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Scientific Visit on Resolving Nuclear Forensics Signatures and Libraries

Prof. Manny Mathuthu from the North-West University (Mafikeng Campus), South Africa, made a scientific visit to the University of Tennessee, Knoxville (under the Institute for Nuclear Security). His visit was hosted by Prof. Howard Lewis Hall, and his advisor was Natacha Peter-Stein, both at the Institute. The purpose of the visit was to recieve advanced training in the methodologies required to rapidly analyse interdicted nuclear material for nuclear forensics.

Since January 2015, Prof. Mathuthu has been supervising three MSc students and one Radiation Protection Officer, in their Lab to resolve nuclear forensics signatures for South Africa's Uranium Mining and Processing under IAEA Project CRP-J2003. From the lab experience and skills gained in this visit, Prof. Mathuthu is confident of setting up a nuclear forensics laboratory to continue this project. This training came at an opportune time; South Africa is presently verifying its nuclear materials stockpile for IAEA Safeguards. The next task for South Africa is developing nuclear forensics signatures and libraries for each and every nuclear material recorded in the South African data base. Setting up a Laboratory at CARST would provide a training facility for capacity building and nuclear materials accounting and control with the end goal of creating a National Nuclear Forensics Library (NNFL).

Prof. Mathuthu participated in all offered courses which proved informative and relevant to the use of nuclear forensics as a tool for nuclear security. Topics included:

- Principles of isotopic signatures and their origins
- Ultra-trace radiochemical separations, and isotope measurements via nuclear counting.
- Applications of nuclear forensics in interdicted materials and crisis response scenarios
- Understanding nuclear threats and their evolution
- Issues and strategies in detecting nuclear threats
- Issues and approaches for nuclear security concerns, both state-level and asymmetric
- Tabletop exercises in applied nuclear security scenarios

Prof. Mathuthu's training involved a mixture of active research, coursework and conferences. He worked with faculty and students to develop a novel type of gas phase separation capability that would support rapid separation of lanthanide elements for nuclear forensics. He was closely engaged in the operation of the inductively coupled plasma time-of-flight mass spectrometer, and learned chemistry methods required to analyse nuclear samples. He took Radiation Safety tests and was awarded three Certificates during his visit. Prof. Mathuthu had the opportunity to attend the Winter 2016 American Nuclear Society Meeting and participated in the melt glass discussion forum. He had many opportunities to network professionally.

Prof. Mathuthu was also afforded an opportunity to visit the Oak Ridge National Lab (ORNL), where he was exposed to various research activities like safeguards protocols and high flux neutron production and applications.

Now back home, Prof. Mathuthu is determined to integrate all the knowledge and lab experience acquired during the Fellowship and share with both the University Management, Radiation Safety Representatives at CARST and at the South African Nuclear Energy Corporation. Immediately after his return, he supported the implementation of Radiation Safety culture in his Laboratory. His visit is expected to generate at least two peer-reviewed publications.

Manny Mathuthu — South Africa

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