AGA 8: Verification

Time: Friday 9:30–11:00 Location: KH 00.016

AGA 8.1 Fri 9:30 KH 00.016

Mimicking Nuclear Warhead Signatures via Shielding of Radioactive Material — •Emma Lucke[1], Christopher Fichtlscherer[2], and Moritz Kütt[1,3] — [1]Hamburg Nuclear Disarmament Laboratory, University of Hamburg — [2]Laboratory for Nuclear Security and Policy, Massachusetts Institute of Technology — [3]Program on Science and Global Security, Princeton University

On the road toward reliable gamma spectroscopy-based warhead confirmation systems, ensuring signature uniqueness remains a challenge. If signatures are not unique, this vulnerability could be exploited by presenting hoax objects in place of actual warheads, thereby cheating procedures during nuclear dismantlement. In our previous work we established that combinations of shielded radioactive isotopes can produce gamma emission signatures indistinguishable from those of actual nuclear warheads. However, it remains unclear whether shielded isotope emissions actually offer any advantages over unshielded ones. In addition, earlier results suggest that some shielding configurations may be more effective than others. Our new work focuses on investigating these aspects. We expand the set of considered isotopes to include all long-lived candidates potentially applicable to cheating, which requires new OpenMC shielding simulations at higher photon energies. Additionally, the set of theoretical warhead models is broadened to incorporate further signatures. In a subsequent systematic search for hoax objects within this expanded space, we explore the role of shielding effects in constructing hoax objects that are capable of deceiving gamma spectroscopy based warhead confirmation systems.

AGA 8.2 Fri 10:00 KH 00.016

Modeling, simulations, database, and GUI: Updates on the Digital Twin for Nuclear Verification Project — •Manuel Kreutle[1], Katharina Aymanns[1], and Irmgard Niemeyer[1,2] — [1]Forschungszentrum Jülich, Germany — [2]International Atomic Energy Agency (IAEA), Vienna, Austria

Nuclear non-proliferation and disarmament efforts are centered around technical verification of related activities. This is true for bilateral agreements (e.g. New START, Open Skies, etc.) as well as multilateral treaties (e.g. NPT, CTBT, etc.). Past, present and potential future verification regimes are complex socio-technical systems that produce increasing amounts of data, nowadays usually in digital from. In convergence to that, "Digital Twins" have become a popular concept to monitor, predict or plan the behavior of cyber-physical systems. Hence it is just another step to combining the two.

In this talk, we will give an update on the state of a project on digital twins for safeguards in nuclear waste management. We will present a framework of database-enabled systems modeling, validated simulations, and visualization. The related software can produce realistic measurement and inspection data which can be displayed in a graphical user interface (GUI). In its current state it can be utilized to plan and improve monitoring systems, but we will discuss how it can be extended to allow for data processing of incoming real (live) data. We will close with sharing thoughts on how this project can be extended to create digital twins for nuclear verification in general.

AGA 8.3 Fri 10:30 KH 00.016

MUTOMCA: Muon Tomography for the Re-Verification of Spent Nuclear Fuel Casks — Paolo Andreetto[1], Katharina Aymanns[2], Massimo Benettoni[1], Nicola Bez[1], •Thomas Boland[2], Germano Bonomi[4], Lorenzo Castellani[1], Enrico Conti[1], Johan Dackner[5], Franco Gonella[1], Altea Lorenzon[1], Fabio Montecassiano[1], Marita Mosconi[5], Mentor Murtezi[5], Julia Niedermeier[6], Irmgard Niemeyer[2], Juha Pekkarinen[5], Andrea Rigoni[1], Daniele Scarpa[1], Maik Stuke[3], Matteo Turcato[1], and Gianni Zumerle[1] — [1]INFN Padova and University of Padova, Padova, Italy — [2]Forschungszentrum Jülich GmbH, Jülich, Germany — [3]BGZ Gesellschaft für Zwischenlagerung mbH, Essen, Germany — [4]University of Brescia, Brescia and INFN Pavia, Pavia, Italy — [5]European Commission, Directorate-General for Energy, Luxembourg — [6]Technical University Munich, Garching, Germany

Safeguards inspectors require reliable information to ensure that nuclear material in heavily shielded casks in dry spent fuel storage facilities is not diverted. In the event that all safeguards-related containment and surveillance measures fail, enhanced verification capabilities are needed. The MUTOMCA project aims to address this necessity by exploring muon tomography as a non-destructive assay method for re-verifying spent fuel casks. A detector setup was developed and tested and two algorithms were designed for reconstructing cask contents from muon absorption and scattering data respectively. A field test was performed with two loaded casks. This talk presents the muon detectors, data collection, preliminary results and future prospects.