AGA 6: Non-Proliferation and Nuclear Verification

Time: Friday 10:00–11:15 Location: H8

AGA 6.1 Fri 10:00 H8

Nuclear Weapon or Hoax Object? Imitating Gamma Spectra in Verification Measurements — •Christopher Fichtlscherer[1,2] and Moritz Kütt[2] — [1]Nuclear Verification and Disarmament Group, RWTH Aachen, Aachen, Germany — [2]Arms Control and Emerging Technologies, IFSH, Hamburg, Germany

Nuclear weapon authentication often relies on the passive gamma spectrum of a warhead. Measurement systems for such authentication need to provide sufficient information to judge whether the measured object is a warhead. At the same time, they need to protect information considered sensitive. Authentication is only possible if the measured spectrum is unique to a specific warhead type for a given measurement system. If it were possible to produce hoax objects whose emissions create the same measured signal, states could present those in verification processes, effectively undermining disarmament efforts. To determine the uniqueness of warhead spectra, we attempted to replicate detector responses of a notional warhead model with mixtures of radioactive isotopes. In the talk, we present simulation results for existing warhead authentication prototypes.

AGA 6.2 Fri 10:30 H8

Simulation Calculations for the Conversion of FRM-II — •Matthias Englert and Christoph Pistner — Institute for Applied Ecology, Rheinstr. 95, 64295 Darmstadt

Minimization of the civil use of highly enriched uranium (HEU) is one of the cornerstones of international nonproliferation efforts to prevent access to fissile material suitable to build nuclear weapons. The only reactor in Germany still using HEU is the FRM-II at the Technical University in Munich (TUM). Since almost 20 years there is a push to convert the reactor to lower enrichment. The extremely compact design of the fuel element, made possible by new uranium silicide fuel, has made the conversion of the reactor into a demanding task ever since. In a series of papers, new promising conversion options were published in recent years by TUM scientists. Especially conversion with the current uranium silicide fuel - an option that was almost neglected in the first 15 years - has seen new interest. We present complementing results from our simulation calculations regarding uranium silicide conversion with the burnup routine VESTA, the latest version of the neutron transport code MCNPX 6.2 and updated evaluation and core design tools implemented in Mathematica 12. For the new simulation environment, a benchmark was performed against older results on the HEU reference model. A new reactor geometry was modeled according to a design choice published by TUM with uranium silicide fuel with a density of 6 gU/cm3 at an enrichment of 35% and burn calculations will be presented. Since the results were promising we investigated whether the uranium silicide fuel qualified for LEU enrichment at 4.8 gU/cm3 would be suitable for use with up to 50% enrichment. Uranium silicide fuel has been used for 16 years at a density of 3.0 gU/cm3 with a high enrichment of 93% in FRM-II. Two strategies were identified to explore the possibilities of a uranium silicide fuel with higher density than 3.0 gU/cm3 (1.5 gU/cm3) with lower enrichment: First, to operate with fuel >4.8 gU/cm3 with as few changes in fuel assembly geometry as possible; second, to operate with the current fuel at a density of 3.0 gU/cm3. Further analysis focused on an investigation of the purely geometrical changes with the current fuel of a density of 3.0 gU/cm3. The dependence on enrichment was investigated and an enrichment of 50-60% was found to be promising. However, the burnup calculations showed that an enrichment of 50% leads to a reduction of the cycle length. Subsequently, the same model was used to investigate the effect of varying the length of the fuel element. We finally present an outlook for further optimizations such as a change in the density jump (or cancellation by using neutron absorbers) or other geometrical changes, such as a reduction in the number of plates and an increase in the cooling channel width.

15 min. break