THE USE OF SEM-EDX FOR THE IDENTIFICATION OF URANIUM COMPOUNDS IN SWIPE SAMPLES FOR NUCLEAR SAFEGUARDS P45

J.E.S. Sarkis[a], R.C.B. Pestana, R.C. Marin and E.F.U. Carvalho

[a] **jesarkis@ipen.br**

Nuclear and Energy Research Institute, São Paulo, Brazil

Environmental swipe sampling for safeguards purposes has been used by International Atomic Energy Agency since 1996 and is a powerful tool to detect undeclared materials and activities in States under safeguards agreements. The Secondary Electron Microscope with Energy-Dispersive X-Ray analyzing system (SEM-EDX) can be particularly useful in the initial identification of uranium in swipe samples and might be appropriate to identify and characterize uranium particles This work describes the use of SEM-EDX, as an initial screening technique, in real-life swipe samples for identifying and characterizing uranium particles. The swipe samples were collected in a conversion plant at the Nuclear and Energy Research Institute – IPEN/CNEN, São Paulo, Brazil

This work was published in the proceedings of International Nuclear Atlantic Conference – INAC 2011 (poster)

RARE EARTH ELEMENTS IN URANIUM COMPOUNDS AND IMPORTANT EVIDENCES FOR NUCLEAR FORENSIC PURPOSES P40

J.E.S. Sarkis[a] and D.S. Rosa

[a] **jesarkis@ipen.br**

Nuclear and Energy Research Institute, São Paulo, Brazil

At the beginning of the 1990's, the first incidents involving nuclear or other radioactive material were reported mainly in Europe, with the breakdown of the Soviet Union. At that period, the International Atomic Energy Agency (IAEA) recorded more than 800 cases of illicit trafficking of nuclear or radioactive materials. Since then, related cases have became known worldwide, as the contamination by radioactive source elapsed from a theft in 1987 in Goiânia, Brazil, and the death of Alexander Litvinenko in 2006 poisoned with the radioactive isotope Polonium-210. As a result of these and other events, nuclear and radioactive materials have been targeted for forensic investigations, creating from there the concept of nuclear forensics. Nuclear forensics mainly focuses on the nuclear or radioactive material and aims to providing indication on the intended use, the history and even the origin of the material. Uranium compounds have isotopic or chemical characteristics that provide unambiguous information concerning their origin and production process. Rare Earth Elements (REE) are a set of sixteen chemical elements in the periodic table, specifically the fourteen Lanthanides in addition Scandium and Yttrium. A large amount of uranium

is in rare earths deposits, and may be extracted as a by-product. Accordingly, REE in uranium compounds can be used as an evidence of uranium origin.

This work was published in the proceedings of International Nuclear Atlantic Conference – INAC 2011 (poster)

P38 THE USE OF NUCLEAR FORENSIC LIBRARY IN ORDER TO IDENTIFY UNKNOWN SEIZED NUCLEAR MATERIAL. BRAZILIAN'S PARTICIPATION IN THE GALAXY SERPENT EXERCISE

J.E.S. Sarkis[a], I.C.A.C. Bordon and R.C.B. Pestana

[a] **jesarkis@ipen.br**

Nuclear and Energy Research Institute, São Paulo, Brazil

Nuclear fission is governed by very well known physical laws which, under certain circumstances, for instance: type of reactor, fuel and irradiation history, allow to preview with high degree of confidence, the production of energy, the build up of fission products and the transmutation of heavy metals. All these information, gathered in a nuclear forensic library (NFL), can be an important tool during the identification of a seized unknown sample, allowing to produce evidences concerning it's irradiation history, the type of reactor or even the origin of the sample. The usefulness of a nuclear forensic library depending on not only the quantity or quality of the available data, as well as the capacity of the investigators to identify, correlate, and interpret the main parameters identified, or measured, in the seized sample. In this paper it will be described the strategy adopted by the Brazilian's team during the Galaxy Serpent Exercise, coordinated by the Nuclear Forensics International Technical Working Group on nuclear forensics, where a NFL was used to identify an unknown sample. Our experience demonstrated the importance of the knowledge on nuclear reactions to select the main parameters to be considered during the evaluation. Then, the importance to use of simple isotopic correlations, to verify the consistency of the available information, before to use a more complex multivariate statistical techniques . Based on our investigation, the following questions were answered: Does Clio reactor belong to the NFL? Is it possible to identify which class of reactor belongs Clio? For the first question the answer is: Conclusive negative. For the second question the answer is: suggestive positive to be a BWR reactor.
