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Twenty Years of Collaborative Materials & Galaxy Serpent Exercises of the Nuclear Forensics International Technical Working Group (ITWG)

The Nuclear Forensics International Technical Working Group (ITWG) is a forum for informal technical collaboration among official nuclear forensics practitioners who share a common interest in preventing illicit trafficking of nuclear and radioactive materials out of regulatory control. Together, this community of scientists, law enforcement personnel, and regulators work to advance the best practices of nuclear forensics largely through the participation in a series of Collaborative Materials Exercises (CMX), formerly known as Round Robin exercises, and Galaxy Serpent Exercises (GS).

The ITWG Exercise Task Group (ETG) is responsible for facilitating Collaborative Materials Exercises (CMXs). These exercises are designed as learning experiences rather than performance tests for the scientific community. They utilize well-characterized materials of a known history and origin that are taken from specific process locations within the nuclear fuel cycle. These "real world" materials are used as the basis of exercise materials, as opposed to laboratory-generated pure phase certified reference materials, in order to fully consider the potential significance of process-derived heterogeneities and characteristics suggestive of the material history. While individual laboratory results are held in confidence, a summary of the major outcomes from each exercise are published in the open literature. To date, the ITWG has carried out six Collaborative Materials Exercises with the sixth (CMX-6) and largest (23 participants) recently completed in June 2019.

The ITWG National Nuclear Forensics Libraries Task Group (NNFL TG) is responsible for organizing the Galaxy Serpent (GS) series of exercises, which focus on advancing global understanding of the NNFL concept. There have been three GS exercises to date, all virtual, and designed to give participants experience with methods for organizing material characteristic data, queries a NNFL might receive, and comparative data analysis techniques that might be useful for answering investigative questions. Exercises start by providing material characteristic data to participating teams, followed by two to three rounds of investigative questions the teams are asked to answer based on the results of a hypothetical forensic examination. Example questions included are "how many populations of material are represented in the data set?", "is a material under examination consistent with any material in the data set?", and "are two materials under investigation consistent with each other?" Each exercise has focused on a different category of material, including spent nuclear fuel (GSv1), radioactive sources (GSv2), and uranium ore concentrates (GSv3), and each illustrated that the methods for organizing data and the data analysis tools and expertise necessary to answer investigative questions vary depending on material type. Results of the GS exercises have been published in peer-reviewed journals, and are serving as important practical guidance for states looking to establish or advance their NNFL.

State

United Kingdom

Gender

Female

Primary authors: SCHWANTES, Jon (Pacific Northwest National Laboratory); Dr EL-JABY, Ali (Directorate of Security and Safeguards, Canadian Nuclear Safety Commission, Government of Canada); CORBEY, J. (Los Alamos National Laboratory); LAMONT, Stephen (United States Department of Energy); Ms MARSDEN, Olivia (AWE)

Presenter: SCHWANTES, Jon (Pacific Northwest National Laboratory)

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