Monte-Carlo simulations of the 2019 Mol configuration allow to evaluate the detectability of fissile material in various scenarios.

**Introduction**
Key challenges of nuclear disarmament verification (NDV):
- Develop measurement procedures and devices to determine the presence or absence of fissile material (and shielding)
- Problem: Information only partially available due to shielding and proliferation concerns
- Simulations (verified with experimental data) can help to assess questions which are experimentally difficult to execute due to resource limits, restricted access to fissile material, safety risks and radiation protection

**Method**
At SCK-CEN in Mol, Belgium, close-to-weapons-grade plutonium, present as unirradiated plutonium-uranium mixed oxide (MOX) fuel rods, was investigated:
- Different shielding materials in varied thickness, fuel amounts and isotope vectors were examined
- For these configurations spontaneous fission (SF) and ($\alpha$,n) spectra were calculated with Geant4

**Results**

**Conclusion:**
- Strongest signal reduction for PE+Cd+Pb shielded configuration
- Neutron signal: variations in isotope composition only detectable through change in flux (due to change of activity)

**Perspectives**
- Simulate floor and walls to calculate neutron reflection
- Include effect of various detectors on signals
- Evaluate further methods, e.g. active measurement techniques