDNA) can be having specific value because it associates the test results with an individuality with a degree of reliability for criminal justice purposes[13]. The utilization of nuclear forensics are also recommended for other purposes such as nuclear security series such as combatting illicit trafficking, nuclear security recommendations on physical protection of nuclear material and nuclear facilities, identification of radioactive sources and devices etc.

The aspiration of characterization of nuclear is to regulate the physical, chemical and elemental composition, isotopic, ratios of nuclear. These are obtained from a wide range of relevant analysis to identify the major and minor traces constituents which are compulsory for the examination. This technique includes the interpretative steps, such as the modelling of nuclear reactor processes possibly related to material origin or the identification of the possible origins.

In its restricted form, handwriting is considered as a written speech, every act of it becomes impressed with characteristics peculiar of an individual. This establish a distinguish style, customary phase in writing which may be more or less varied from time to time either by accidental causes such as haste carelessness, position of writing, disease or weakness[14]. There is a transitory phase of maturation between the teenaged and adults handwriting because the teenager's handwriting (Formation of letters) is much influenced by teacher's handwriting, while the adults create their own formation or standard formation of letters. Nuclear forensic signatures are a set or sets of data characteristics of a given sample of nuclear or other radioactive material that may enable the sample to be identified as being consistent with, or as not being consistent with, particular nuclear or other radioactive material used, produced or stored in a State by way of either exclusion or inclusion[15]. These signatures may help to identify the processes that created the material and its subsequent history.Reference (Exemplar or admitted) signatures for processes and facilities throughout the nuclear fuel cycle, as a basis for interpreting analytical results from samples, are established using both empirical approaches, involving results from previous analyses of nuclear and other radioactive material, and modelling approaches based on the chemistry and physics of nuclear fuel cycle processes. Knowledge of analytical science can guide the selection of the appropriate methods to verify the presence or absence of specific nuclear forensic signatures[16].

Unlike the traditional fingerprints examination (analysis of fingerprints pattern), palm prints and sole prints which are used more than a century to identify the individuals. The friction ridges analysis and nDNA analysis that enables the individualization might yield result like to those of nDNA analysis. During the forensic examination of Palm prints, fingerprints or sole prints which are recovered from the place of accident, it should be consider in developing from the nuclear and radioactive materials[17].Analysis of tool marks and firearms exploits the markings generated by a tool or the firing pin of a firearm, encounters the object. Comparisons of tool marks and markings from firearms can be considered a specialized form of impression analysis. Analysis of these marks can be used to narrow the focus of an investigation, both by indicating certain manufacturers or manufacturing processes of tools or firearms and by eliminating others.

Humans and animals routinely shed hair. These hairs might be left at a crime scene or might be transferred to another individual at the scene or at another location of interest for investigative purposes. Therefore, an investigation of a nuclear security event should consider the possibility that hair might have been shed onto, or in the vicinity of, the nuclear and other radioactive material out of regulatory control[18]. Microscopic analysis of hair is useful with regard to class characteristics, rather than individual characteristics. That is, results can associate the hair with a type of person (based, e.g., on hair colour or use of dye) rather than on a unique individual. Such results can be useful when excluding certain persons from the pool of possible sources of the hair, thus narrowing the focus of the investigation.

Feasibility in Forensic Science

As we know the radionuclides when introduced to any substance get attached to it and shows a characteristic feature on which the examination. It will provide the individual characterization. In other words the radionuclides bonded with a substance due to the presence of different materials at different composition will show a reliable result which can be determined even at a very small amount. The comparative study has been made by number of scientists where they have concluded that the use of Nuclear isotopes have been used for the determination of the purity of the substance or the mixture is made up of the known material or not. As we know, the nuclear changes occur at atomic level, the trace amount of evidences even in nano-grams which can be identified using nuclear energy[19].

Descanting about advancement in forensics, this field had growth so far that use of nano devices are very common for detection procedure and the evidences needed to be analyzed. Nuclear forensic which will lead to go beyond the limits and the introduction of radionuclides can be made possible at microscopic scale. The analysis of constituents is possible at microscopic level and the presence of different constituents at distinctive amount in every individual for individualization purpose that can be done easily[20]. The technique may cost higher as compared to the other techniques that are being used now but the detection will be very accurate and at microscopic level and it will be time efficient as well.

According to a study on isotopes to determine the amount of radioactive matter which probably present antecedent to the decay of the same. When it happened, the mother isotopes get converted into daughter isotopes which make it arduous to get the actual amount of matter. Nuclear forensic can be used in forensic pathology to determine a victim succumbed to the effect of exposure of radiation or any other cause. It might be very useful to estimate the distance of each victim from the dispersal point findings. Even in case of digital instrumentation and control system, it also yields. Nuclear forensic has proved it forensic significance in every aspect and being utilized for manufacturing nano- devices and in the establishment of individualization.

Therefore, it can be said that Nuclear Science is feasible in Forensic Science while investigating over any case. And the result can be verified accurately correct at any point of time, and the individualization can also be done.Government of India has also drafted a proposal to construct a National Nuclear Forensic Lab in Karnataka by 2018-2019 as a part of International efforts to reduce the threat of Nuclear Terrorism.

Need of Advancement in Forensic Sciences

Forensic Science is a very vast subject it includes almost all the known techniques used. The need of advancement in the subject is necessary as because we can't rely on the traditional methods or the techniques that are being used from a decade or even earlier. As the criminals now a day have got expertise in technology and advance knowledge of committing crime such that they try to escape out of the crime by any means. Although the modernization and advancement has taken place and instead of using the traditional one, the experts are utilizing nano particles, advance material and nuclear forensic to apprehended the culprits even based on the micro quantity or from the contaminated evidences. Therefore, if we talk about radioactive materials or a nuclear device, there are certain shield which can resist the recognition of those materials and so by using that shield burglars can easily transport them to anywhere of their wish. So, a much awaited but advanced technique should be invented which may detect the presence of radioactive material at any point and under any circumstances.

