

Accounting reports of nuclear material, submitted to the International Atomic Energy Agency by States that have concluded a Comprehensive Safeguards Agreement, contain a wealth of information about nuclear material composition, movement, and location. Advanced signal processing and data science techniques could be used to analyze and synthesize these reports in novel ways with the potential to offer deeper insights and lighten the amount of manual analysis required to process them. However, these reports are Safeguards Confidential and are not available to the general R&D community.

Since there is currently no public access to a full State's worth of nuclear material accountancy information, this project uses nuclear fuel cycle simulation in order to produce synthetic, yet realistic, State accounting data for fictional States. The information that is generated includes the location, mass, and composition of all nuclear material in all peaceful nuclear activities within the territory of the State or under its jurisdiction anywhere, as well as transfers of nuclear material between material balance areas (MBAs) and imports/exports of safeguarded material. Cyclus, the tool used to model nuclear material movement within and between fictional States, has been modified to support the spatial and temporal fidelities required for safeguards data generation.

The synthetic data is converted into Code 10 labeled format in order to effectively replicate realistic State records as contained in the Agency safeguards information system. These data can be used to identify patterns of material movement throughout a State's nuclear fuel cycle, collectively called its "cadence of operations". In response to an operational change in one MBA, the disruption to the cadence of operations can be seen both upstream and downstream from its source, offering additional opportunities to identify and characterize disruptions in the case of errors or intentional concealment.