As the world is concern to the fact of terrorism and the national security, the advancement in the techniques of the terrorist can easily be encountered if we compare the case happening now with the cases took place years ago, and we still lack behind in recognizing the radioactive materials. The advancement has been seen in the cases of fingerprints or in the drug detection techniques and is still going on. There must be proper plan executed for the Nuclear Forensic action. Nuclear measurable examination and translation may prompt discoveries in regardof the material related with nuclear security occasion. At the point, when joined with distinct parts of the examination that includes conventional legal discoveries, conclusions might be drawn about the relationship between the material and individuals, places,occasions and creation forms. States need to perceive that despite the fact that a nuclear scientific capacity may not be utilized all the time, it might assume a critical part in the examination of a nuclear security occasion.

CONCLUSION

Forensic science is not bound only with the crimes of fingerprints, drugs, or serology but the crime commission of any kind is to be dealt with the Forensic view. By this time, a few of the traditional methods such as questioned document examination, fingerprints development and their analysis, tool marks examination etc. are still followed. In the recent meeting of American association for the advancement of science, it was mentioned that such type of analysis should be replaced by new advanced methods which could yield better and appropriate information than the traditional one. Development of new software are taking over these methods. In this era, scientists are focusing over the micro, nano-elements, radioactive and nuclear particles of the materials. Therefore, the advancement in this subject is useful in recognizing the nuclear devices at any point of time and so will put a stop in the trafficking of the radioactive materials. The trafficking of the radioactive material is very high and due to the absence of proper devices for the recognition of them leaves out a big loop hole for the security system. These advance techniques can help in the recognizing the material and will automatically lead the Forensic Science advancement in the matter of national security.

References

1. Nuclear forensics: what, why and how? Formerly at Fuel Chemistry Division, Bhabha Atomic Research Centre, Trombay, Mumbai 400085, India.
2. Rukmani Krishnamurthy, Menon Nisha. Role of Nuclear Forensics in Preventing N- Terrorism. (technical advisor, Institute of Forensic science, govt. of Maharashtra).
3. International atomic energy agency, establishing the nuclear security infrastructure for a nuclear power programme, iaea nuclear security series no. 19, iaea, vienna (2013).
4. Kristo, M.J., Smith, D.K., Niemeyer, S., Dudder, G.B., model action plan for nuclear forensics and nuclear attribution, rep. Ucrl-tr-202675, lawrence livermore natl lab., livermore, ca (2004).
5. The convention on the physical protection of nuclear material, infcirc/274/rev. 1, iaea, vienna (1980).
6. European police office, international atomic energy agency, international civil aviation organization, international criminal police organization–interpol, united nations interregional crime and justice research institute, united nations office on drugs and crime, world customs organization, nuclear security recommendations on nuclear and other radioactive material out of regulatory control, iaea nuclear security series no. 15, iaea, vienna (2011).
7. European police office, international atomic energy agency, international police organization, world customs organization, combating illicit trafficking in nuclear and other radioactive material, iaea nuclear security series no. 6, iaea, vienna (2007).
8. International atomic energy agency, nuclear security recommendations on physical protection of nuclear material and nuclear facilities (infcirc/225/revision 5), iaea nuclear security series no. 13, iaea, vienna (2011).
9. International atomic energy agency, identification of radioactive sources and devices, iaea nuclear security series no. 5, iaea, vienna (2007).
10. International atomic energy agency, international criminal police organization–interpol, united nations interregional crime and justice research institute, radiological crime scene management, iaea nuclear security series no. 22-g, iaea, vienna (2014).
11. Treaty on the non-proliferation of nuclear weapons, infcirc/140, iaea, vienna (1970).
12. International Convention for the Suppression of Acts of Nuclear Terrorism, A/59/766, United Nations, New York (2005).
13. International Convention for the Suppression of Terrorist Bombings, A/52/653, United Nations, New York (1997).
14. International Convention for the Suppression of the Financing of Terrorism, A/RES/54/109, United Nations, New York (1999).
15. Protocol of 2005 to the Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation, International Maritime Organization, London (2005).
16. Protocol of 2005 to the Protocol for the Suppression of Unlawful Acts Against the Safety of Fixed Platforms

Located on the Continental Shelf, International Maritime Organization, London (2005).
17. Convention on the Suppression of Unlawful Acts Relating to International Civil Aviation, International Civil Aviation Organization, Beijing (2010).
18. Protocol Supplementary to the Convention for the Suppression of Unlawful Seizure of Aircraft, International Civil Aviation Organization, Beijing (2010).
19. Parkinson, A., Colella, M., Evans, T., The development and evaluation of radiological decontamination procedures for documents, document inks, and latent fingermarks on porous surfaces, *j. Forensic sci*. 55 (2010) 728-734.
20. International atomic energy agency, application of nuclear forensics in combating illicit trafficking of nuclear and other radioactive material, iaea-tecdoc-1730, iaea, vienna (2014).

How to cite this article:

Amit Chauhan *et al* (2017) 'Nuclear Forensics; An Advancement For Establishment of Individualization and its Role in Investigation ', *International Journal of Current Advanced Research,* 06(11), pp. 7140-7144
DOI: http://dx.doi.org/10.24327/ijcar.2017.7144.1088

****